

Seismic Processing Workshop

SPW™

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Parallel Geoscience, LLC.

About This Manual

This manual is organized into two sections. The first section is an introduction to SPW and an overview of its processing library. The second section is a reference manual that describes each of the processing steps and associated parameters in the SPW Processing library.

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Introduction to SPW

SPW is a seismic processing solution written by Parallel Geoscience. SPW was originally written for the Macintosh computer platform and has been redesigned and rewritten for the third time (Version 3) using the Qt library. The current release, SPW 5, is a native 64-bit application built for Windows 11.

The SPW version 5 Flowchart has a project model for data management. Flowchart allows you to create or select a project, build processing flows, set the parameters for the processing steps and display seismic data and maps. Additionally, it uses SEG-Y format as the default native format for processing data. A simple graphical user interface reduces the learning curve and accelerates your analysis and processing time.

The SPW system is designed to be user expandable. Parallel Geoscience can release a programming API interface for the SPW Flowchart. which allows for easily adding customized processing algorithms and data formats to the SPW system.

This document contains the help information for the processing steps that are built up to make flows.

Product Support

For solutions to questions about SPW, first look in this manual or consult the release notes file accompanying every software release. If you cannot find answers in the documentation, contact Parallel Geoscience using the support email: support@parallelgeo.com. Please be ready to provide the following information:

- Your name.
- Your company name.
- The SPW version you are using.
- The operating system you are using.
- The type of hardware you are using.
- What you were doing when the problem occurred.
- The exact wording of any error messages appearing on your screen.
- Any other pertinent data set information.

The Processing Library:

Overview

The library of processing steps is separated into different categories depending on the objective of each processing step, as follows:

Processing Categories	
Amplitude Adjustment	Statics
Auxiliary Data A-P	Trace Attributes
Auxiliary Data R-Z	VSP
Display	Velocities
Editing	Wavelet Shaping
Filtering	
Geometry	
Migration	
Multi-component	
Mutes	
Nodes	
Quality Analysis	
Seismic Data	
Single Channel	
Spectral Attributes	
Spectral Decomposition	
Stacking / Summing	

The standard use of each processing step is described below individually. This information includes the expected input and output data formats, a brief description of the theoretical background and a detailed explanation of each step parameter. If the step is enabled for a specific type of project (e.g., 2D, 3D, VSP, crooked line) this information is explicitly mentioned in the step description; otherwise, the process may be used for any

kind of project available (i.e., 2D, 3D, VSP, crooked line). When creating a new project, the user has the possibility to define all the project parameters.

Project Creation

Project Name
Survey Information
Seismic Data
Processing Flows
Seismic Display
Auxiliary Data
Well Logs
Images
Reports

Project root directory : Browse...

Project name :

Data dimensions
☐ 2D ☐ Crooked line
☒ 3D ☐ VSP

Data units
☒ Feet
☐ Meters

Survey type
☒ Land ☐ Transition
☐ Marine ☐ OBC/OBS

☒ Set as current project ☐ Select project on application start-up

Create Help Cancel

Each of the Processing Step descriptions lists the mandatory and optional input and output links required for execution and contains an illustration of an example flow chart. References are given for some processing steps based upon specific published techniques or algorithms. An image of the processing step's parameter dialog is also displayed for reference. Finally, each step parameter is detailed. When relevant, the valid range for each parameter is shown in brackets {}.

Abbreviations for the parameters are as follows –

> - Greater than

<= - Less than or equal to

< - Less than

>= - Greater than or equal to

#,# - Range of values from first number to last number

Parameter range checking is enabled for some of the processing step parameters.

Note: For processing parameters with spatial units such as feet, meters, feet per second, meters per second, etc., SPW assumes that the information provided by the user matches

the definition in the project setting. For example, if the geometry information is defined in meters, then metric units should be used consistently in all processing steps. Combining different metric units of measure when processing in SPW will yield erroneous results. SPW does not perform any unit and/or coordinate conversion.

Amplitude Adjustment Steps

This section documents the processing steps available for Amplitude Adjustment. Processing steps currently available are:

Amplitude Adjustment
↑ Processing Categories
AVA Calculator
Amplitude Equalization
Amplitude versus Angle
Angle Gather
Apply Gain
Automatic Gain Control
Clipping
Offset Amplitude Corrections
Random Noise
Spherical Divergence
Surface Consistent Gain Corrections
Time Variant Gain Scaling
Trace Header Amplitude Math
Windowed AGC
Windowed Trace Balance

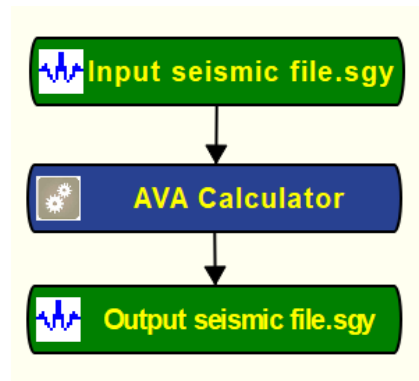
AVA Calculator

Usage: The AVA Calculator step computes traditional Amplitude Versus Angle (AVA) operations using estimates of AVA intercept (A) and gradient (B)

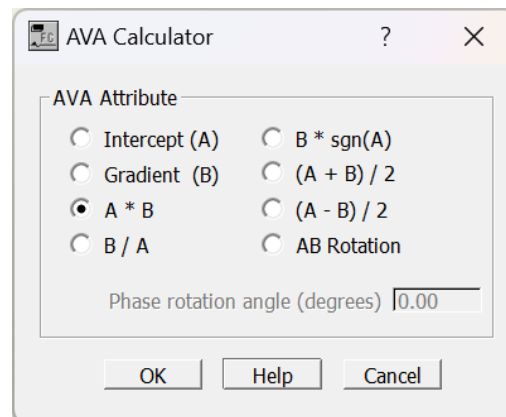
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **AVA Attribute** specifies the type of AVA attributes to be calculated.

Intercept (A) — If selected, compute AVA Intercept.

Gradient (B) — If selected, compute Gradient.

A * B — If selected, compute AVA Intercept and AVA Gradient and multiply both.

B / A — If selected, compute the division between the AVA Gradient with the AVA Intercept.

B * sign(A) — If selected, compute the AVA Gradient and multiplies it by the signed AVA Gradient.

(A + B) / 2 — If selected, computes the average between AVA Intercept and Gradient.

(A - B) / 2 — If selected, computes the difference between AVA Intercept and Gradient and divides by two.

AB Rotation — If selected, sums AVA Intercept and Gradient after input traces being rotated by the Phase rotation angle (degrees).

Phase rotation angle (degrees) — Enabled if AB Rotation is selected.

Enter constant angle in degrees used to rotate the phase of each trace.

{>=0}

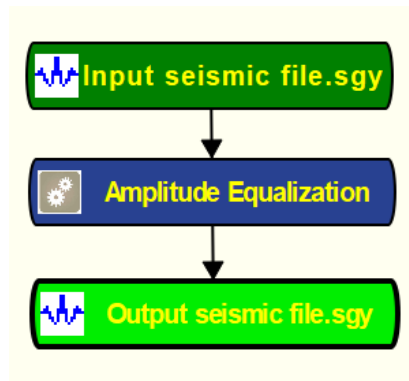
Amplitude Equalization

Usage: The Amplitude Equalization step allows the user to balance the RMS values of the seismic data to a constant specified RMS level. The user can also clip the seismic data at a specified level and specify the data window to use in calculating the RMS amplitudes, the output RMS and clipping levels, and the method of amplitude equalization, which may be either trace constant or record constant.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Amplitude Equalization' with a question mark icon and a close button. It contains several input fields and a method selection section.

Parameter	Value
Equalization window start (ms)	0.0
Window length (ms)	1000.0
RMS level	20000.0
Clipping level	32767.0

Method

- ☒ Trace constant equalization
- ☐ Record constant equalization

☒ Apply moveout to equalization window

Linear moveout velocity: 7000.0

Buttons: OK, Help, Cancel

Parameter Description:

Equalization window start (ms) — Enter the start time in milliseconds of the window to be used in calculating the trace amplitude. {>=0}

Window length (ms) — Enter the length in milliseconds of the window to be used in calculating the trace amplitude. {>0.0}

RMS level — Enter the output RMS level of the data window specified. {>0.0}

Clipping level — Enter the clipping level of the trace data. {>0.0}

The **Method** specifies whether to apply the equalization on a trace-by-trace basis or to maintain relative amplitudes and level the RMS value of the entire record.

Trace constant equalization — If selected, the seismic data will be equalized on a trace-by-trace basis.

Record constant equalization — If selected, the seismic data will be equalized on a record-by-record basis, which will depend on the sort order of the input data.

Apply moveout to equalization window — If checked, the equalization will be performed after linear moveout at the specified velocity. The window start time will shift by: $\Delta time = offset/velocity$.

Linear moveout velocity — Enabled if *Apply moveout to equalization window* is checked. Enter the constant moveout velocity. {>0.0}

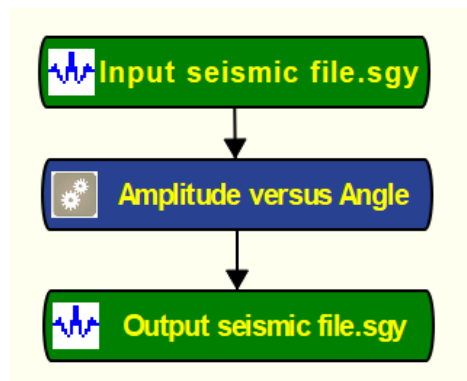
Amplitude Versus Angle

Usage: The Amplitude Versus Angle step allows the user to map seismic reflection information in the biangular domain using various methods to interpret the amplitude values. The step also allows to define the velocity field, select the ray tracing type, specify the angle range, and choose the velocity curve fit type.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Amplitude Versus Angle" and contains the following sections:

- Method:** Radio buttons for "Shuey" (selected) and "Aki and Richards". A text field for "Gardner exponent" is set to 0.3.
- Ray tracing type:** Radio buttons for "Straight ray" (selected), "Perturbed ray", "Curved ray", and "Eikonal".
- Angle range:** Text fields for "Minimum angle" (0.0) and "Maximum angle" (30.0).
- Velocity field definition:** Checkboxes for "Use velocity field from data file", "Use velocity field from seismic file", and "Use constant velocity". A text field for "Constant velocity" is set to 10000.0. A text field for "Scale input velocities by (%)" is set to 1.0.
- Velocity curve fit type:** Radio buttons for "Polynomial fit" (selected) and "Spline fit".

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Method** specifies the approximation to the Zoeppritz equation that will be used to interpret the amplitude values. The Shuey method is accurate to approximately 30 degrees of incidence angle, whereas the Aki and Richards method can be considered accurate to 40 degrees.

Shuey — If selected, the Shuey approximation will be used.

Aki and Richards — If selected, the Aki and Richards approximation will be used.

Gardner exponent — Only applies if the Aki and Richards method is selected. Enter the value to be used for the exponent in the Gardner equation $\{>0\}$.

The **Velocity field definition** specifies the velocity field to be used.

Use velocity field from data file — If checked, the velocity field will be used from the data file.

Use velocity field from seismic file — If checked, the velocity field will be used from the seismic file.

Use constant velocity — If checked, a constant velocity will be used.

Constant velocity (m/s) — Only applies if *Use Constant Velocity* is checked, enter a constant velocity $\{>0\}$.

Scale input velocities by (%) — Enter a percentage to scale input velocities. $\{1.0, 100\}$

The **Ray tracing type** specifies the ray tracing method used in the estimation of propagation angles.

Straight ray — If selected, rays will be traced using a straight ray algorithm.

Perturbed ray — If selected, rays will be traced using a perturbed ray algorithm.

Curved ray — If selected, rays will be traced using a curved ray algorithm.

Eikonal ray — If selected, rays will be traced using an eikonal ray algorithm.

The **Angle range** specifies the minimum and maximum angles used in the calculation of AVA attributes.

Minimum angle (degrees) — Enter the minimum angle {>0}.

Maximum angle (degrees) — Enter the maximum angle. {>0}.

The **Velocity curve fit type** defines the procedure to interpolate velocities between time-velocity pairs specified in the linked velocity file.

Polynomial fit — If selected, velocities will be interpolated with a polynomial interpolator.

Spline fit — If selected, velocities will be interpolated with a spline interpolator.

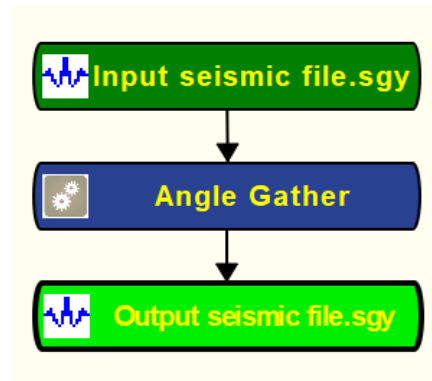
Angle Gather

Usage: The Angle Gather step produces angle domain common image gathers, allowing the user to specify the angle range to calculate AVA attributes. The user may also define the velocity field, select the ray tracing type, and choose the velocity curve fit type.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in angle domain (mandatory); 2) Velocity card file or velocity file (optional).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the 'Angle Gather' dialog box with the following settings:

- Angle range:** Minimum angle: 0.0, Maximum angle: 30.0
- Ray tracing type:** Straight ray (selected), Perturbed ray, Curved ray, Eikonal
- Velocity curve fit type:** Polynomial fit (selected), Spline fit
- Velocity field definition:** Use velocity field from data file, Use velocity field from seismic file, Use constant velocity (unchecked). Constant velocity: 10000.0
- Scale input velocities by (%):** 1.0

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Angle range** defines the minimum and maximum angles used in the calculation of the angle gathers.

Minimum angle (degrees) — Enter the minimum angle {>0}.

Maximum angle (degrees) — Enter the maximum angle {>0}.

The **Velocity field definition** defines the velocity field used for the AVA Attributes calculation.

Use velocity field from data file — If checked, the velocity field will be used from the data file.

Use velocity field from seismic file — If checked, the velocity field will be used from the seismic file.

Use constant velocity — If checked, a constant velocity will be used.

Constant velocity (m/s) — Only applies if *Use Constant Velocity* is checked, enter a constant velocity {>0}.

Scale input velocities by (%) — Enter a percentage to scale input velocities {1.0, 100}.

The **Ray tracing type** defines the ray tracing method used in the estimation of propagation angles.

Straight ray — If selected, rays will be traced using a straight ray algorithm.

Perturbed ray — If selected, rays will be traced using a perturbed ray algorithm.

Curved ray — If selected, rays will be traced using a curved ray algorithm.

Eikonal ray — If selected, rays will be traced using an eikonal ray algorithm.

The **Velocity curve fit type** defines the procedure to interpolate velocities between time-velocity pairs specified in the linked velocity file.

Polynomial fit — If selected, velocities will be interpolated with a polynomial interpolator.

Spline fit — If selected, velocities will be interpolated with a spline interpolator.

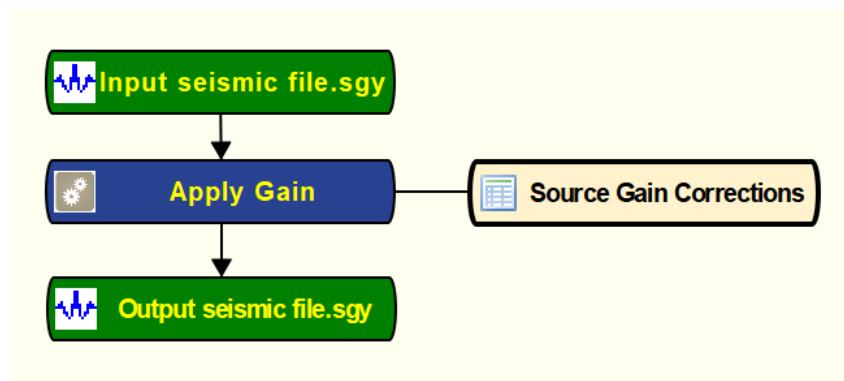
Apply Gain

Usage: The Apply Gain step allows the user to apply gain function curves to the seismic data. Any, or all, source, receiver, offset or gain card data may be applied. Gain curves may also be applied from an auxiliary card data file. Additionally, gain may be applied by entering dB/second. Gain curves are specified as time – dB pairs and are linearly interpolated to each location along the line. A constant gain multiplier may also be applied to the data.

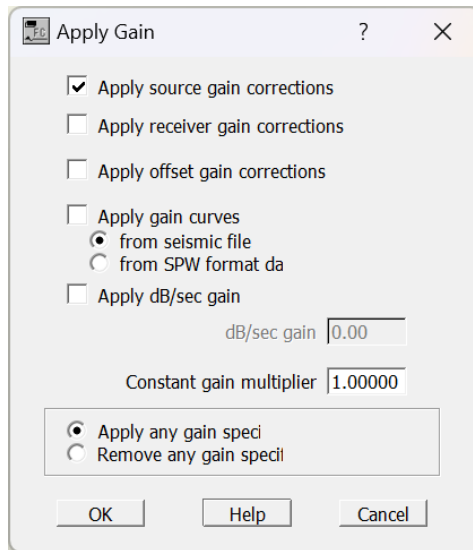
Input Links: 1) Seismic data in any sort order (mandatory); 2) Source Gain Corrections cards (optional); 3) Receiver Gain Corrections cards (optional); 4) Offset Gain Corrections cards (optional); 5) Gain Curves cards (optional).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flow chart:



Step Parameter Dialog:



Parameter Description:

Apply source gain corrections — If checked, source gain corrections will be applied to the seismic data from a source gain correction auxiliary file.

Apply receiver gain corrections — If checked, receiver gain corrections will be applied to the seismic data from a receiver gain correction auxiliary file.

Apply offset gain corrections — If checked, offset gain corrections will be applied to the seismic data from an offset gain correction auxiliary file.

Apply gain curves— If checked, gain curves will be applied to the seismic data from an auxiliary file.

From seismic file — If selected, gain curves will be applied to the seismic data from a seismic file.

From SPW format data — If selected, gain curves will be applied to the seismic data from an auxiliary card data file.

Apply dB/sec gain — If checked, gain will be applied to the data in decibels per second.

dB/sec gain — If *Apply dB/sec gain* is checked, enter the gain in decibels per second.

Constant gain multiplier — Enter a constant gain multiplier by which value each trace data sample will be multiplied {>0}.

Apply any gain specified — If selected, apply specified gain to the seismic data.

Remove any gain specified — If selected, remove specified gain from the seismic data.

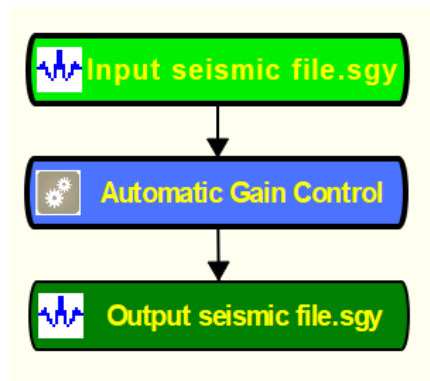
Automatic Gain Control

Usage: The Automatic Gain Control step allows the user to apply up to ten sliding window gain functions to each data trace. The user can specify the number of gated windows, the overlap between the gated windows, and the start time and length of each gate. The calculated gain functions may be output to an optional seismic file, which allows you the option to remove the AGC functions prior to subsequent processing steps.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowcharts:



Step Parameter Dialog:

Automatic Gain Control

Number of operators: 2

Overlap between gates (ms): 50.0

Output type:

- ☒ Data after application of AGC
- ☐ Gain functions only

Window	Start time (ms)	Window length (ms)
1	0.00	500.00
2	450.00	500.00

☐ Equalize RMS amplitudes

OK Help Cancel

Parameter Description:

Number of operators — Enter the number of operators to design and apply on each trace. Each trace will be divided into this number of time gates (windows) {1, 10}.

Overlap between gates (ms) — Enter the overlap between gates in milliseconds. Longer overlap between gates results in a smoother transition between the gated windows {>=0}.

The **Output type** selects the type of output after applying this processing step.

Data after application of AGC — If selected, output the seismic reflection data after the AGC.

Gain functions only — If selected, output only the gain functions that might be applied to the seismic data using Apply Gain processing step.

Start time (ms) — Enter the start time in milliseconds for each gate {>=0.0}.

Window length (ms) — Enter the operator length in milliseconds for each gate {>=0.0}.

Equalize RMS amplitudes — If checked, the trace RMS amplitude prior to AGC and after AGC will be the same.

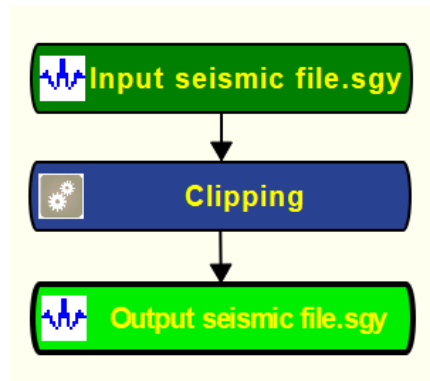
Clipping

Usage: The Clipping step is used to remove high-amplitude sample values from the input data and replace them with a user supplied threshold sample value. The largest positive and largest negative acceptable sample amplitudes are provided by the user. Values outside of this range are replaced by the threshold value.

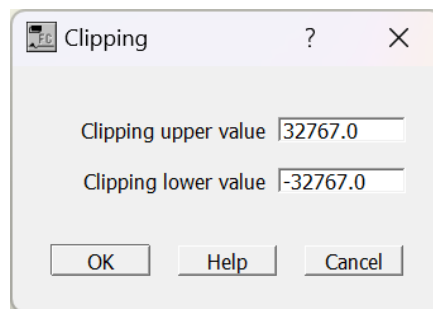
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Clipping upper value — Specify the largest acceptable positive value. Positive values larger than the clipping upper limit are replaced with the clipping upper limit.

Clipping lower value — Specify the largest acceptable negative value. Negative values greater than the clipping lower limit are replaced with the clipping lower limit.

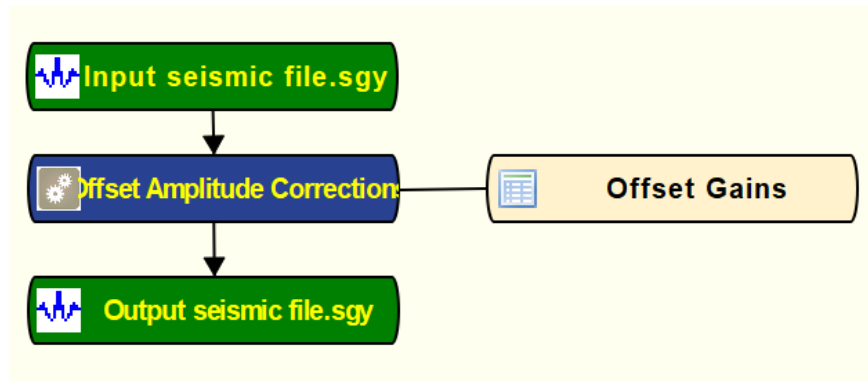
Offset Amplitude Corrections

Usage: The Offset Amplitude Corrections step allows the user to correct the amplitude values of the seismic reflection data with the offset. The user needs to specify a function of gain with the offset.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Offset Gains cart data (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory); 2) Offset gains card data (mandatory).

Example Flowchart:



Step Parameter Dialog:

Offset Amplitude Corrections

Design window

☒ Use fixed window to build pilot

Design window start time (ms) 1000.0

Design window stop time (ms) 2000.0

☐ Apply linear moveout to design window

Linear moveout velocity (m/s) 2400.0

☐ Offset limit traces in design window

Minimum offset 0.0

Maximum offset 3000.0

Offset gain calculations

Offset bin size 1000.0

Minimum hit count per bin 6

OK Help Cancel

Parameter Description:

The **Define window** defines the window configuration where the correction is going to be applied. The window may be defined within a constant time gate, and/or by applying a linear moveout and/or by limiting the traces in the calculation by the offset.

Use fixed window to build pilot — If checked, the pilot window is defined within a time gate.

Design window start time (ms) — If used fixed window to build pilot is checked, enter the start time for the design window.

Design window stop time (ms) — If used fixed window to build pilot is checked, enter the end time for the design window.

Apply linear moveout to design window — If checked, apply a linear moveout to the design window with a constant velocity as defined in Linear moveout velocity.

Linear moveout velocity (m/s) — If *Apply linear moveout to design window* is checked, enter velocity to apply the linear moveout to the design window. {>=0.0}

Offset limit traces in design window — If checked, the traces considered to the design window are limited by offset.

Minimum offset — If *Offset limit traces in design window* is checked, enter the minimum offset to be considered in the design window.

Maximum offset — If *Offset limit traces in design window* is checked, enter the maximum offset to be considered in the design window.

The **Offset gain calculations** defines the parameters related to the gain calculation.

Offset bin size — Enter bin size to compute offset gain. {>=0}

Minimum hit count per bin — Enter minimum hit count per bin. {>=0}

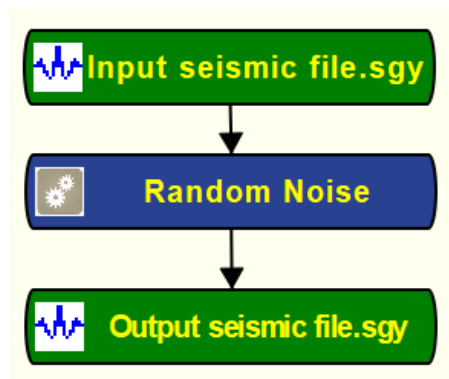
Random Noise

Usage: The Random Noise step estimates the signal level then generates random noise to add to the data at a specified Signal to Noise ratio. It is useful for creating noise in model data.

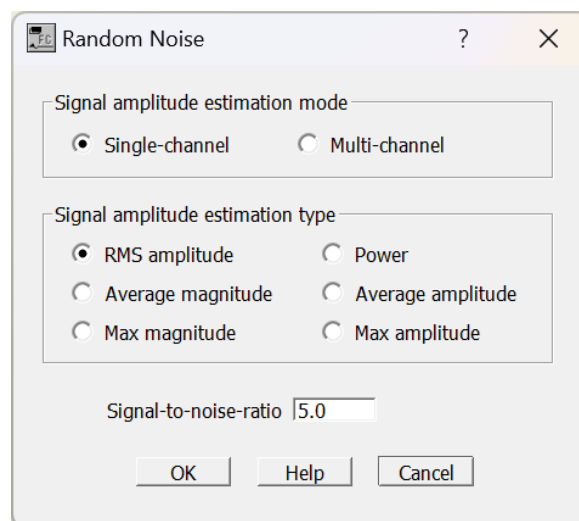
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Signal amplitude estimation mode** estimate the signal amplitude either on a single channel or on multi-channel.

Single-channel — If selected, use a single channel to estimate the signal amplitude.

Multi-channel — If selected, use multi-channel to estimate the signal amplitude.

The **Signal amplitude estimation type** selects the type of signal amplitude estimation.

RMS amplitude — If selected, the signal amplitude is estimated by RMS amplitude.

Average magnitude — If selected, the signal amplitude is estimated by average magnitude.

Max magnitude — If selected, the signal amplitude is estimated by maximum magnitude.

Power — If selected, the signal amplitude is estimated by the power of amplitude.

Average amplitude — If selected, the signal amplitude is estimated by average amplitude.

Max amplitude — If selected, the signal amplitude is estimated by maximum amplitude.

Signal-to-noise ratio — Enter the desired signal-to-noise ratio.

Spherical Divergence

Usage: The Spherical Divergence correction step is designed to compensate for the decrease in seismic amplitude as a wavefront propagates away from the source location. The Spherical Divergence Correction step applies a gain to the data traces based on the equation:

$$\text{Gain} = T_{\text{Multiplier}} * (\text{Time}^{T_{\text{Exponent}}}) * V_{\text{Multiplier}} * (\text{Velocity}(\text{Time})^{V_{\text{Exponent}}}).$$

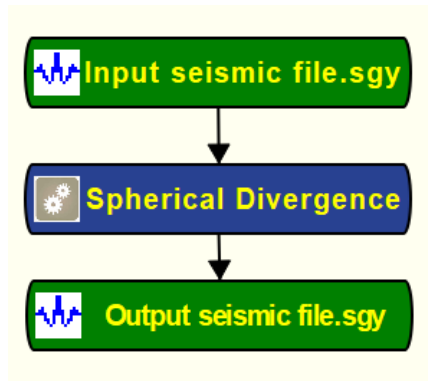
The $T_{\text{Multiplier}}$ and the $V_{\text{Multiplier}}$ are constant gain factors and the T_{Exponent} and the V_{Exponent} vary the gain with time. Multipliers of one (1) and an exponent of two (2) are commonly used for the spherical divergence correction since energy from a point source dissipates in proportion to the square of distance traveled. To apply the spherical divergence correction as a function of both time and velocity, the user must supply the optional velocity function. Otherwise, the velocity terms in the above equation will be ignored and the spherical divergence correction will only be applied as a function of time. The user also has the option to apply the inverse spherical divergence correction function to the seismic data.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Velocity field card (optional).

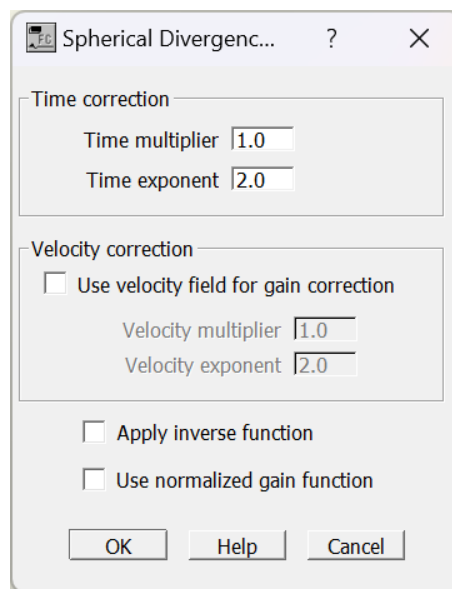
Output Links: 1) Seismic data in same sort order as input (mandatory).

Reference: Claerbout, Jon F., 1985, Fundamentals of Geophysical Data Processing: Blackwell Scientific Publications.

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Time correction** specifies the parameters related to spherical correction based on time.

Time multiplier — Enter the time multiplier in the gain equation.

Time exponent — Enter the time exponent in the gain equation.

The **Velocity correction** specifies the parameters related to spherical correction based on velocity.

Use velocity field for gain correction — If checked, spherical correction is applied based on a velocity field.

Velocity multiplier — If *Use velocity field for gain correction* is checked, enter the velocity multiplier in the gain equation.

Velocity exponent — If *Use velocity field for gain correction* is checked, enter the velocity exponent in the gain equation.

Apply inverse function — If checked, an inverse spherical divergence correction will be applied to the seismic data.

Use normalized gain function — Normalize the gain function to be applied.

Surface Consistent Gain Corrections

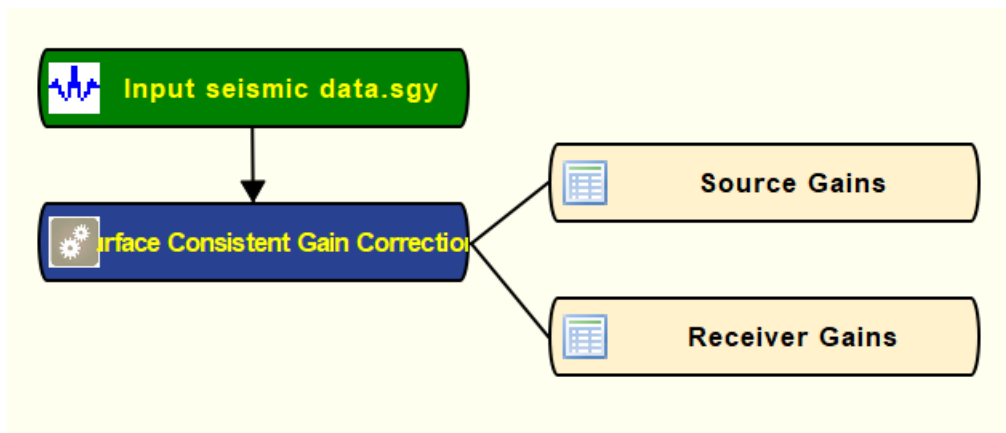
Usage: The Surface Consistent Gain Corrections step calculates source and receiver amplitude variations in a surface consistent manner. Gain curves must be specified for source and receiver.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Source Gain Corrections cards; 2) Receiver Gain Corrections cards; 3) Offset Gain Corrections cards (optional).

Reference: Taner, M. T., and Coburn, K. W., 1980, Surface consistent estimation of source and receiver response functions: 50th International Meeting of Soc. Expl. Geophy., Expanded Abstract.

Example Flowchart:



Step Parameter Dialog:

Surface Consistent Gain Corrections

Design window

☐ Use window definition file

☒ Use fixed window

Start time (ms) 1000.0

Stop time (ms) 2000.0

☐ Apply linear moveout to window

Linear moveout velocity 2400.0

☐ Specify offset bin size:

Offset bin size 0.0

☐ Offset limit traces used

Minimum offset 0.0

Maximum offset 3000.0

Surface consistent amplitude decomposition

% RMS error change for termination 10.00000

Compute log amplitude Yes

Compute source term Yes

Output source gain corrections Yes

Compute receiver term Yes

Output receiver gain corrections Yes

Compute offset term Yes

Output offset gain corrections No

Compute structure term Yes

OK Help Cancel

Parameter Description:

The **Define window** defines the window configuration where the correction is going to be applied. The window may be defined within a constant time gate, and/or by applying a linear moveout and/or by limiting the traces in the calculation by the offset.

Use window definition file — If selected, the pilot area is defined with a Window Definition card.

Use fixed window — If selected, the pilot area is defined within a fixed time gate.

Start time (ms) — Enter the window starting time in ms $\{ \geq 0 \}$.

Stop time (ms) — Enter the window ending time in ms $\{ \geq 0 \}$.

Apply linear moveout to window — If checked, the window is defined based on a linear moveout with the velocity defined in Linear moveout velocity.

Linear moveout velocity — Enter the linear moveout velocity in m/s.

Specify offset bin size — If checked, the window is defined based on the bin size of the offset.

Offset bin size — Enter the bin size of the offset.

Offset limit traces used — If checked, the window definition is limited by a Minimum and Maximum offset values.

Minimum offset — Enter the minimum offset in field units to build the window.

Maximum offset — Enter the maximum offset in field units to build the window.

The **Surface consistent amplitude decomposition** specifies the decomposition parameters and step outputs.

% RMS error change for termination — Enter the RMS error threshold to terminate the iterative process.

Compute log amplitude — Select if amplitude logs are output.

Compute source term — If selected, compute the source term.

Output source gain corrections — If selected, outputs the source gain corrections.

Compute receiver term — If selected, compute the receiver term.

Output receiver gain corrections — If selected, outputs the receiver gain corrections.

Compute offset term — If selected, compute the offset term.

Output offset gain corrections — If selected, outputs the offset gain corrections.

Compute structure term — If selected, compute the structure term.

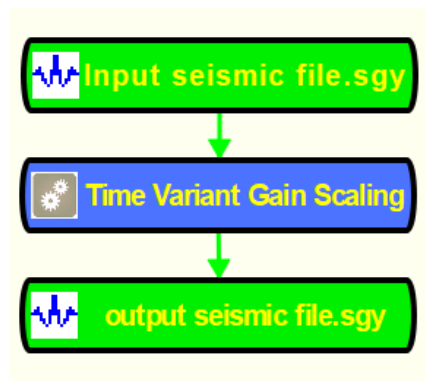
Time Variant Gain Scaling

Usage: The Variant Gain Scaling step allows applying an amplitude scalars per different vertical non-overlapping time windows defined in milliseconds.

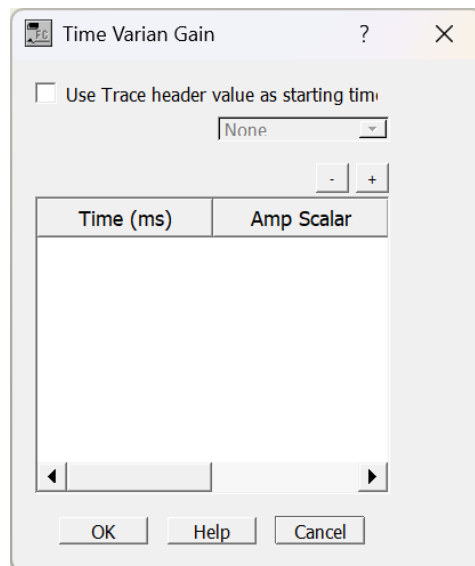
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Use Trace header value as starting time — If selected, allow selecting the trace header word where the starting time of the time variant gain will be applied on a trace-by-trace basis.

Amplitude Scalar table — Amplitude gain scalars are defined per constant time value.
Amplitude gain scalars are interpolated in between the defined times.

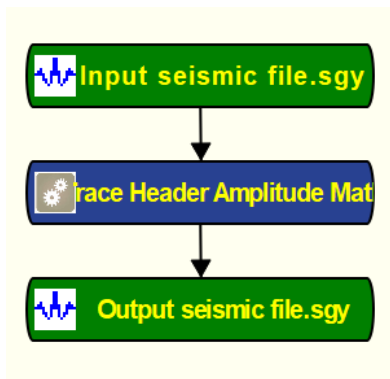
Trace Header Amplitude Math

Usage: The Trace Header Amplitude Math step allows to modify sample values using mathematical operations on trace header fields. Any of the trace header fields can be used.

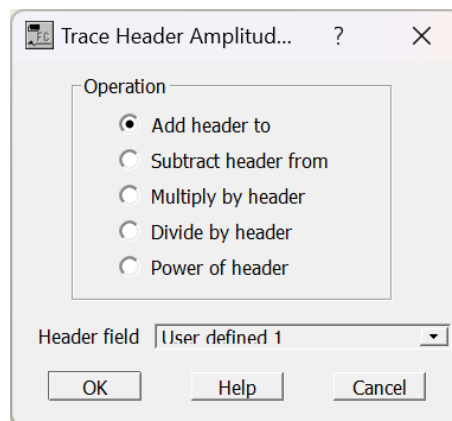
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Operation** specifies the mathematical operation that will modify the seismic amplitude values based on value specified on a user-defined header.

Add header to — If selected, add header value to each seismic amplitude value.

Subtract header from — If selected, subtract header value to each seismic amplitude value.

Multiply by header — If selected, multiply each seismic amplitude value by header.

Divide by header — If selected, divide each seismic amplitude value by header.

Power of header — If selected, compute the power of each seismic amplitude value by an exponent as defined in header.

Header Field — Select the trace header field that will modify the seismic amplitude values.

Example: If the Multiply by header operator is selected and the Header field is set to offset, then the sample values in each input trace will be multiplied by the value of offset in the corresponding trace header.

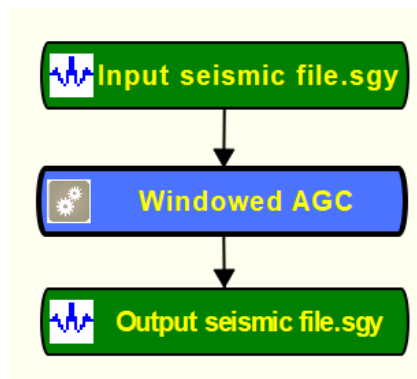
Windowed AGC

Usage: The Windowed AGC step allows the user to apply window gain functions to each data trace based on user-defined windows. The step allows to specify the number of windows by setting the start time and length of each gate. The calculated gain functions may be output to an optional seismic file, which allows the user the option to remove the AGC functions prior to subsequent processing steps.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory); 2) Gain functions (optional).

Example Flowchart:



Step Parameter Dialog:

Windowed AGC

☐ Output gain functions

Number of windows: 3

Window	Window start (ms)	Window length (ms)
1	0.00	1000.00
2	1000.00	1000.00
3	2000.00	1000.00

OK Help Cancel

Parameter Description:

Output gain functions — If checked, output the gain functions to a gain functions card. This allows removing the AGC effect later on the processing flow.

Number of Windows — Define number of different windows where the AGC is going to be applied. Each window is defined by its **starting time** (ms) and length (ms) {1, 10}.

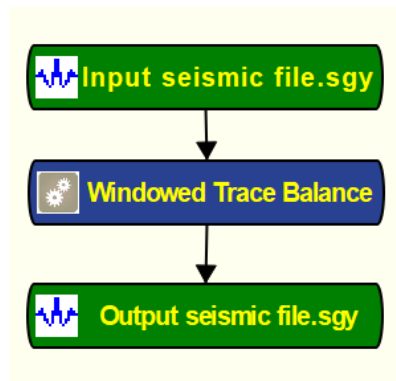
Windowed Trace Balance

Usage: The Windowed Trace Balance step allows the step to balance the seismic amplitudes within user-defined windows based on RMS amplitude or Mean amplitude within each window.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as input (mandatory).

Example Flowchart:



Step Parameter Dialog:

Windowed Trace

Number of windows per trace: 3

Reference type:

☒ RMS amplitude ☐ Mean amplitude

Window	Window start (ms)	Window length (ms)	Reference level
1	0.00	500.00	5000.00
2	500.00	500.00	5000.00
3	1000.00	500.00	5000.00

OK Help Cancel

Parameter Description:

Number of windows per trace — Define the number of balancing windows per data trace {1, 10}.

The **Reference type** selects whether the traces will be leveled according to RMS amplitude or mean amplitude.

RMS amplitude — If selected, level the seismic traces by the RMS Amplitude.

Mean amplitude — If selected, level the seismic traces by the Mean Amplitude.

Window start (ms) — Enter the start time in milliseconds for the balancing window $\{ \geq 0 \}$.

Window length (ms) — Enter the length in milliseconds for the balancing window. The window will extend from the start time to start time + length $\{ \geq 0 \}$.

Reference level — Enter the reference level for the balancing window. On output, the RMS or mean amplitude of the data trace will be equal to the specified value.

Creating and Editing Auxiliary Data File

This section documents the support information available as Auxiliary Data.

Auxiliary data may be imported from foreign data formats or output as foreign data formats. Auxiliary Data items currently available may be selected from the processing list below (A-P or R-Z):

Auxiliary Data A-P	
↑ Processing Categories	
CMP Flex Locations	
CMP Statics	
Early Mutes	
Exclusion Zones	
FK Mutes	
Field File Statics	
First Break Times	
Gain Curves	
Horizon File	
Line Definition File	
Offset Gain Corrections	
PP NHMO Eta Function	
PS NHMO Gamma Function	
Polygon Definition	
	Auxiliary Data R-Z
	↑ Processing Categories
	Receiver Gain Corrections
	Receiver Statics
	SPS Observer Notes
	SPS Receiver Locations
	SPS Source Locations
	Source Gain Corrections
	Source Statics
	Surgical Mutes
	Tail Mutes
	UK00A P1 90
	Velocity Function
	Window Definition

Creating and Editing Auxiliary Data Files

Each of the auxiliary data types can be created and edited within Flowchart. Below there are two examples: in the first example, we manually create and write a source SPS file; in the second example, we will retrieve and edit an existing source SPS file.

In this first example, we create and write a new SPS file in SPW.

Step 1. Click on Auxiliary Data R-Z from the list of Processing Categories.



Step 2. Click on the SPS Source Locations auxiliary card data file from the list.

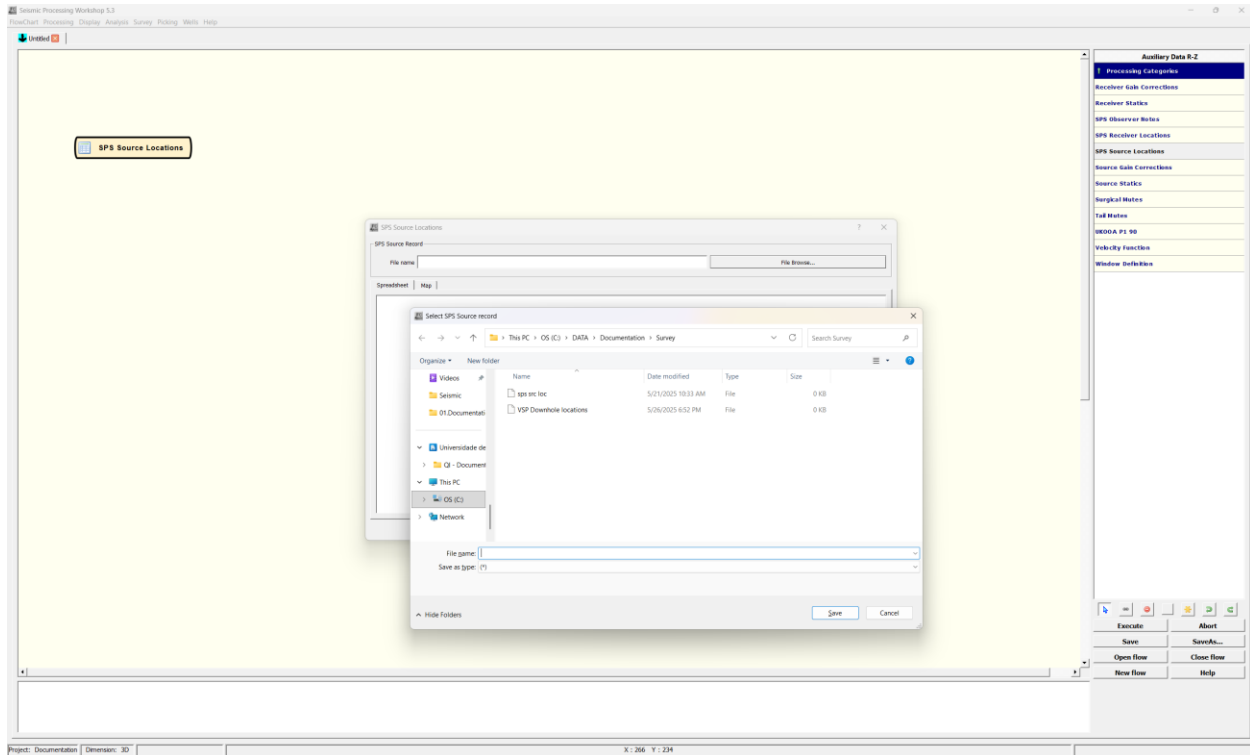
An example of selecting the SPS Source Locations auxiliary data file.



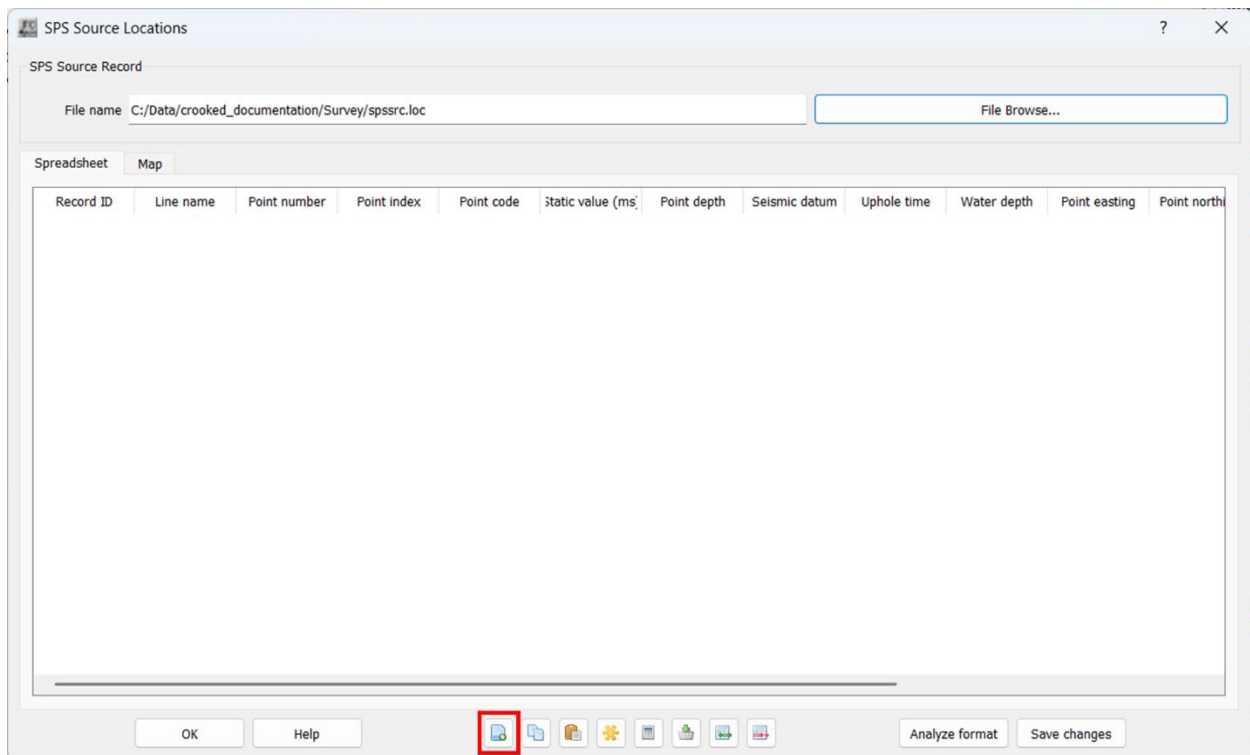
Step 3. Click on the FlowChart canvas to place the SPS Source Locations icon. You may click and drag the icon to relocate it. Double click on the SPS Source Locations auxiliary card data file to open it.



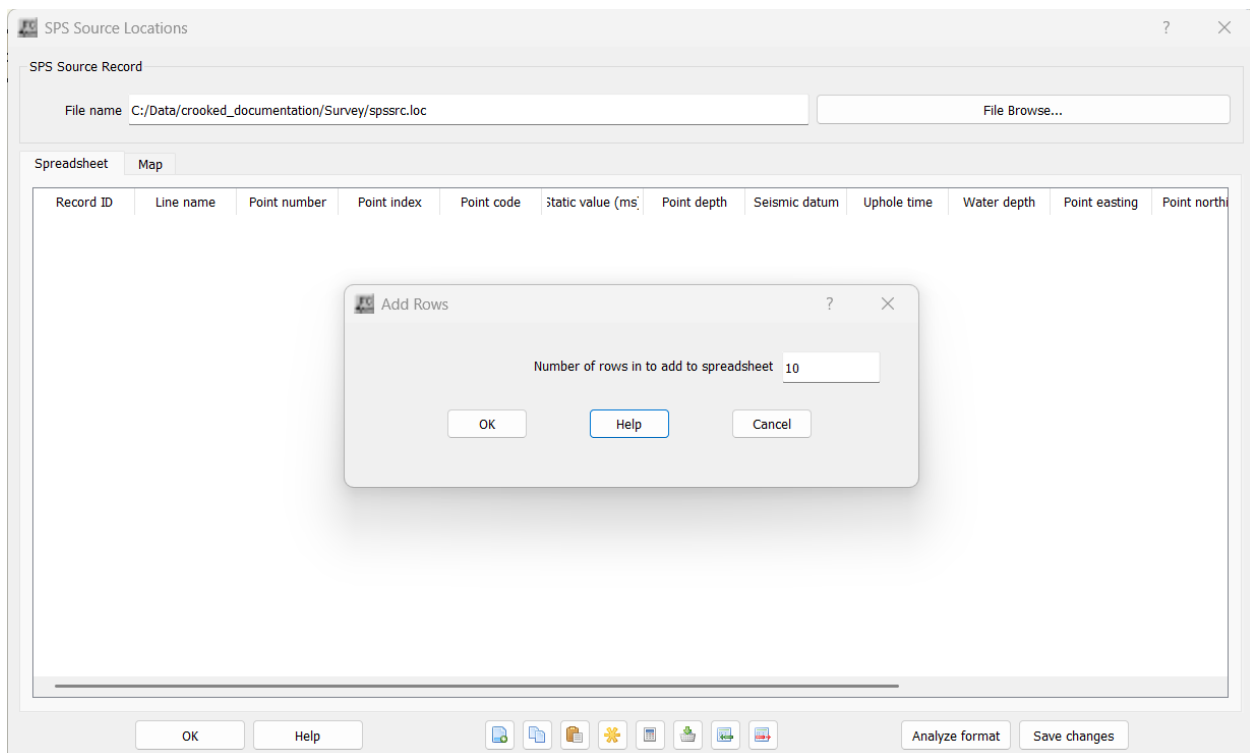
Step 4. To create a new SPS Source Point Record, click on the File Browse... button. A dialog box allows you to enter a desired name for your new file (e.g., New File) in the File name: text entry box. Click open.



Step 5. Click on Save changes. Notice that the directory path is automatically saved to the Survey directory. Notice also the empty columns.



Step 6. Select adds rows to create a spreadsheet for data entry. When the Add Rows dialog box comes up, enter the number of desired rows, click OK and then Save changes.



Step 7. Click on the Insert rows in spreadsheet button at the bottom of the SPS Source Point Record to add a single row one at a time if desired.

The screenshot shows the 'SPS Source Locations' window. At the top, the title bar reads 'SPS Source Locations'. Below it, the 'SPS Source Record' section contains a 'File name' field with the path 'C:/Data/crooked_documentation/Survey/spssrc.loc' and a 'File Browse...' button. Below this, there are two tabs: 'Spreadsheet' (selected) and 'Map'. The 'Spreadsheet' tab displays a table with 13 columns: Record ID, Line name, Point number, Point index, Point code, Static value (ms), Point depth, Seismic datum, Uphole time, Water depth, Point easting, Point northing, and Point elevation. The table contains 10 rows of data, all with zeros in the numerical columns. At the bottom of the window, there is a toolbar with icons for file operations and a button labeled 'Insert rows in spreadsheet'. Below the toolbar are buttons for 'OK', 'Help', 'Analyze format', and 'Save changes'.

	Record ID	Line name	Point number	Point index	Point code	Static value (ms)	Point depth	Seismic datum	Uphole time	Water depth	Point easting	Point northing	Point elevation
1	S			0		0	0.0	0	0	0			
2	S			0		0	0.0	0	0	0			
3	S			0		0	0.0	0	0	0			
4	S			0		0	0.0	0	0	0			
5	S			0		0	0.0	0	0	0			
6	S			0		0	0.0	0	0	0			
7	S			0		0	0.0	0	0	0			
8	S			0		0	0.0	0	0	0			
9	S			0		0	0.0	0	0	0			
10	S			0		0	0.0	0	0	0			

Most values may be entered in the spreadsheet by using the fill column function.

SPS Source Locations

SPS Source Record

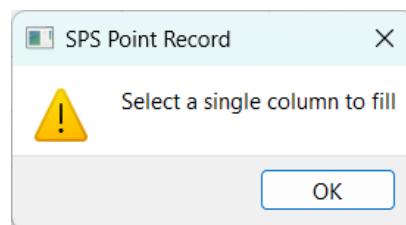
File name: C:/Data/crooked_documentation/Survey/spssrc.loc File Browse...

Spreadsheet Map

	Record ID	Line name	Point number	Point index	Point code	Static value (ms)	Point depth	Seismic datum	Uphole time	Water depth	Point easting	Point n
1	S			0		0	0.0	0	0	0		
2	S			0		0	0.0	0	0	0		
3	S			0		0	0.0	0	0	0		
4	S			0		0	0.0	0	0	0		
5	S			0		0	0.0	0	0	0		
6	S			0		0	0.0	0	0	0		
7	S			0		0	0.0	0	0	0		
8	S			0		0	0.0	0	0	0		
9	S			0		0	0.0	0	0	0		
10	S			0		0	0.0	0	0	0		

OK Help Icons Analyze format Save changes

If a column is not selected, an error check dialog box will prompt you to select a single column to fill.



Step 8. Select a column to fill in the spreadsheet by clicking on the column header (e.g. Point number).

SPS Source Locations

SPS Source Record

File name: C:/Data/crooked_documentation/Survey/spssrc.loc

File Browse...

Spreadsheet Map

	Record ID	Line name	Point number	Point index	Point code	Static value (ms)	Point depth	Seismic datum	Uphole time	Water depth	Point easting	Point n
1	S			0		0	0.0	0	0	0		
2	S			0		0	0.0	0	0	0		
3	S			0		0	0.0	0	0	0		
4	S			0		0	0.0	0	0	0		
5	S			0		0	0.0	0	0	0		
6	S			0		0	0.0	0	0	0		
7	S			0		0	0.0	0	0	0		
8	S			0		0	0.0	0	0	0		
9	S			0		0	0.0	0	0	0		
10	S			0		0	0.0	0	0	0		

OK Help Analyze format Save changes

Step 9. Enter the Starting value, the Increment value and the Number of items in pattern and click Apply to fill the column you have selected.

Fill Columns

Fill method

☐ Constant

☐ Series

☒ Pattern

Fill values

Starting value 101

Increment value 2

of items in pattern 10

Apply Help Cancel

Example of using the Fill Columns dialog box.

Cell Math may also be used to edit information in the SPS Source Point Record.

SPS Source Locations

?

×

SPS Source Record

File name

C:/Data/crooked_documentation/Survey/spssrc.loc

File Browse...

Spreadsheet

Map

	Record ID	Line name	Point number	Point index	Point code	Static value (ms)	Point depth	Seismic datum	Uphole time	Water depth	Point easting	Point n
1	S		101	0		0	0.0	0	0	0		
2	S		103	0		0	0.0	0	0	0		
3	S		105	0		0	0.0	0	0	0		
4	S		107	0		0	0.0	0	0	0		
5	S		109	0		0	0.0	0	0	0		
6	S		111	0		0	0.0	0	0	0		
7	S		113	0		0	0.0	0	0	0		
8	S		115	0		0	0.0	0	0	0		
9	S		117	0		0	0.0	0	0	0		
10	S		119	0		0	0.0	0	0	0		

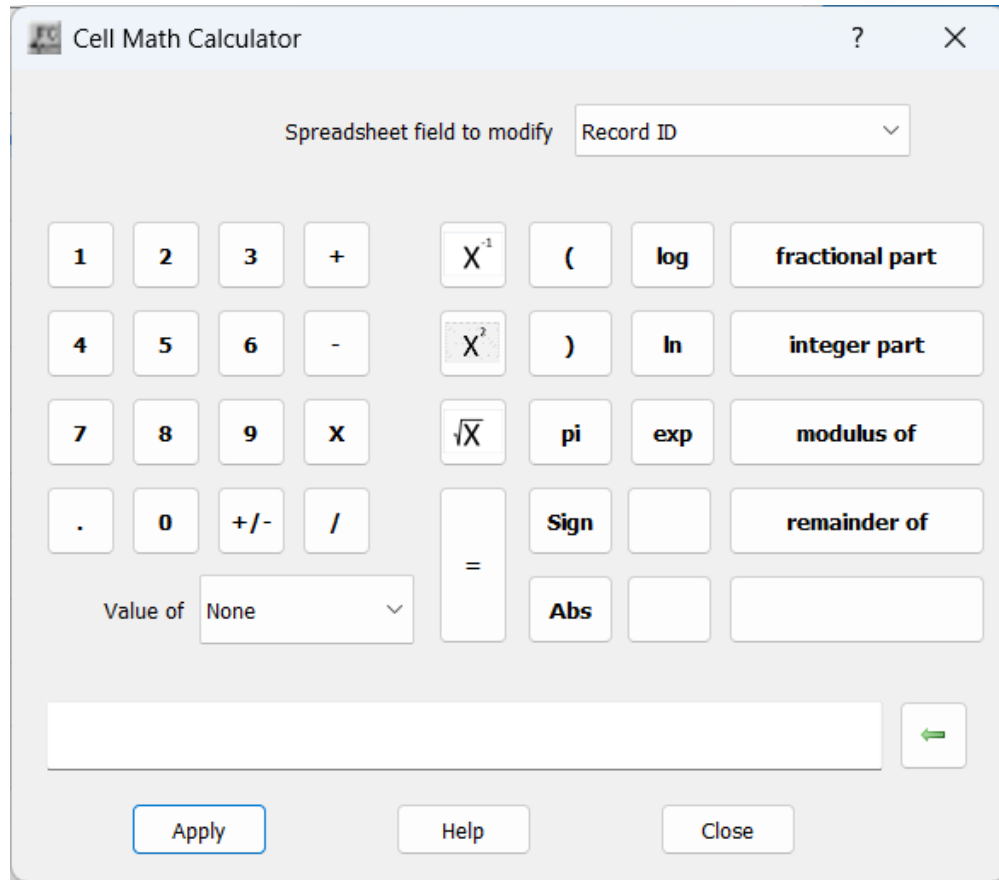
OK

Help

Analyze format

Save changes

Step 10. Click on the Cell math calculator button to view the functions available in the Cell Math Calculator.

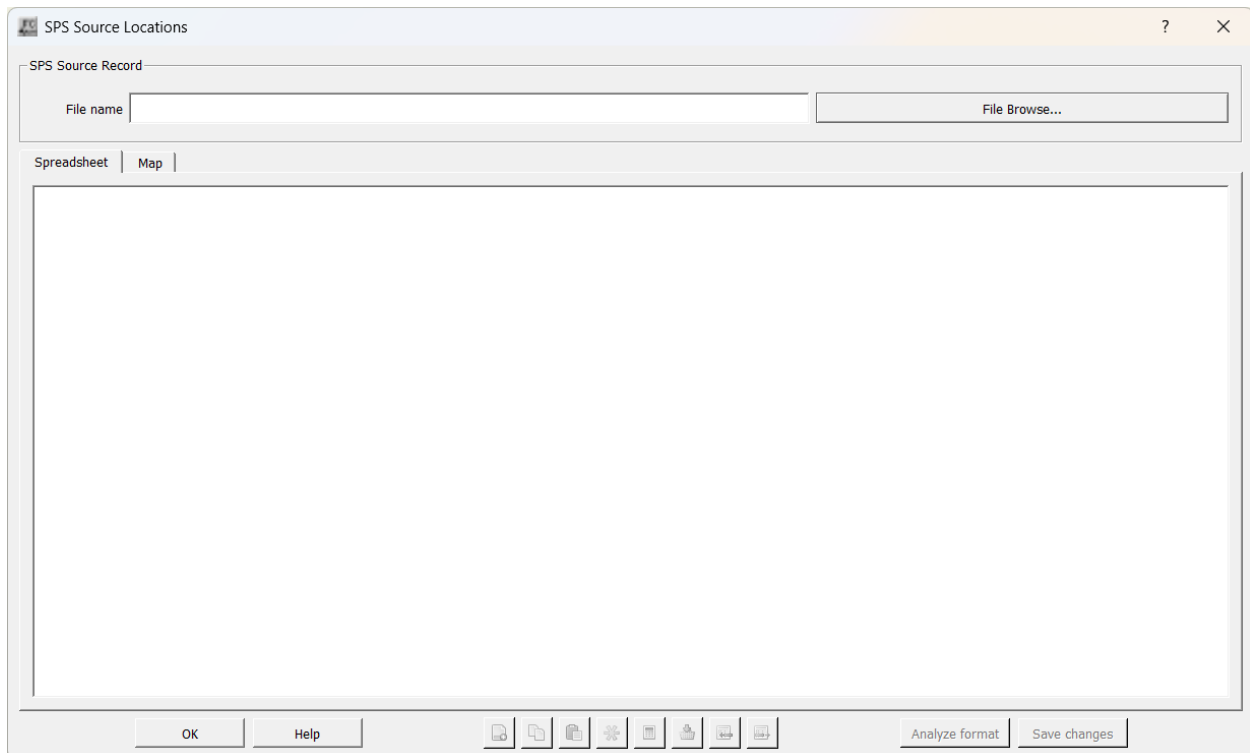


An example of selecting the Cell math calculator button.

The Cell Math Calculator consists of intuitive functions that can be used to edit the values in card data spreadsheet.

Click on the Apply button then Close to exit when finished with the Cell Math Calculator. When finished in the spreadsheet, be sure to Save changes and click OK to exit.

In this second example, we will locate and manually edit an existing SPS file in SPW.



Step 1. Select the File Browse button to call an existing Source Locations – SPS Format auxiliary card data file into the Flowchart.

SPS Source Locations

SPS Source Record

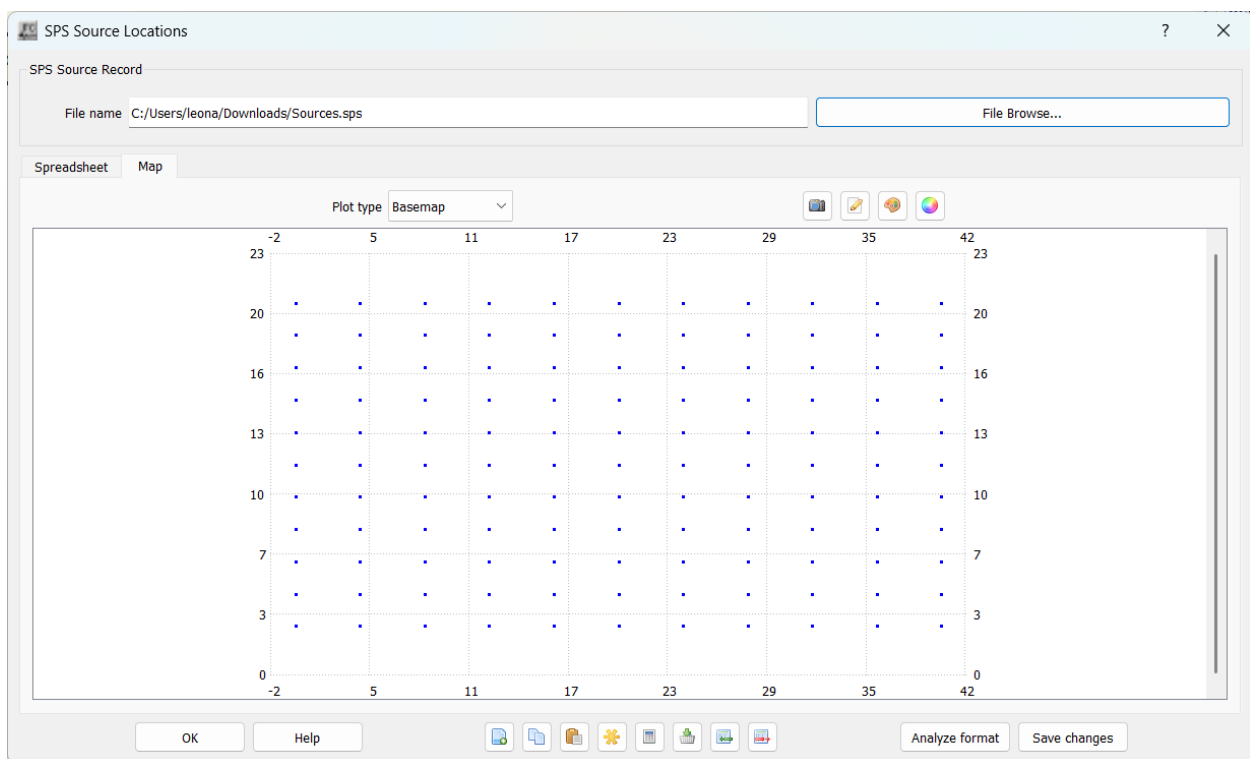
File name:

Spreadsheet | Map

	Record ID	Line name	Point number	Point index	Point code	Static value (ms)	Point depth	Seismic datum	Uphole time	Water depth	Point easting	P _r
1	S	1	1	0		0	0.0	0	0	0	40.0	
2	S	1	2	0		0	0.0	0	0	0	40.0	
3	S	1	3	0		0	0.0	0	0	0	40.0	
4	S	1	4	0		0	0.0	0	0	0	40.0	
5	S	1	5	0		0	0.0	0	0	0	40.0	
6	S	1	6	0		0	0.0	0	0	0	40.0	
7	S	1	7	0		0	0.0	0	0	0	40.0	
8	S	1	8	0		0	0.0	0	0	0	40.0	
9	S	1	9	0		0	0.0	0	0	0	40.0	
10	S	1	10	0		0	0.0	0	0	0	40.0	
11	S	1	11	0		0	0.0	0	0	0	40.0	
12	S	2	1	0		0	0.0	0	0	0	36.0	

OK Help  Analyze format Save changes

Step 2. Select the Map tab to view the basemap of the same file.



Step 3. To view and analyze the data format click on the Analyze Format button in the lower right portion of the SPS Source Point dialog box.

The SPS Analyzer dialog box is shown with the 'Source record identification' tab selected. The 'Record identification' is set to '1' and '1'. The 'Read lines with source record ID "S"' checkbox is checked. The 'First line to read' is set to '1'.

	Start	End	Load	Min	Max
Line	2	17	☒	1	11
Location	18	25	☒	1	11
Index	26	26	☒	0	0
Code	27	28	☒		
Easting	47	55	☒	0.0	40.0
Northing	56	65	☒	0.0	20.0
Elevation	66	71	☒	0.0	0.0

	Start	End	Load	Min	Max
Source static	29	32	☒	0	0
Source depth	33	36	☒	0.0	0.0
Source datum	37	40	☒	0	0
Source uphole	41	42	☒	0	0
Water depth	43	46	☒	0.0	0.0
Recording date	72	74	☒	0	0
Recording time	75	80	☒	0	0

123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789	123456789
S1		10	0 0.0	0 0 0.0	40.0	0.0	0.0	0	0
S1		20	0 0.0	0 0 0.0	40.0	2.0	0.0	0	0
S1		30	0 0.0	0 0 0.0	40.0	4.0	0.0	0	0
S1		40	0 0.0	0 0 0.0	40.0	6.0	0.0	0	0
S1		50	0 0.0	0 0 0.0	40.0	8.0	0.0	0	0
S1		60	0 0.0	0 0 0.0	40.0	10.0	0.0	0	0
S1		70	0 0.0	0 0 0.0	40.0	12.0	0.0	0	0
S1		80	0 0.0	0 0 0.0	40.0	14.0	0.0	0	0
S1		90	0 0.0	0 0 0.0	40.0	16.0	0.0	0	0
S1		100	0 0.0	0 0 0.0	40.0	18.0	0.0	0	0
S1		110	0 0.0	0 0 0.0	40.0	20.0	0.0	0	0
S2		10	0 0.0	0 0 0.0	36.0	0.0	0.0	0	0
S2		20	0 0.0	0 0 0.0	36.0	2.0	0.0	0	0

Buttons: Set as the default, Save format, Help, Close

SPS Receiver Point Records may be created and edited in the same way as SPS Source Point Records or they may be created in Microsoft Excel and then copied and pasted into SPW.

Below is an excerpt from SPW Help for specifying an SPS Point Record.

SPS Point Record

General description:

The SPS Point Record is used to describe shot and receiver positions in a land seismic survey. In the case of a shot location, the point record contains details regarding the position of the shot at the time of recording. In the case of a receiver location, the point record contains details regarding the position of the receiver at the time of the first shot recorded into that receiver.

Point Record Specification:

Field definition	Columns	Format	Minimum & Maximum
Record ID	1-1	ASCII	“R” or “S”
Line name	2-17	ASCII	Free form
Point number	18-25	ASCII	Free form
Point index	26-26	Integer	1-9
Point code	27-28	ASCII	
Static correction	29-32	Integer	-999 to +999
Point depth	33-36	Floating point	0 to 99.9
Seismic datum	37-40	Integer	-999 to + 9999
Uphole time	41-42	Integer	0 to 99
Water depth	43-46	Floating point	0 to 99.9 or 0 to 999
Easting	47-55	Floating point	None
Northing	56-65	Floating point	None

Elevation	66-71	Floating point	-999.9 to + 9999.9
Day of year	72-74	Integer	1 to 999
Time of day	75-80	Integer	0 to 235959

Point Record Description:

Record ID: “R” identifies the record as a receiver record. “S” identifies the record as a shot record

Line name: Identifier for the shotpoint or receiver line.

Point number: Identifier for the shotpoint or receiver group number.

Point index: Index of the shotpoint or receiver number. In the case of shotpoints, 1 indicates the first shot at the specified location. The value of the index is incremented by 1 for each additional shot at the specified location. In the case of receivers, 1 indicates the first positioning of the receiver at the specified location. The value of the index is incremented by 1 each time the receiver group is moved or repositioned.

Point code: A code that characterizes the shot or receiver used at the point.

Static correction: The shot or receiver static, in units of milliseconds, that has been computed in the field to correct the seismic recording for the effects of elevation, weathering thickness, or weathering velocity at the point. The correction is referenced to the seismic datum specified in field 8.

Point depth: The depth of the shot or receiver.

Seismic datum: Elevation of the seismic datum.

Uphole time: In the case of a shot, this is the vertical travelttime from the charge to surface, in units of milliseconds. The value is always positive.

Water depth: The measured height of the water surface above the seafloor or water bottom. In the case of shotpoints, the value should be the depth at the time of

recording. In the case of receivers, the value should be the depth at the time of recording the first shot into the receiver.

Easting: Map easting for the point. The coordinate system is defined in header H13 of the point record.

Northing: Map northing for the point. The coordinate system is defined in header H13 of the point record.

Elevation: Surface elevation with respect to the datum defined in header H17 of the point record. Elevations above datum are positive. In the case of shotpoints, the value should be the elevation at the time of recording. In the case of receivers, the value should be the elevation at the time of recording the first shot into the receiver.

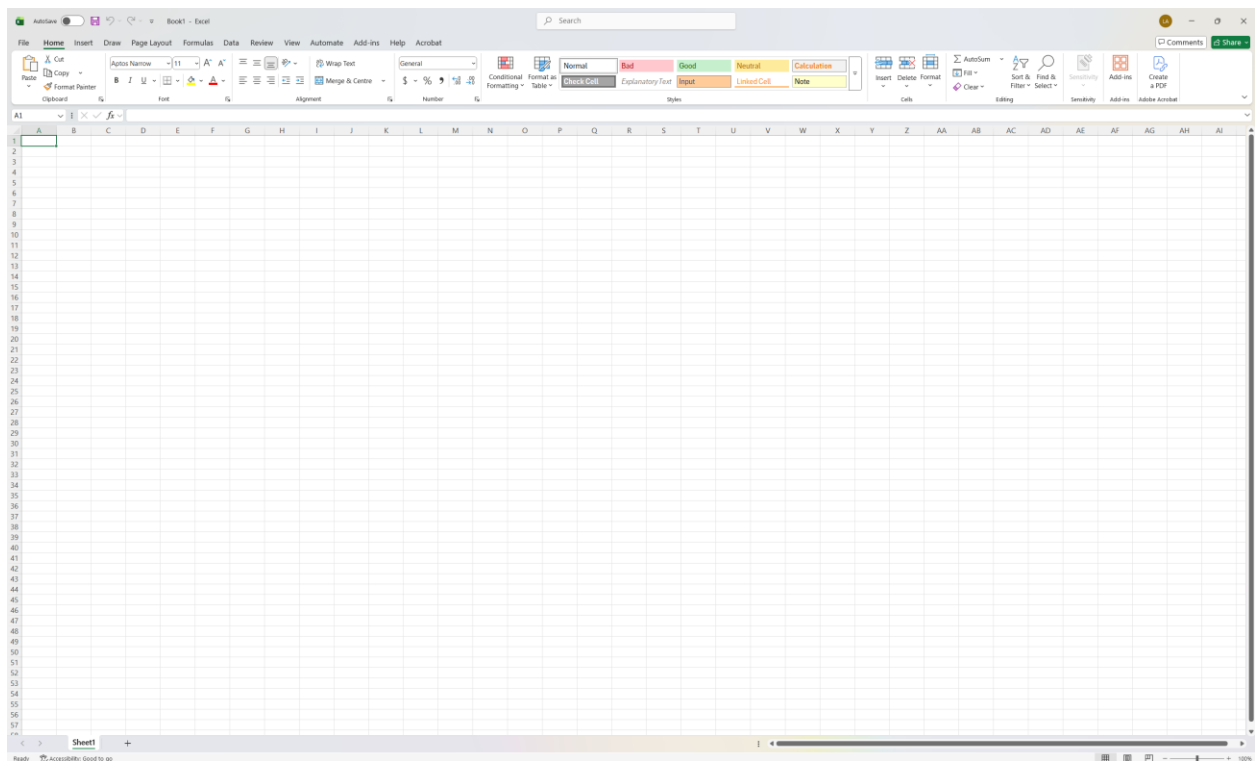
Day of year: Julian day of recording. In the case of shotpoints, the value should be the day of recording the shot. In the case of receivers, the value should be the day of recording the first shot into the receiver.

Creating Card Data Using Excel

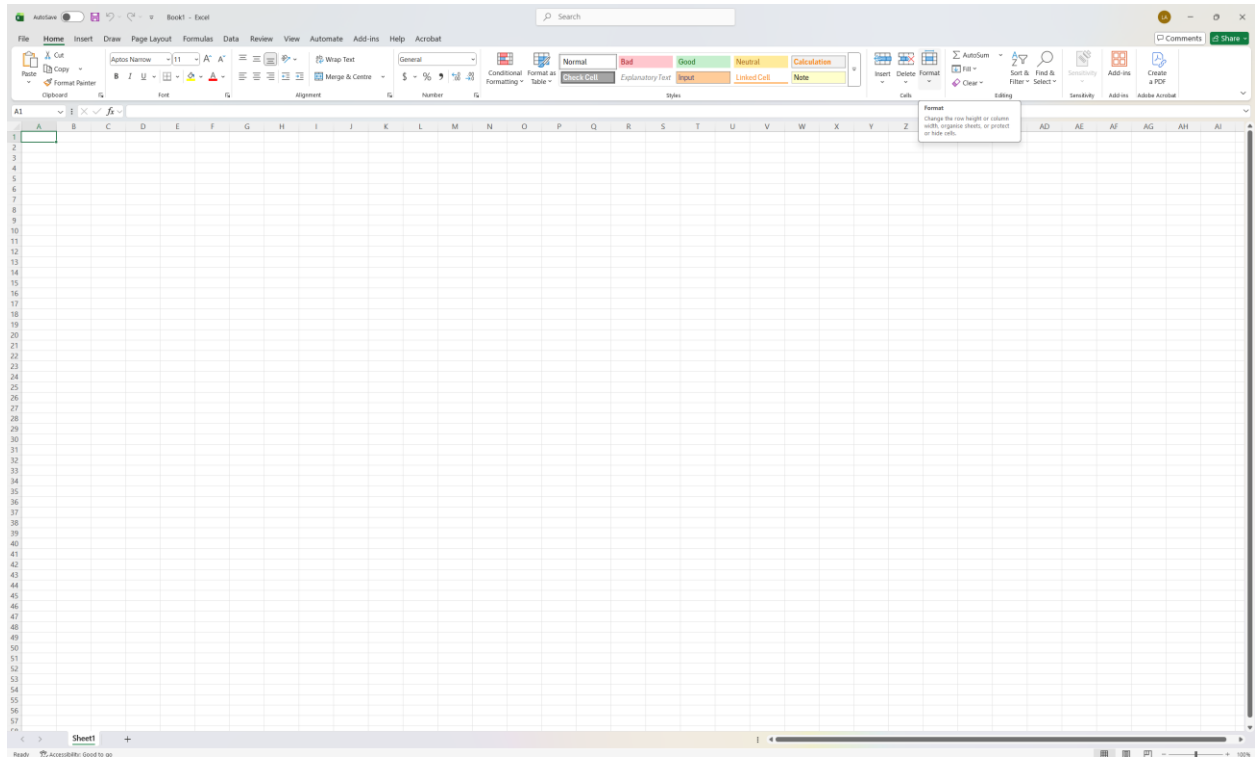
In addition to calling existing files into or creating new data files within SPW, you may create data in a Microsoft Excel spreadsheet and transfer these data into any auxiliary card data record spreadsheet. To transfer a few data values, simply copy and paste from the Excel spreadsheet to the SPW card data file spreadsheet. However, the array of data you cut from Excel must match in size the area you select in the SPW spreadsheet prior to pasting.

To transfer an entire file, you will need to reformat the Excel file as an SPW card data file. The following example will demonstrate how to create a SPS Receiver Point Record in Excel and format the file for use in the SPW Flowchart.

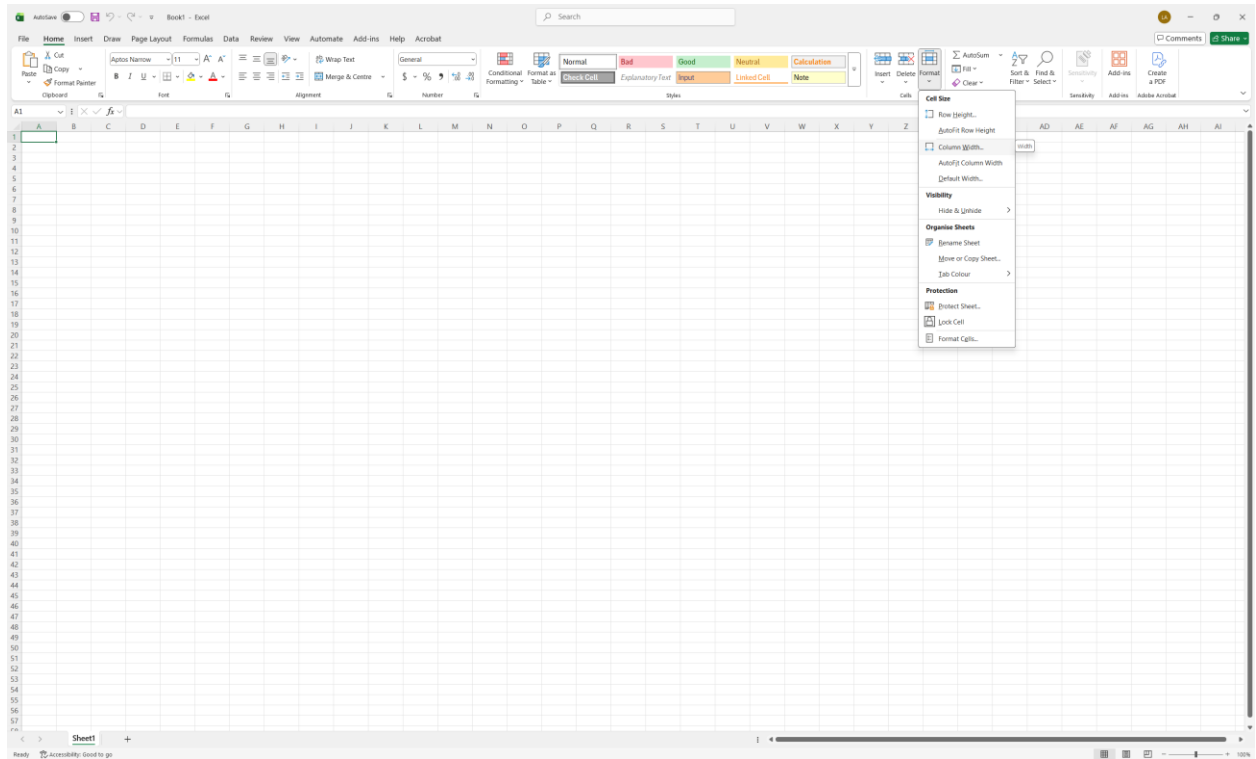
Step 1: Open the Excel application.



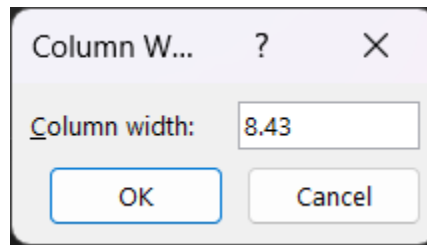
Step 2: Determine or set the width of the required amount of columns. Locate the format drop-down list on the right side of the tool bar above the spreadsheet.



Step 3: The column width is set by clicking on the Format menu and selecting Column Width.

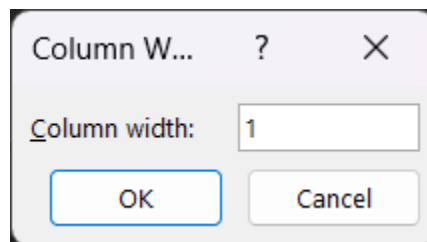


The default width of an Excel spreadsheet column is 8.43, which means you will get 8 spaces if you save the file as a space delimited text file.



Step 4: You can format each column from the Point Record Specification list (see above). Since the first column is defined for identifying the field record for either source or receiver card data (“R” or “S”) and uses only 1 column, set the column width to 1 and click OK.

Field definition	Columns	Format	Minimum & Maximum
Record ID	1-1	ASCII	“R” or “S”



Step 5: Click on the Format dropdown menu and select Format Cells and set the format to Text (i.e. ASCII) on the Number tab. Set all text as ‘Left-to-Right’ justified.

Format Cells



Number

Alignment

Font

Border

Fill

Protection

Category:

General
Number
Currency
Accounting
Date
Time
Percentage
Fraction
Scientific
Text
Special
Custom

Sample

Text format cells are treated as text even when a number is in the cell.
The cell is displayed exactly as entered.

OK

Cancel

Format Cells
?
X

Number
Alignment
Font
Border
Fill
Protection

Text alignment

Horizontal:

General

Vertical:

Bottom

☐ Justify distributed

Text control

☐ Wrap text

☐ Shrink to fit

☐ Merge cells

Right to left

Text direction:

Left-to-Right

Orientation

Text

0
Degrees

OK
Cancel

Field definition	Columns	Format	Minimum & Maximum
Record ID	1-1	ASCII	"R" or "S"
Line name	2-17	ASCII	Free form
Point number	18-25	ASCII	Free form
Point index	26-26	Integer	1-9

Point code	27-28	ASCII	
Static correction	29-32	Integer	-999 to +999
Point depth	33-36	Floating point	0 to 99.9
Seismic datum	37-40	Integer	-999 to + 9999
Uphole time	41-42	Integer	0 to 99
Water depth	43-46	Floating point	0 to 99.9 or 0 to 999
Easting	47-55	Floating point	None
Northing	56-65	Floating point	None
Elevation	66-71	Floating point	-999.9 to + 9999.9
Day of year	72-74	Integer	1 to 999
Time of day	75-80	Integer	0 to 235959

Step 6: Enter data values. In the case of a receiver SPS file there are five columns, which from column 1 to column 5 are labeled as Receiver Line, Receiver Location, Receiver Easting, Receiver Northing, and Receiver Elevation.

Step 7: Save the file as a space delimited text file. To save a space delimited text file go to the File menu and select Save As. Open the Save as type drop down menu in the Save As dialog and select Formatted Text (Space delimited). The default extension for Formatted Text files is *.prn.

Step 8: In Flowchart, select the appropriate auxiliary data item (in this case SPS Receiver Locations) from the Auxiliary Data R-Z category in the Processing Categories list and place the item on the SPW FlowChart.

Step 9: Locate the Formatted Text file created in Excel. To locate the file, double click on the card data icon in Flowchart and a Format File dialog will appear. Click on the Browse button and a Select File dialog will appear that allows you to maneuver through your directory structure and locate the file.

Step 10: Customize the file format so that SPW can properly read your text file. To customize the file, click on the Customize button in the Format File dialog, and a Customize Format dialog will appear. In the case of the receiver SPS file created in Excel, we will load five columns (Line, Location, Easting, Northing, and Elevation), each of which is 8 characters wide. The starting column for Line number is 1 and the length of the Line field is 8. The starting column for the Location number is 9 and the length of the Location field is 8..... The starting column for the Elevation field is 33 and the length of the Elevation field is 8. When the appropriate parameters have been entered, select OK.

Step 11: View the card data spreadsheet to verify the data values.

Auxiliary Data A-P

This section documents the auxiliary card data between A and P:

Auxiliary Data A-P

 Processing Categories
CMP Flex Locations
CMP Statics
Early Mutes
Exclusion Zones
FK Mutes
Field File Statics
First Break Times
Gain Curves
Horizon File
Line Definition File
Offset Gain Corrections
PP NHMO Eta Function
PS NHMO Gamma Function
Polygon Definition

CMP Flex Locations

Usage: The CMP Flex Location card data item is used to store the location of flex binned location as computed by CMP Binning processing step.

Step Parameter Dialog:

CMP Flex Locations

File Browse ☐ Verbose message output

☒ Append to existing dataset

☒ Save a labelled copy on exit

Current Records

Field File ID range: to

Channel numbers range: to

Trace ID range: to

Offsets range: to

CMP Line numbers range: to

CMP Location numbers range: to

Flex binning specification

Inline % bin flex Crossline % bin flex

Fold file output

☒ Include flex traces

☐ Specify lines range

☐ Specify locations range

Parameter descriptions:

File Browse — Browse for file to store CMP flex locations

Verbose message output — If checked, outputs a report log into the command window.

Append to existing dataset — If checked, new flex locations will be added to existing file.

Scan file — Select to scan existing file where data will be appended.

Save a labelled copy on exit — If checked, a labelled copy of the existing file will be save.

The **Current Records** specify parameters related to existing file in terms of Field File ID range, Trace ID range, Offset range, CMP Line numbers and CMP Location numbers.

Field File ID range — Enter the minimum and maximum values for Field File ID.

Channel numbers range — Enter the minimum and maximum values for channels.

Trace ID Range — Enter the minimum and maximum values for Trace ID.

Offsets range — Enter the minimum and maximum values for offset ID.

CMP Line numbers range — Enter the minimum and maximum values for CMP Line.

CMP Locations numbers range — Enter the minimum and maximum values for CMP Locations.

The **Flex binning specification** specifies the flex binning parameters related to existing file in terms of Inline % bin flex, Inline % offset flex, Crossline % bin flex and Crossline % offset flex.

Inlines % bin flex — Enter the percentage of bin flex in the inline direction.

Crossline % bin flex — Enter the percentage of bin flex in the crossline direction.

The **Fold file output** specifies parameters related to fold file output.

Include flex traces — If checked, include flex traces in output file.

Specify lines range — If checked, specify lines range in output file.

CMP Lines — Enter the CMP line range to be considered for the flex binning.

Specify locations range — If checked, specify locations range in output file.

CMP Locations — Enter the CMP location range to be considered for the flex binning.

Fold file browse — Select file to store fold information.

Make fold file — Not yet implemented.

CMP Statics

Usage: The CMP Statics card data item is used to store CMP based static shift values in milliseconds.

Step Parameter Dialog: CMP Statics card data file may be sorted in CMP Line, Source Line, Receiver Line or Offset.

The image shows two overlapping software dialog boxes. The background window is titled "Auxiliary Dialog" and contains a "CMP static file" section with a text field for "CMP static file name" containing the path "DATA/2D-Land-example-1/Auxiliary/CMP Statics" and a "File Browse..." button. To the right is a "Format" section with a "Format type" dropdown menu set to "SPW". The foreground window is titled "Spreadsheet Information" and features a table with two columns: "Trace header" and "Value". The first row has "Primary sort order" in the header column and a dropdown menu set to "CMP line" in the value column. Below the table is a text field labeled "Number of rows to add to spreadsheet". At the bottom of this window are "OK", "Help", and "Cancel" buttons. The "Auxiliary Dialog" window also has "OK", "Save", "Help", and "Cancel" buttons at its bottom. A toolbar with various icons is located at the bottom left of the "Auxiliary Dialog" window.

Trace header	Value
Primary sort order	CMP line

Number of rows to add to spreadsheet

Example Card Data:

Auxiliary Dialog

CMP static file

CMP static file name C:/DATA/Documentation/Auxiliary/cmpstatistics File Browse...

Format

Format type SPW

Line-1

	Bin location	ExtraOne
1	0	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing **CMP Statics** file or to define the name of a new file to be saved.

Format Type — Select format type.

Line-0 — Navigate through record.

Bin location — Enter the location of the bin.

ExtraOne — Enter the value of the statics for the corresponding **Bin Location** at the current record as defined in **Line-0**.

Early Mutes

Usage: The Early Mutes card data item is used to store the mute definition for early (top) mutes. Mute times are in units of seconds. Early mutes may be interactively built in a seismic display using the Seismic Picker tool located in the seismic view at the lower right corner. Picks may be manually adjusted using the Early Mutes card data.

Step Parameter Dialog: Early Mutes need two sort keys. Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.

The image shows two overlapping dialog boxes from a software application. The background window is titled "Auxiliary Dialog" and contains fields for "Early mute file" (with a text input showing "DATA/2D-Land-example-1/Auxiliary/Early Mutes" and a "File Browse..." button) and a "Format" section with a "Format type" dropdown set to "SPW". The foreground window is titled "Spreadsheet Information" and contains a table for defining sort keys. The table has two columns: "Trace header" and "Value". It has two rows: "Primary sort order" with "Source line" in the header and an empty value box, and "Secondary sort order" with "Source location" in the header and an empty value box. Below the table is a field for "Number of rows to add to spreadsheet" with an empty input box. At the bottom of the "Spreadsheet Information" window are "OK", "Help", and "Cancel" buttons. The "Auxiliary Dialog" window also has "OK", "Save", "Help", and "Cancel" buttons at the bottom. A toolbar with various icons is visible at the bottom left of the "Auxiliary Dialog" window.

	Trace header	Value
Primary sort order	Source line	
Secondary sort order	Source location	

Number of rows to add to spreadsheet:

Example Card Data:

Auxiliary Dialog

Early mute file

Early mute file name C:/DATA/Documentation/Auxiliary/early mute File Browse...

Format

Format type SPW

Line-1 Location-1

	Time (ms)	Offset
1	0.00	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing Early Mute file or to define the name of a new file to be saved.

Format Type — Select format type.

— Navigate through record.

Time (ms) — Enter the two-way-traveltime for the pick at the current record for a given Offset.

Offset — Enter the value of the offset of the pick.

Exclusion Zones

Usage: The Exclusion Zones card data item is used to define exclusion zones (i.e., exclusion polygons) to be used for example in map displays. Accepted formats are MESA, SPW and PIKESA.

Example Card Data:

The screenshot shows the 'Auxiliary Dialog' window. It has a title bar with a question mark and a close button. The main area is divided into several sections:

- Exclusion zone file:** Contains a text field for 'Exclusion zone file name' with the value 'TA/Training_1/Auxiliary/River Excl_Mesa.xcl' and a 'File Browse...' button.
- Format:** A dropdown menu labeled 'Format type' with 'MESA' selected.
- Zone-1:** A dropdown menu with 'Zone-1' selected, flanked by left and right arrow buttons.
- Data Table:** A table with 3 columns: 'Source', 'Easting', and 'Northing'. It contains 9 rows of data points forming a polygon.
- Map:** A graph showing the polygon defined by the data points. The x-axis is labeled 'Easting' and the y-axis is labeled 'Northing'. The axes have numerical scales.
- Buttons:** At the bottom are 'OK', 'Save', 'Help', and 'Cancel' buttons.
- Icons:** A row of small icons is located below the data table.

	Source	Easting	Northing
1		31794.94	48528.31
2		33258.31	47847.31
3		35134.63	47405.44
4		36438.56	46738.94
5		36648.69	46963.50
6		37409.31	48137.13
7		35822.81	49528.00
8		33098.94	49817.81
9		31794.94	48528.31

Parameter descriptions:

File Browse — Select to browse for existing Exclusion Zones file or to define the name of a new file to be saved.

Format Type — Select format type. Available formats are MESA, SPW and PIKESA.

— Navigate through record.

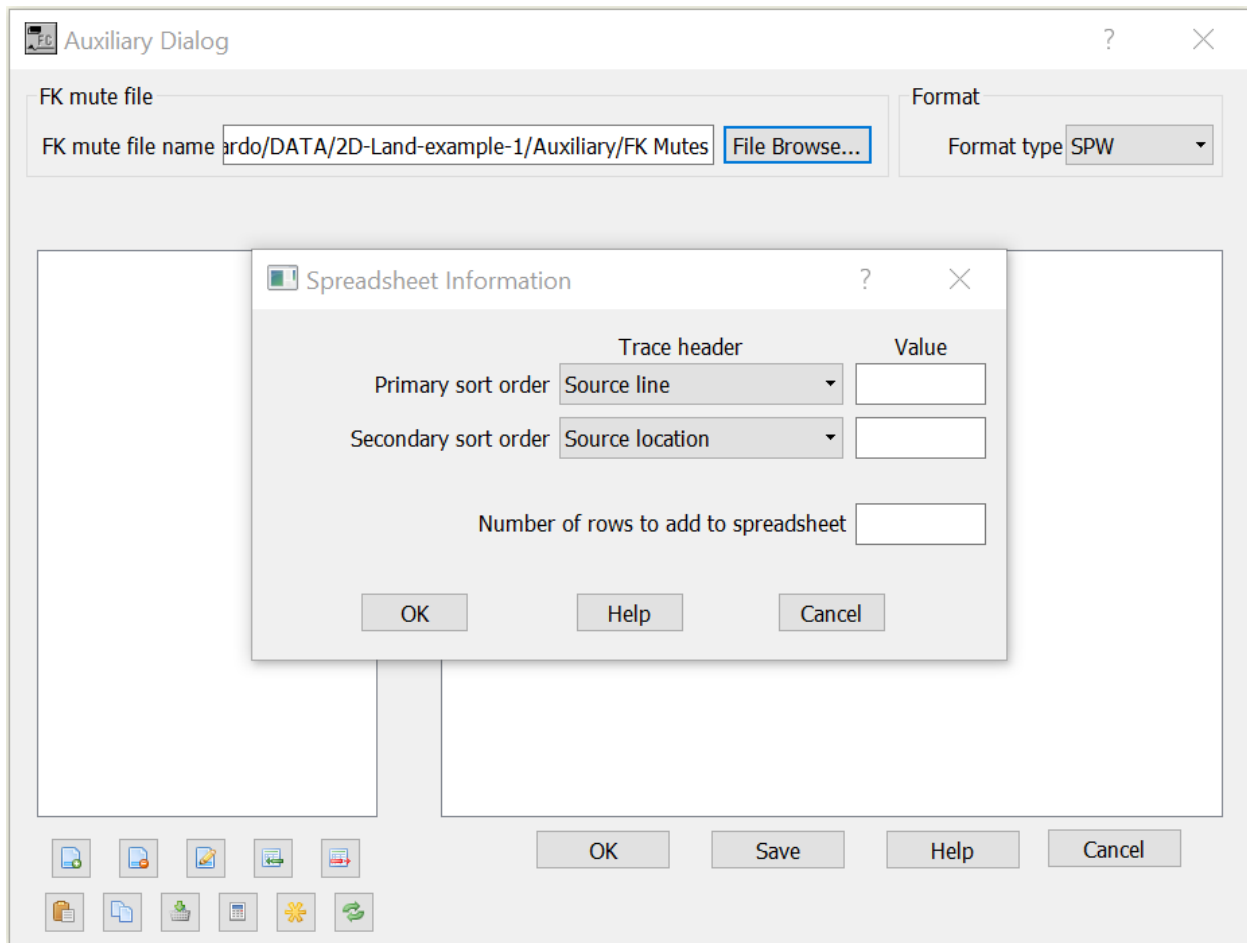
Source Easting — Enter the Easting coordinates of each point of the exclusion polygon.

Source Northing — Enter the Northing coordinates of each point of the exclusion polygon.

FK Mutes

Usage: The FK Mutes card data item is used to store the mute definition for mutes in the FK domain. Mute are defined in wavenumber (k) and velocity. FK mutes may be interactively built in a FK spectrum display using the Seismic Picker tool located in the seismic view at the lower right corner. Picks may be manually adjusted using the FK Mutes card data.

Step Parameter Dialog: FK Mutes need two sort keys. Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.



Example Card Data:

Auxiliary Dialog

FK mute file

FK mute file name ardo/DATA/2D-Land-example-1/Auxiliary/FK Mutes [File Browse...](#)

Format

Format type SPW

Line-0 Location-0

	Wavenumber(km)	Velocity
1	0.00	0.00
2	0.00	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing FK Mutes file or to define the name of a new file to be saved.

Format Type — Select format type.

Line-0 — Navigate through record.

Wavenumber (k) — Enter the value for the wavenumber of the pick.

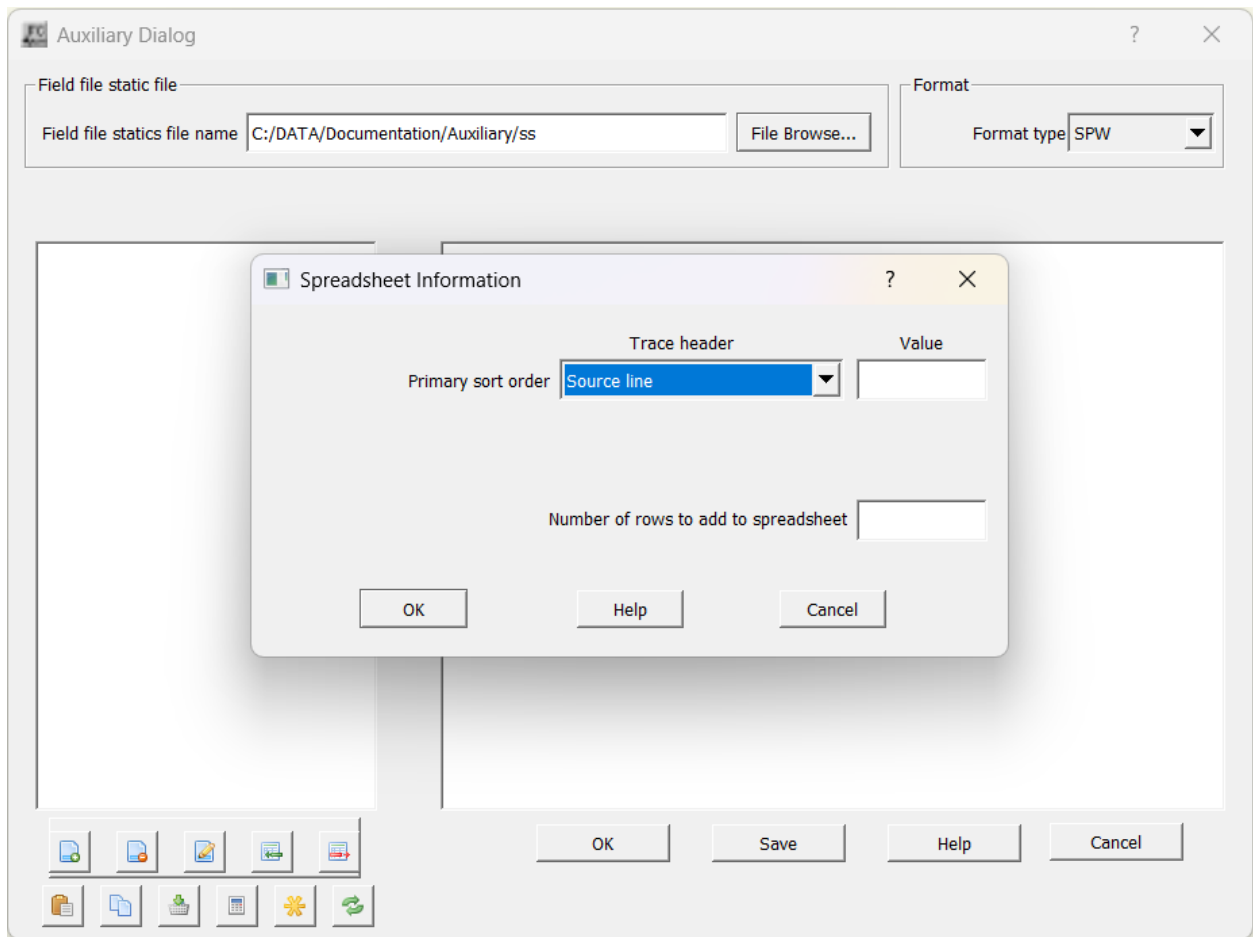
Velocity — Enter the value of the velocity of the pick.

Field File Statics

Usage: The Field File Statics card data item is used to store static shifts for records corresponding to Field Files.

Step Parameter Dialog: Field File Statics card data file may be sorted in CMP Line, Source Line, Receiver Line or Offset.

Example Card Data:



Parameter descriptions:

Auxiliary Dialog

Field file static file

Field file statics file name D-Land-example-1/Auxiliary/Field File Statics [File Browse...](#)

Format

Format type SPW

Line-0

	Field file	ExtraOne
1	0	0.00
2	0	0.00

OK Save Help Cancel

File Browse — Select to browse for existing Field File Statics file or to define the name of a new file to be saved.

Format Type — Select format type.

Line-0 — Navigate through record.

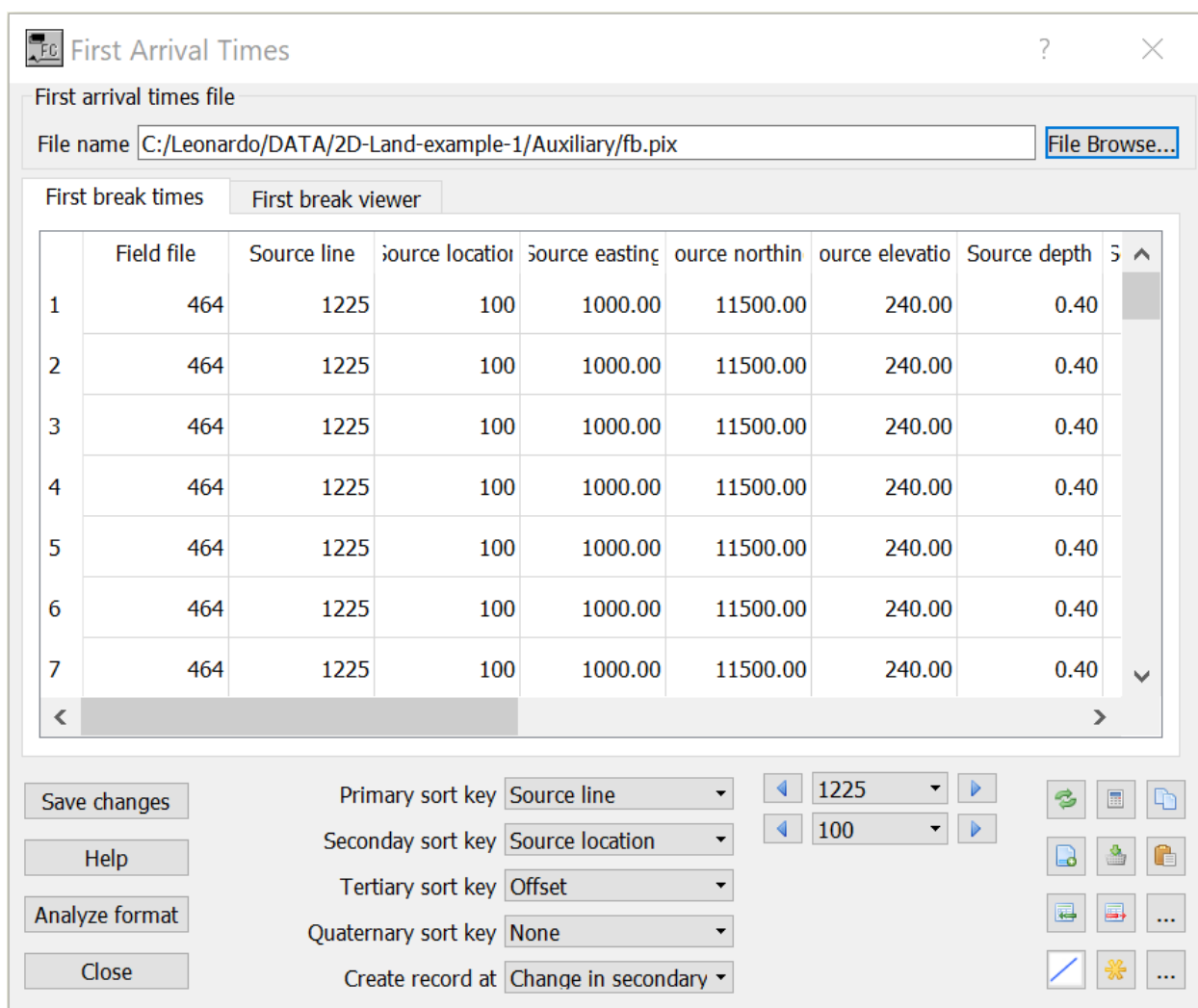
Field file — Enter the number of the Field file.

ExtraOne — Enter the value of the statics for the corresponding Field file at the current record as defined in Line-0.

First Break Times

Usage: The First Break Time Picks card data item is used to store the first break time picks (in milliseconds). First break may be picked interactively in a seismic display using the Seismic Picker tool located in the lower left corner of the seismic display.

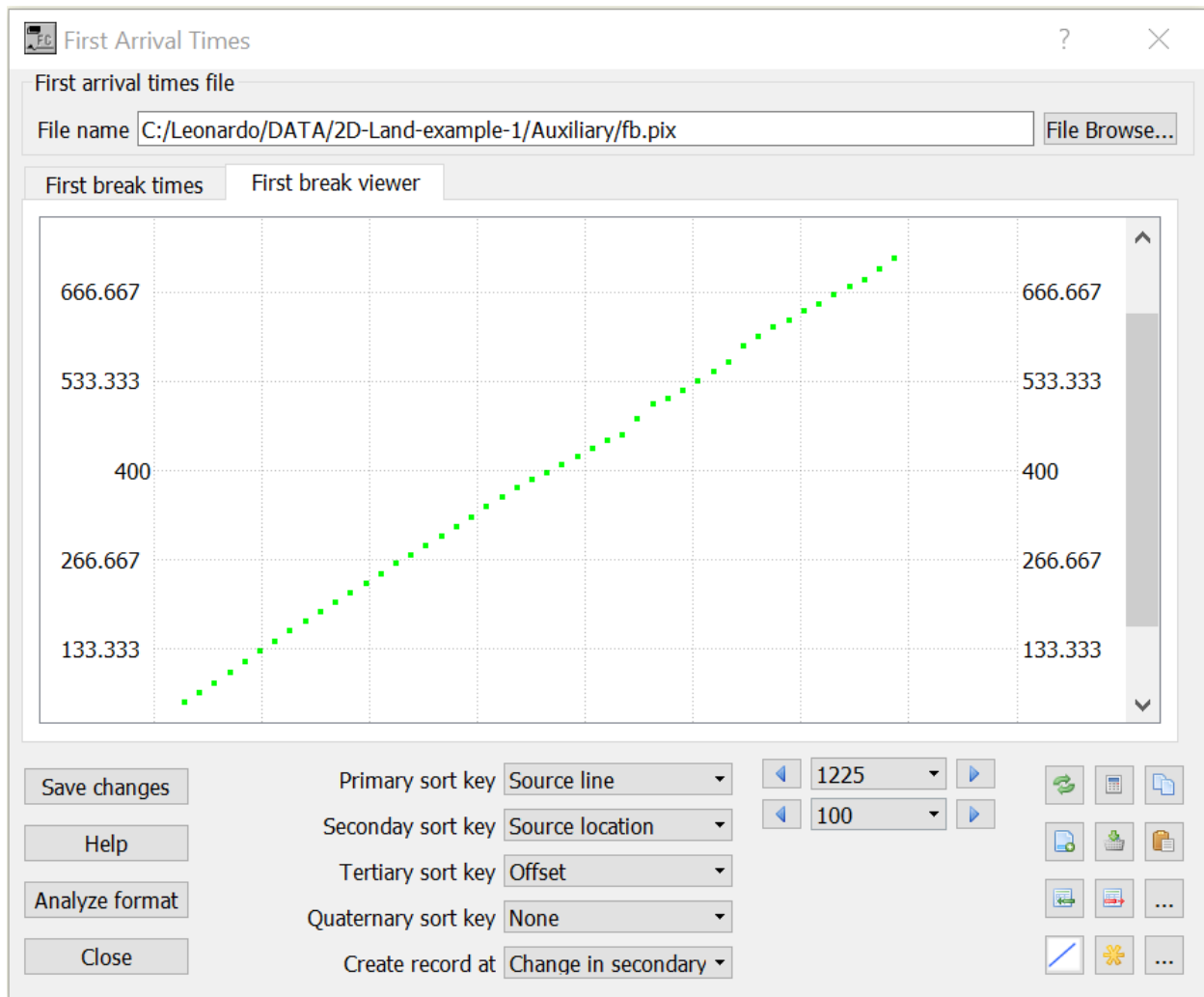
Step Parameter Dialog:



The dialog box is titled "First Arrival Times" and contains a "First arrival times file" section with a text field showing the file path "C:/Leonardo/DATA/2D-Land-example-1/Auxiliary/fb.pix" and a "File Browse..." button. Below this are two tabs: "First break times" (selected) and "First break viewer". The "First break times" tab displays a table with 8 columns: "Field file", "Source line", "Source location", "Source easting", "Source northin", "Source elevatio", "Source depth", and a scroll bar. The table contains 7 rows of data, all with identical values. Below the table are buttons for "Save changes", "Help", "Analyze format", and "Close". To the right of these buttons are four sort key dropdowns: "Primary sort key" (Source line), "Seconday sort key" (Source location), "Tertiary sort key" (Offset), and "Quaternary sort key" (None). Next to these are two numeric input fields with arrows, showing "1225" and "100". At the bottom right is a "Create record at" dropdown set to "Change in secondary". A vertical toolbar on the far right contains icons for file operations and data manipulation.

	Field file	Source line	Source location	Source easting	Source northin	Source elevatio	Source depth
1	464	1225	100	1000.00	11500.00	240.00	0.40
2	464	1225	100	1000.00	11500.00	240.00	0.40
3	464	1225	100	1000.00	11500.00	240.00	0.40
4	464	1225	100	1000.00	11500.00	240.00	0.40
5	464	1225	100	1000.00	11500.00	240.00	0.40
6	464	1225	100	1000.00	11500.00	240.00	0.40
7	464	1225	100	1000.00	11500.00	240.00	0.40

First break picks might be viewed in a table and edited manually: First break picks can be plotted in offset versus TWT. This allows the screening of possible picking errors.



Parameter descriptions:

File Browse — Select to browse for existing First Break Times file or to define the name of a new file to be saved.

Primary sort key — Select the primary sort key to be used in the navigation from record to record.

Secondary sort key — Select the secondary sort key to be used in the navigation from record to record.

Tertiary sort key — Select the tertiary sort key to be used in the navigation from record to record.

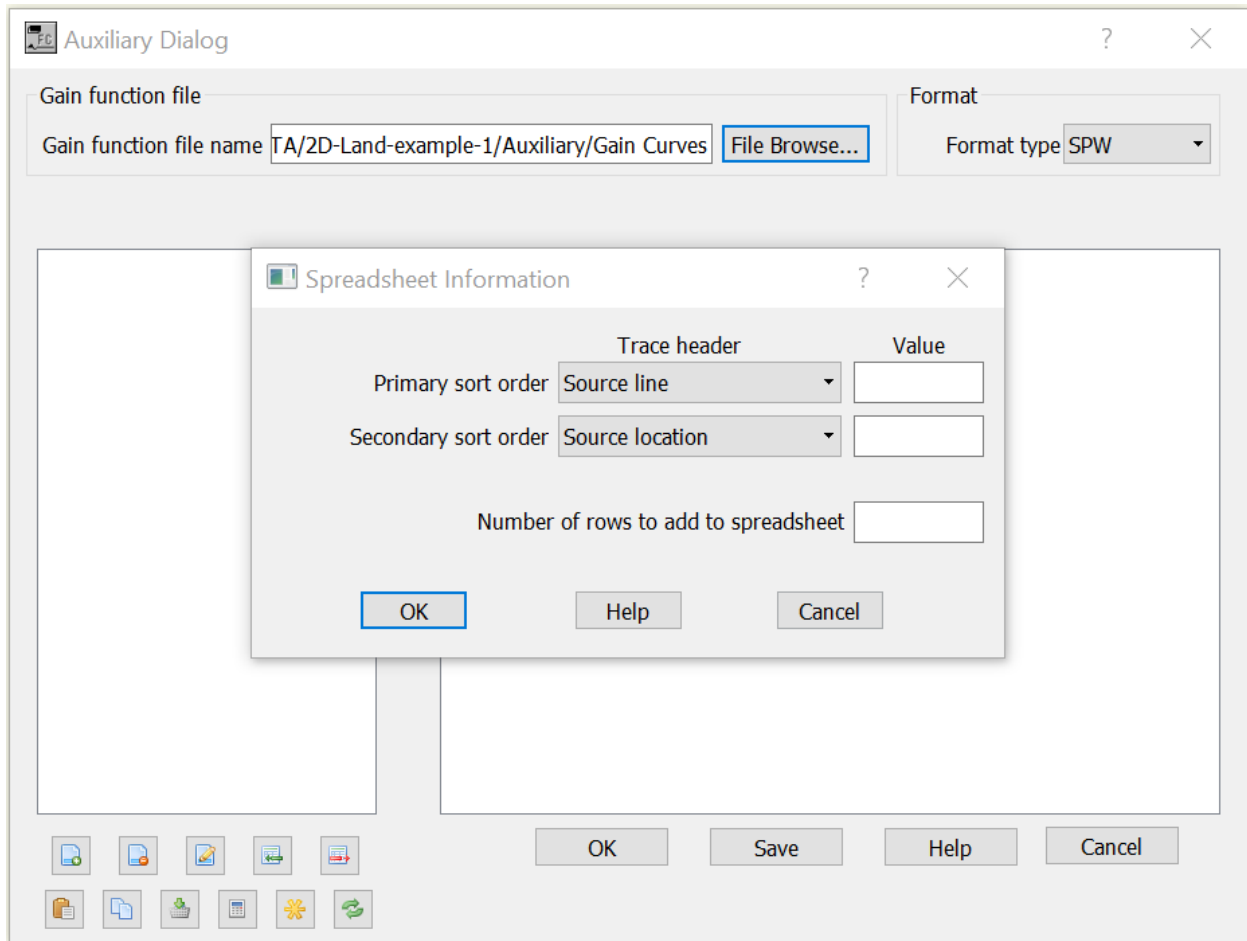
Quaternary sort key — Select the quaternary sort key to be used in the navigation from record to record.

Create record at — Select the sort key used to create records.

Gain Curves

Usage: The Gain Curves card data item is used to store time-decibel gain pairs. A gain of 0 dB is equivalent to scalar multiplication by a factor of 1, a gain of 6 dB by a factor of 2, a gain of 12 dB by a factor of 4, a gain of 18 dB by a factor of 8, and so on. Time is in milliseconds.

Step Parameter Dialog: Gain functions card data file may be sorted in CMP Line, Source Line, Receiver Line or Offset.



Example Card Data:

Auxiliary Dialog

Gain function file

Gain function file name TA/2D-Land-example-1/Auxiliary/Gain Curves File Browse...

Format

Format type SPW

Line-0 Location-0

	Time (ms)	ExtraOne
1	0.00	10.00

Gain (dB)

OK Save Help Cancel

Parameter descriptions:

Format Type — Select format type.

Line-0 — Navigate through record.

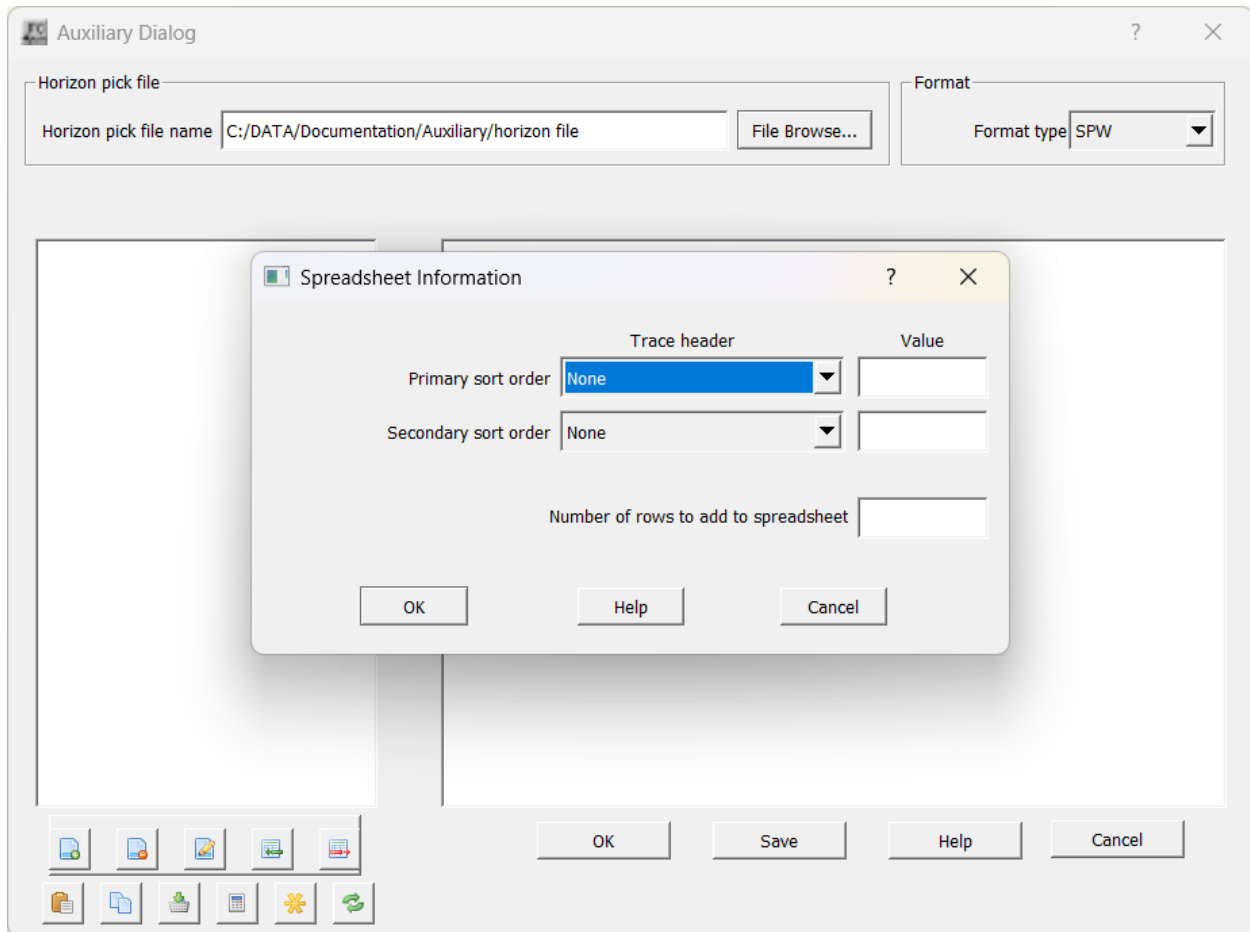
Time (ms) — Enter the start column and the number of columns allocated to write the two-way time (in milliseconds) associated with a given gain value in the output gain file.

ExtraOne — Enter the start column and the number of columns allocated to write the gain in dB associated with a given two-way travel time in the output gain file.

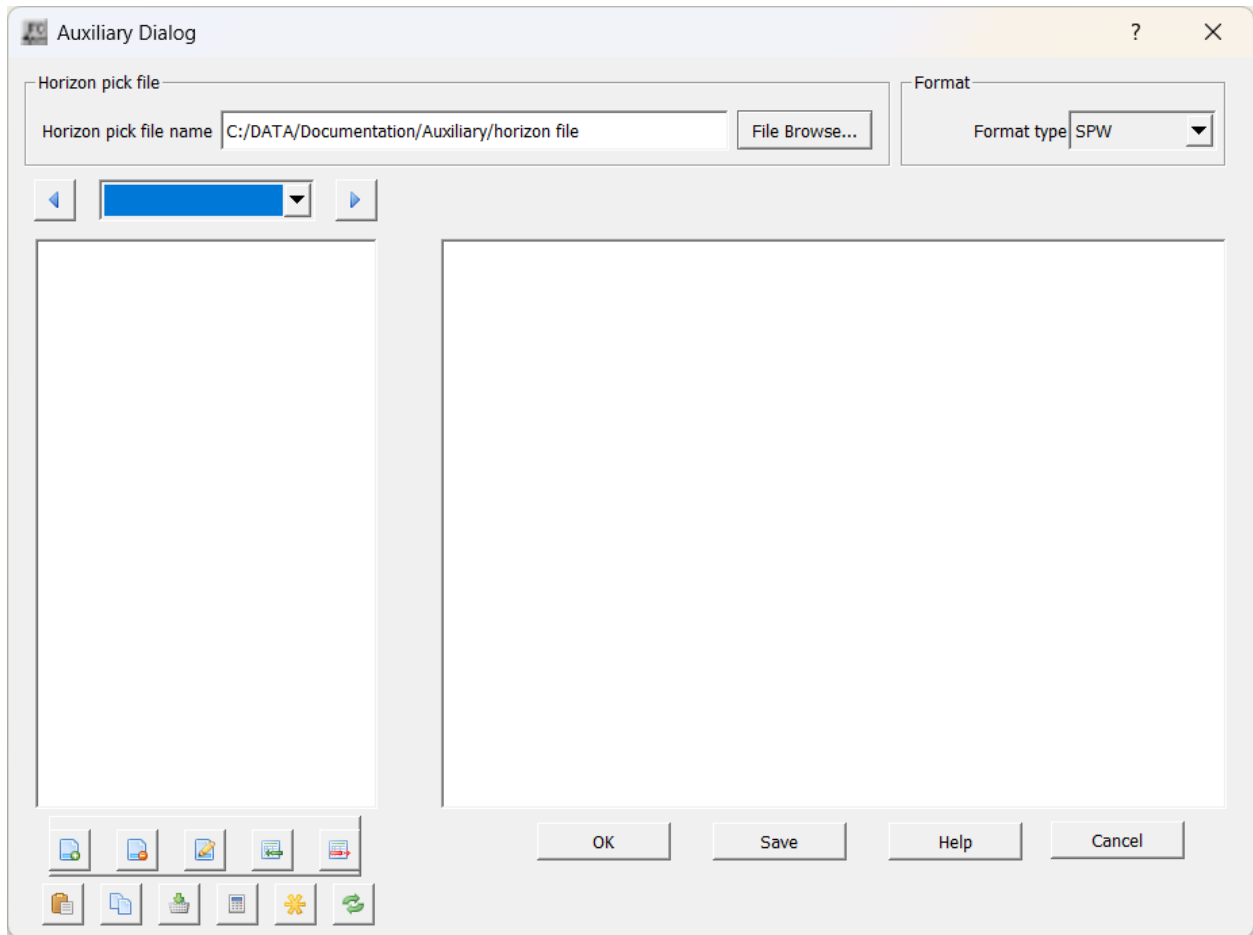
Horizon File

Usage: The Horizon File card data item is used to store horizon time picks. Horizon event picking may be performed interactively in a seismic display using the Seismic Picker tool located in the Picking menu.

Step Parameter Dialog: Horizon File card data file may be sorted in CMP Line, Source Line, Receiver Line or Offset.



Example Card Data:



Parameter descriptions:

Format Type — Select format type.


 — Navigate through record.

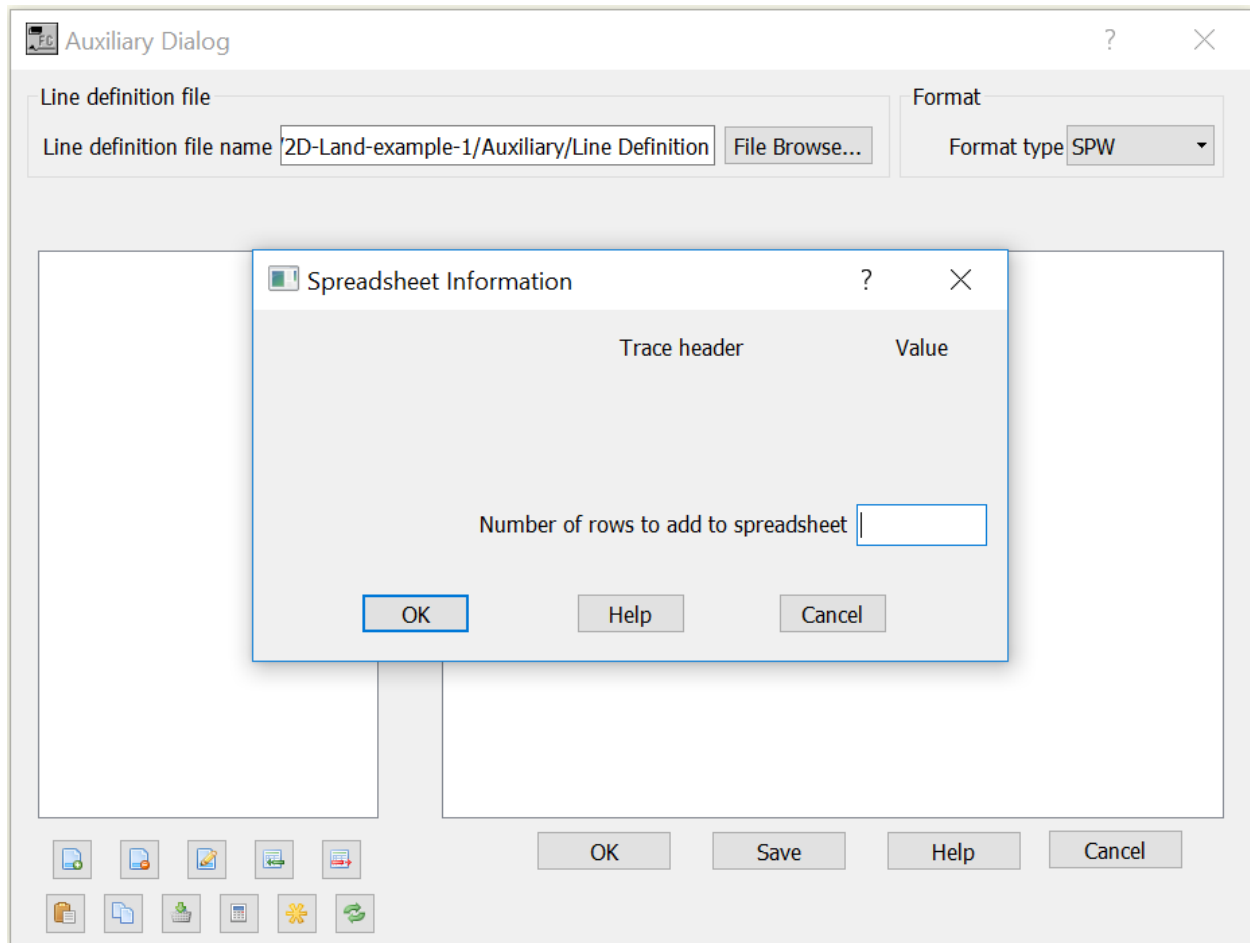
Time (ms) — Enter the start column and the number of columns allocated to write the two-way time (in milliseconds) associated with a given gain value in the output gain file.

ExtraOne — Enter the start column and the number of columns allocated to write the gain in dB associated with a given two-way travel time in the output gain file.

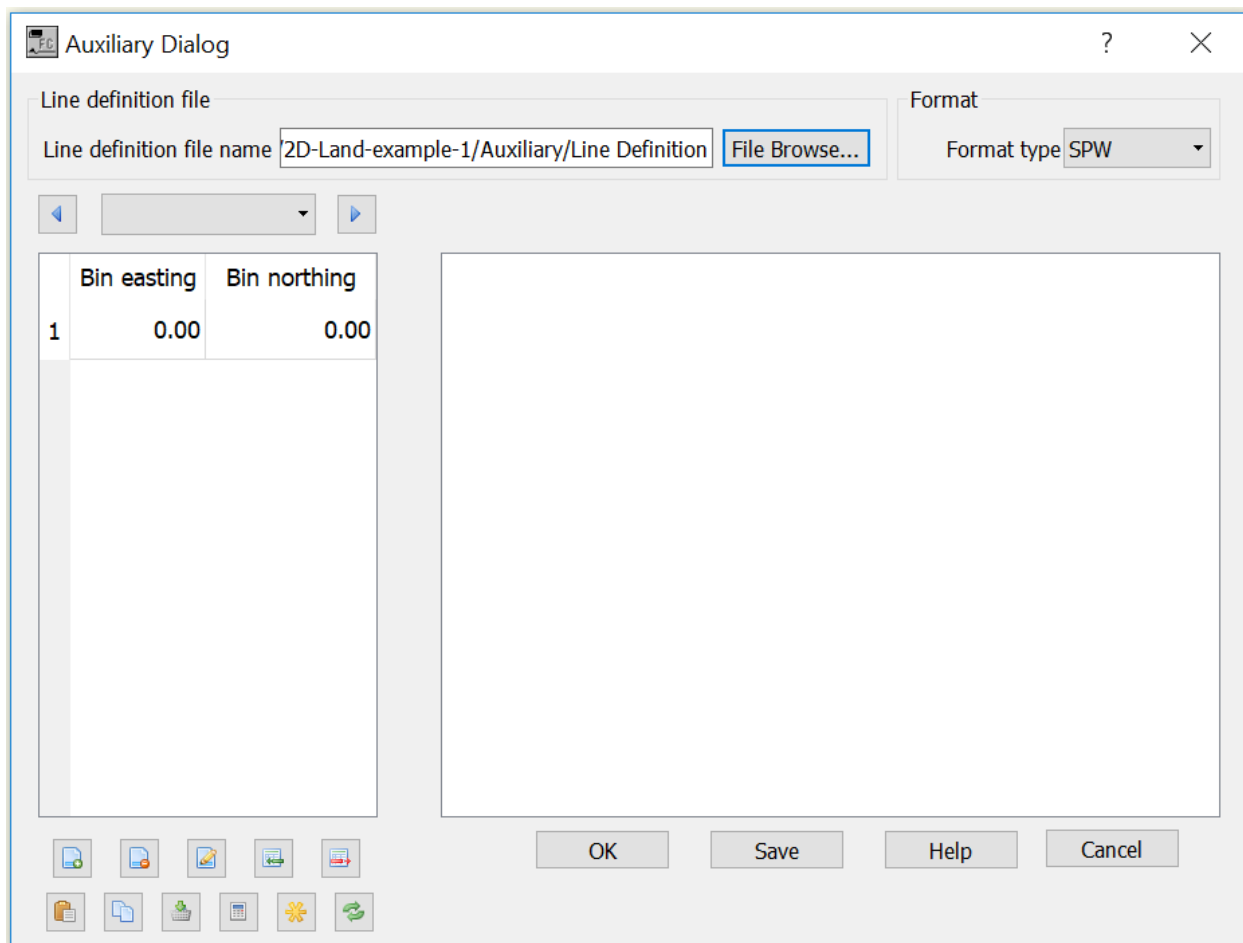
Line Definition File

Usage: The Line Definition File card data is used to (1) store the best fit line to the scatter of CMP resulting from a crooked line seismic survey, and (2) to specify, and ultimately extract a random 2-D line from a 3-D data volume

Step Parameter Dialog: Line Definition File does not require any type of sort order.



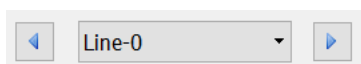
Example Card Data:



Parameter descriptions:

File Browse — Select to browse for existing Line Definition File file or to define the name of a new file to be saved.

Format Type — Select format type.



— Navigate through record.

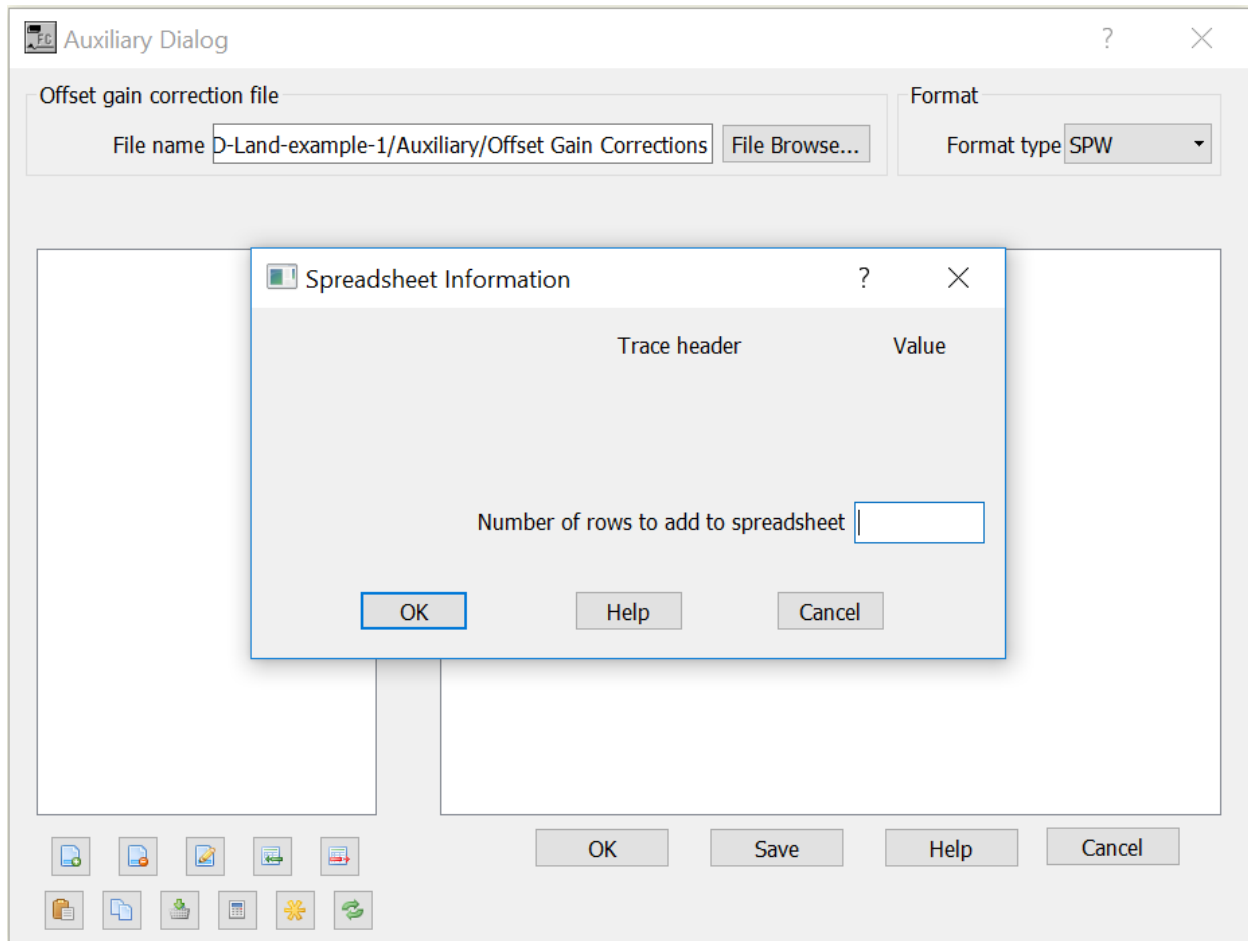
Bin Easting — Enter the start column and the number of columns allocated to write the easting associated with a given coordinate pair in the output line definition file.

Bin Northing — Enter the start column and the number of columns allocated to write the northing associated with a given coordinate pair in the output line definition file.

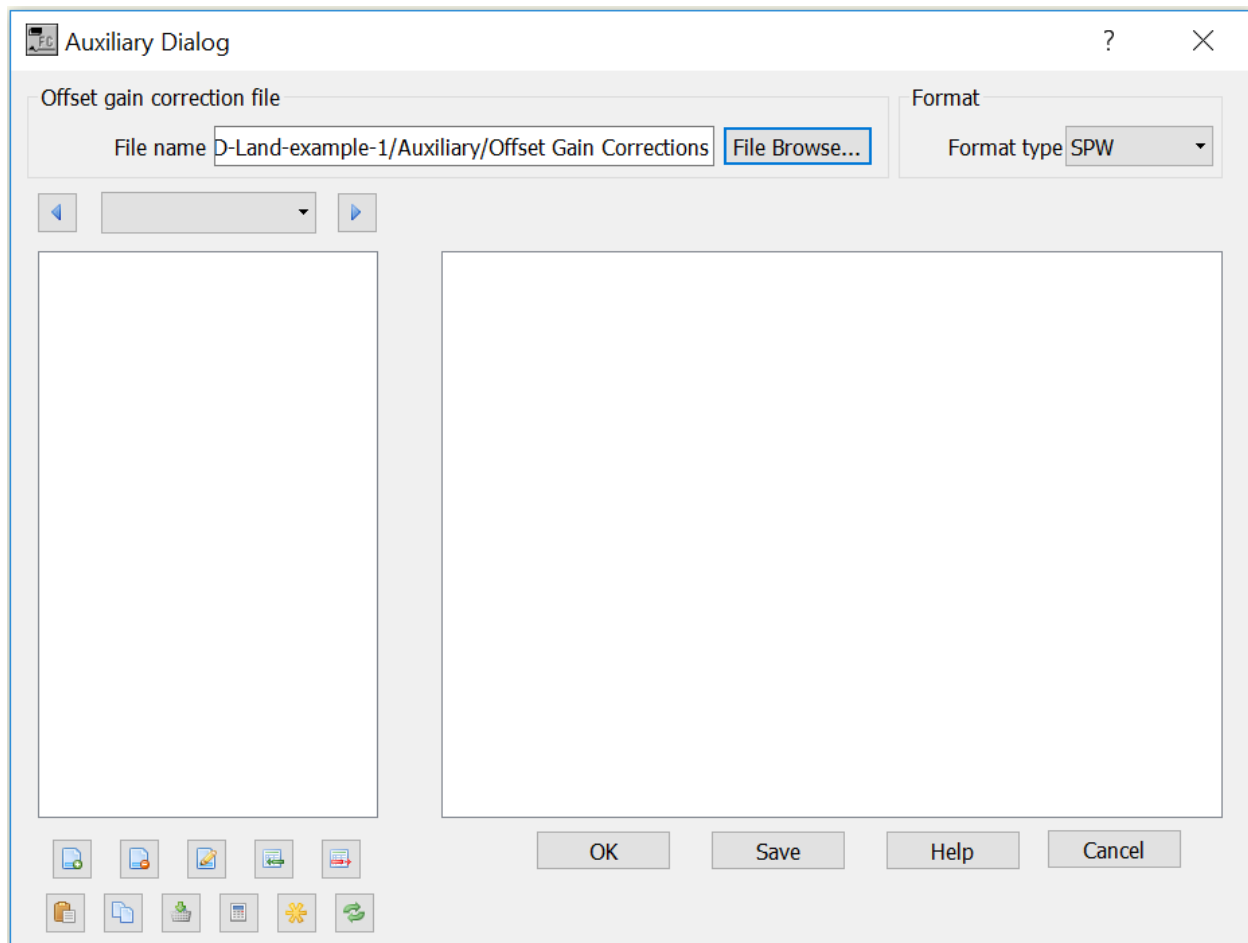
Offset Gain Corrections

Usage: The Offset Gain Corrections auxiliary card data allows defining offset varying functions for gain correction.

Step Parameter Dialog:



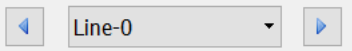
Example Card Data:



Parameter descriptions:

File Browse — Select to browse for existing Offset Gain Corrections file or to define the name of a new file to be saved.

Format Type — Select format type.


 — Navigate through record.

PP NHMO Eta Function

Usage: The PP Nhmo Eta Function card data item is used to store time-eta pairs for the case of P-wave non-hyperbolic moveout, where Eta is a parameter that characterizes the anisotropy in transversely isotropic media. Once the short-spread P-wave stacking velocity function has been picked, corresponding Eta functions may be picked interactively on Eta Semblance gathers. The PP Nhmo Eta Function card has the same structure as a Velocity Function card.

Step Parameter Dialog: Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line. Select output velocity type from RMS (Stacking) velocity, Interval velocity or Average Velocity. Velocity field may be defined in the Two-way time or Depth domain.

The screenshot shows a software interface with a main dialog box titled "RMS Velocitytwo-way-time" and a sub-dialog box titled "Spreadsheet Information".

Main Dialog Box:

- Tab: "Format"
- Field: "Eta function file name" (empty)
- Field: "Output type" (dropdown menu showing "SPW")

Spreadsheet Information Sub-dialog Box:

Trace header	Value
Primary sort order	CMP line
Secondary sort order	CMP location

Number of rows to add to spreadsheet: [empty text box]

Output velocity type:

- ☒ RMS (Stacking) velocity
- ☐ Interval velocity
- ☐ Average velocity

Output vertical domain:

- ☒ Two-way time
- ☐ Depth

Buttons: OK, Help, Cancel

Main Dialog Box Buttons: OK, Save, Help, Cancel

At the bottom of the main dialog box, there is a row of icons for file operations (new, open, save, print, etc.) and a row of icons for data operations (load, save, delete, etc.).

Example Card Data:

RMS Velocitytwo-way-time

Eta function file

Eta function file name: \\TA/2D-Land-example-1/Auxiliary/Eta Function [File Browse...](#)

Format

Format type: SPW

Line-0 Location-0

	Time (ms)	Attribute
1	0.00	1000.00
2	2.00	1500
3	0.00	0.00

Eta

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing PP NHMO Eta Function file or to define the name of a new file to be saved.

Format Type — Select format type.

Line-0 — Navigate through record.

Time (ms) — Enter the start column and the number of columns allocated to write the two-way travel time (in milliseconds) associated with a given velocity pick in the velocity file.

Attribute — Enter the start column and the number of columns allocated to write the RMS or interval velocity value associated with a given velocity pick in the velocity file.

PP NHMO Gamma Function

Usage: The PP Nhmo Gamma Function card data item is used to store time-gamma pairs for the case of PS-wave (i.e. converted wave) non-hyperbolic moveout, where Gamma is the effective V_p/V_s ratio down to the event being analyzed. Once the short-spread P-wave stacking velocity function has been picked, corresponding Gamma functions may be picked interactively on Gamma Semblance gathers. The PP Nhmo Gamma Function card has the same structure as a Velocity Function card.

Step Parameter Dialog: Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.

Spreadsheet Information

	Trace header	Value
Primary sort order	CMP line	
Secondary sort order	CMP location	

Number of rows to add to spreadsheet

Output velocity type

- ☒ RMS (Stacking) velocity
- ☐ Interval velocity
- ☐ Average velocity

Output vertical domain

- ☒ Two-way time
- ☐ Depth

OK Help Cancel

Example Card Data:

RMS Velocity two-way-time

Gamma function file

Gamma function file name: D:/UserData/SPW/velo.picks File Browse...

Format

Format type: SPW

Line-12 Location-2051

	Time (ms)	Attribute
1	2464.00	2000.00

Gamma

Two-way time (ms)

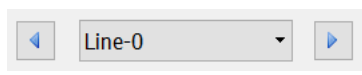
0, 1000, 2000, 3000

OK, Save, Help, Cancel

Parameter descriptions:

File Browse — Select to browse for existing *PP NHMO Gamma Function* file or to define the name of a new file to be saved.

Format Type — Select format type.


 — Navigate through record.

Time (ms) — Enter the start column and the number of columns allocated to write the two-way travel time (in milliseconds) associated with a given velocity pick in the velocity file.

Attribute — Enter the start column and the number of columns allocated to write the RMS or interval velocity value associated with a given velocity pick in the velocity file.

Polygon Definition

Usage: The Polygon Definition card data item is used to specify the coordinates of a polygon that will be used to select data from a seismic volume. The Polygon Definition File may be used to selectively input data in conjunction with the SPW Tape Utility or may be linked to the Select Traces processing step for the same purpose.

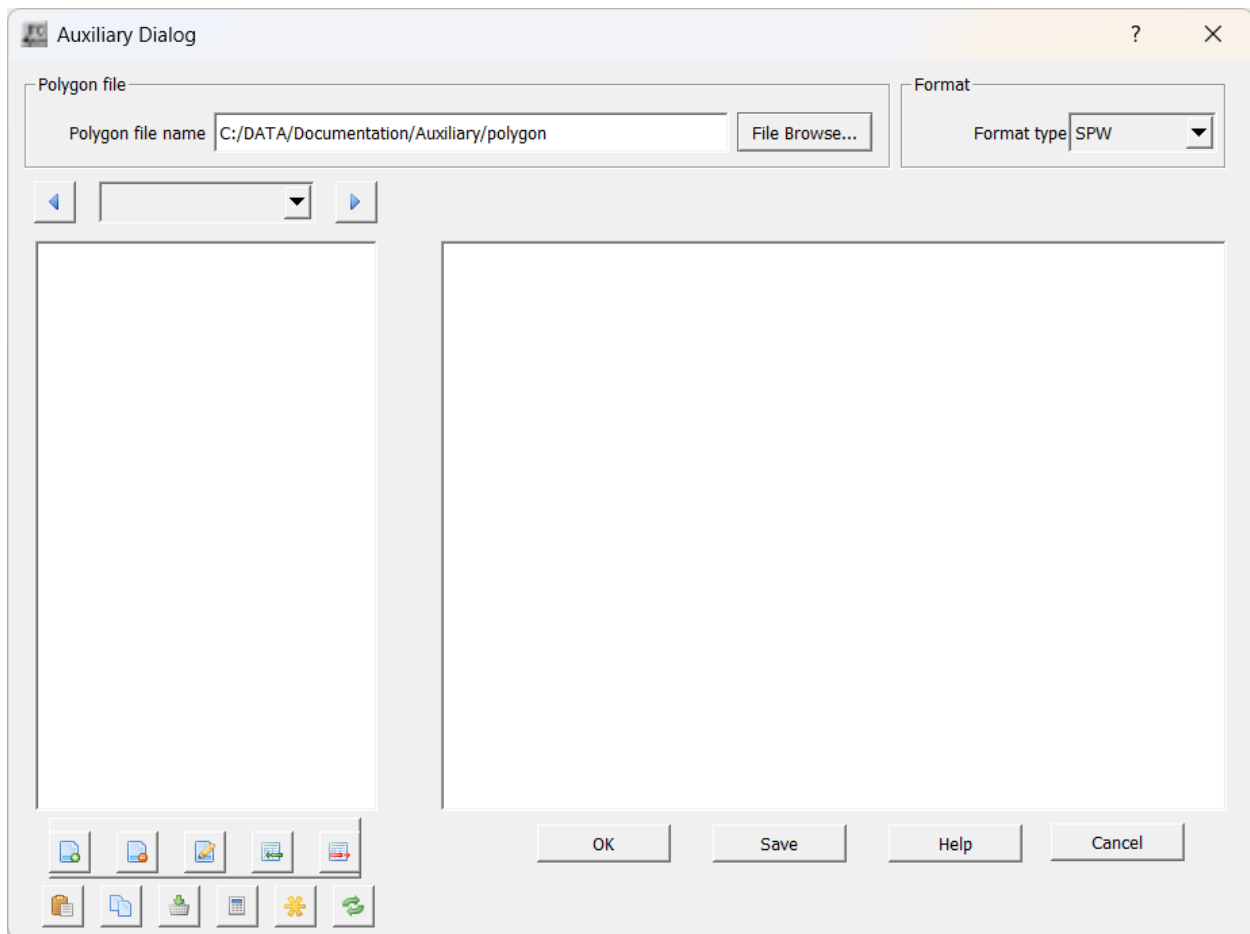
Step Parameter Dialog: Polygon Definition need two sort keys. Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.

The image shows a screenshot of a software interface. The main window is titled "Auxiliary Dialog" and contains a "Polygon file" section with a text field for "Polygon file name" (containing "A/2D-Land-example-1/Auxiliary/Polygon Definition") and a "File Browse..." button. To the right is a "Format" section with a "Format type" dropdown menu set to "SPW". Overlaid on this window is a smaller "Spreadsheet Information" dialog. This dialog has a table with two columns: "Trace header" and "Value". It contains two rows: "Primary sort order" with a dropdown set to "Source line" and an empty text field; and "Secondary sort order" with a dropdown set to "Source location" and an empty text field. Below the table is a label "Number of rows to add to spreadsheet" followed by an empty text field. At the bottom of the dialog are three buttons: "OK", "Help", and "Cancel". The main "Auxiliary Dialog" window also has a toolbar at the bottom with various icons and four buttons: "OK", "Save", "Help", and "Cancel".

	Trace header	Value
Primary sort order	Source line	
Secondary sort order	Source location	

Number of rows to add to spreadsheet:

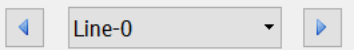
Example Card Data:



Parameter descriptions:

File Browse — Select to browse for existing Polygon Definition file or to define the name of a new file to be saved.

Format Type — Select format type.


 — Navigate through record.

X (first key value) — Enter the start column and the number of columns allocated to write the X coordinate associated with a given coordinate pair in the output polygon definition file.

Y (second key value) — Enter the start column and the number of columns allocated to write the Y coordinate associated with a given coordinate pair in the output polygon definition file.

Auxiliary Data R-Z

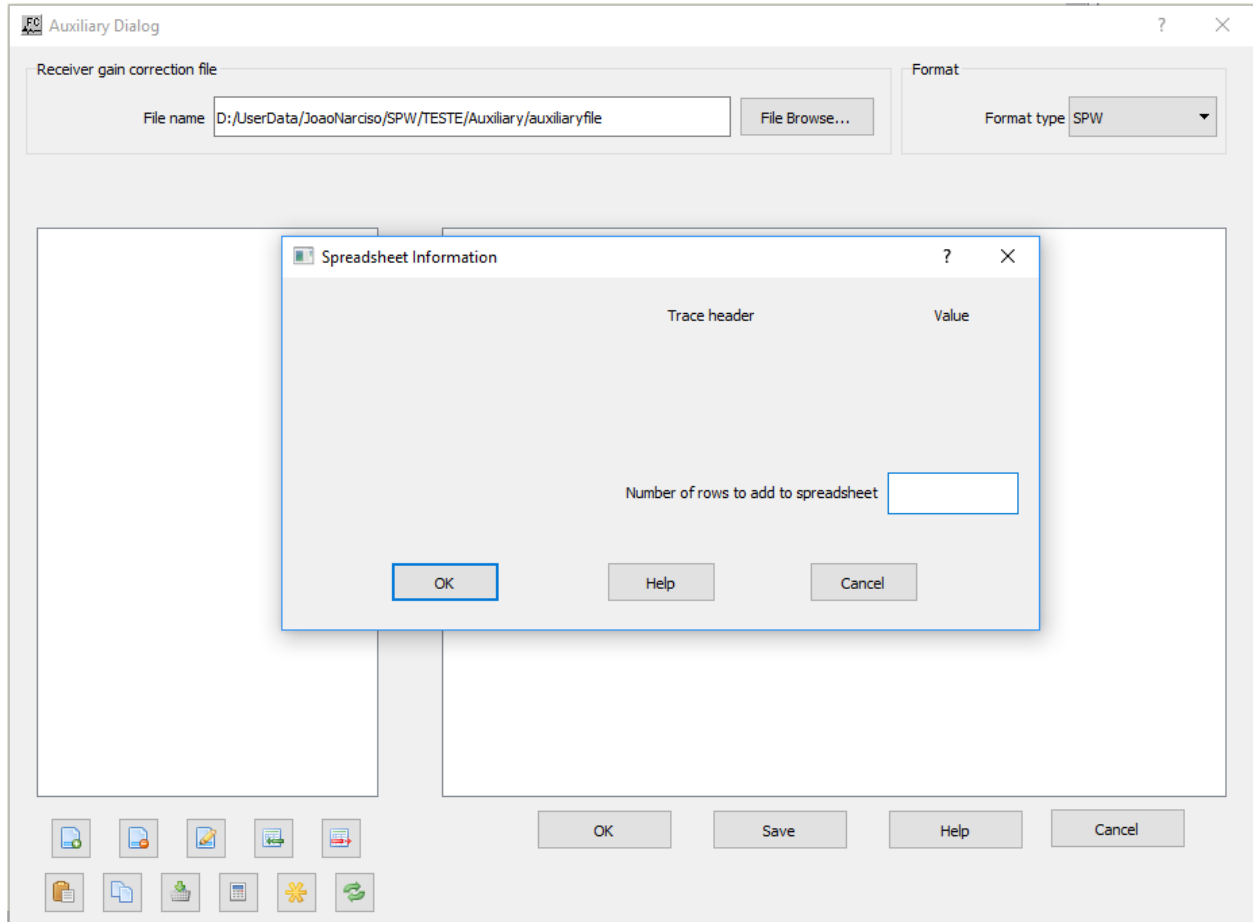
This section documents the auxiliary card data between R and Z:

Auxiliary Data R-Z
 Processing Categories
Receiver Gain Corrections
Receiver Statics
SPS Observer Notes
SPS Receiver Locations
SPS Source Locations
Source Gain Corrections
Source Statics
Surgical Mutes
Tail Mutes
UK00A P1 90
Velocity Function
Window Definition

Receiver Gain Corrections

Usage: The Receiver Gains card data item is used to store surface consistent gains associated with receiver locations.

Step Parameter Dialog: Receiver Gain Corrections may be sorted in any sort order.



Example Card Data:

Auxiliary Dialog

Receiver gain correction file

File name: D:/UserData/JoaoNarciso/SPW/TESTE/Auxiliary/auxiliaryfile File Browse...

Format

Format type: SPW

	Receiver location	ExtraOne
1	0	0.00

Line-0

OK Save Help Cancel

Parameter descriptions:

File Browse — the name of a new file to be saved.

Format Type — Select format type.

— Navigate through record.

Receiver location — Enter the receiver location number

ExtraOne — Enter the gain correction value.

Receiver Statics

Usage: The Receiver Statics card data item is used to store receiver static information in units of milliseconds.

Step Parameter Dialog: The Receiver Statics card data needs a primary sort order key and it might be Receiver line, CMP line, source line, offset.

The image shows two overlapping dialog boxes from a software application. The background dialog is titled "Auxiliary Dialog" and contains a "Receiver static file" section with a text field showing "D:/UserData/SPW/auxiliaryfile" and a "File Browse..." button. To the right is a "Format" section with a "Format type" dropdown menu set to "SPW". The foreground dialog is titled "Spreadsheet Information" and features a "Trace header" section with a "Primary sort order" dropdown menu set to "Receiver line" and an adjacent empty "Value" text field. Below this is a "Number of rows to add to spreadsheet" text field. At the bottom of the "Spreadsheet Information" dialog are "OK", "Help", and "Cancel" buttons. The "Auxiliary Dialog" also has "OK", "Save", "Help", and "Cancel" buttons at its bottom. A toolbar with various icons is visible at the very bottom of the "Auxiliary Dialog" window.

Example Card Data:

Auxiliary Dialog

Receiver static file

Receiver static file name: D:/UserData/SPW/auxiliaryfile File Browse...

Format

Format type: SPW

Line-0

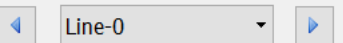
	Receiver location	ExtraOne
1	0	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing **Receiver Statics** file or to define the name of a new file to be saved.

Format Type — Select format type.


 — Navigate through record.

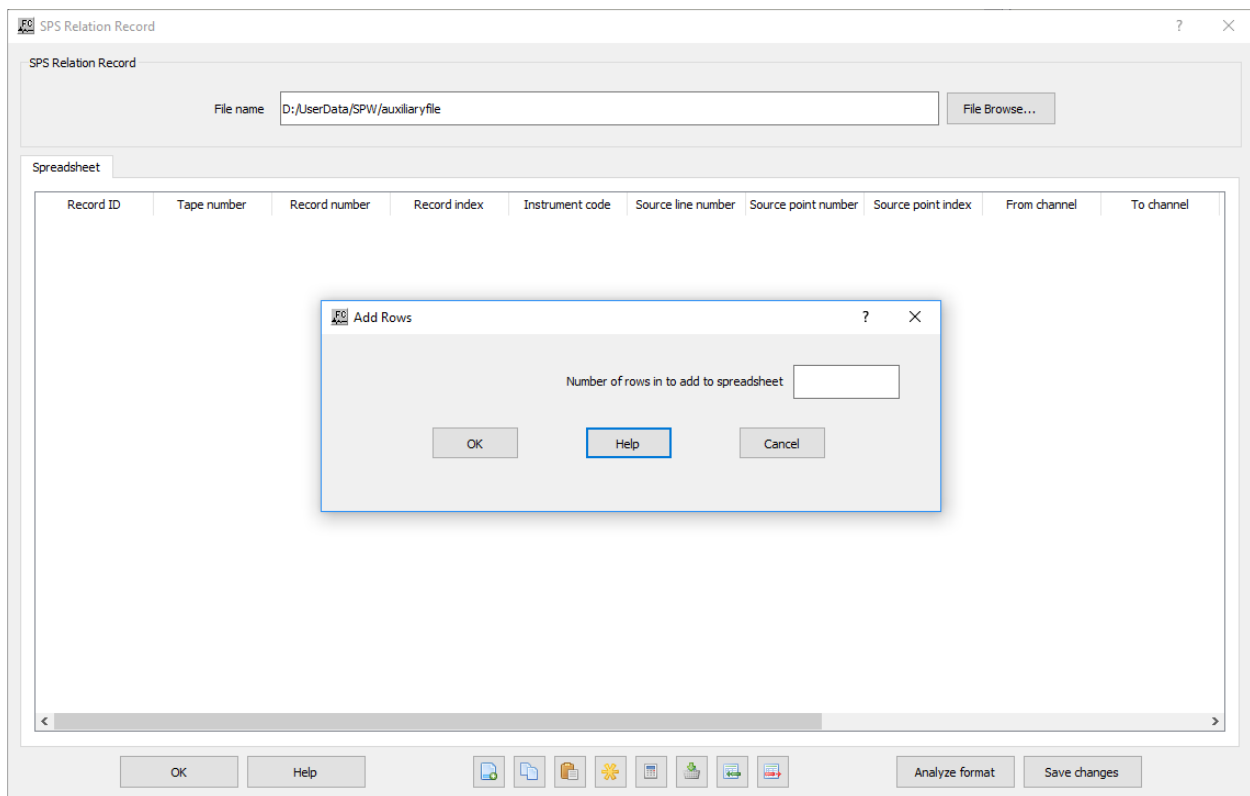
Receiver location — Enter the receiver location value.

ExtraOne — Enter the receiver statics for the location.

SPS Observer Notes

Usage: The Observer Notes card data item is used to store the relational acquisition geometry information for sources and receivers. In the SPS lingo this is referred to as the Cross Reference file. An example seismic survey with the corresponding source, receiver, and observer SPS files is illustrated in the Geometry Definition step (p. 243).

Step Parameter Dialog: Polygon Definition need two sort keys. Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.



Example Card Data:

SPS Relation Record

File name: D:/UserData/SPW/auxiliaryfile File Browse...

Spreadsheet

	Record ID	Tape number	Record number	Record index	Instrument code	Source line number	Source point number	Source point index	From channel	To channel
1	X			1				1		
2	X			1				1		
3	X			1				1		
4	X			1				1		
5	X			1				1		

OK Help File Browse... Analyze format Save changes

Card Data Customization Parameter Dialog:

SPS Relation Record

File name: D:/UserData/SPW/auxiliaryfile File Browse...

Spreadsheet

	Record ID	Tape number	Record number	Record index	Instrument code	Source line number	Source point number	Source point index	From channel	To channel
1	X			1				1		
2	X			1				1		
3	X			1				1		
4	X			1				1		
5	X			1				1		

OK Help File Browse... Analyze format Save changes

Parameter descriptions:

File Browse — Select to browse for existing ***Receiver Statics*** file or to define the name of a new file to be saved.

Record ID — Enter the Record ID. The 'X' value is default.

Tape number — Enter the tape number.

Record number — Enter the record number.

Record index — Enter the record index.

Instrument code — Enter the instrument code.

Source line number — Enter source line number.

Source point number — Enter source point number.

Source point index — Enter source point index.

From channel — Enter the corresponding minimum channel for the record.

To channel — Enter the corresponding maximum channel for the record.

Channel increment — Enter the channel increment.

Receiver line number — Enter the receiver line number.

From receiver — Enter the corresponding minimum receiver number for the record.

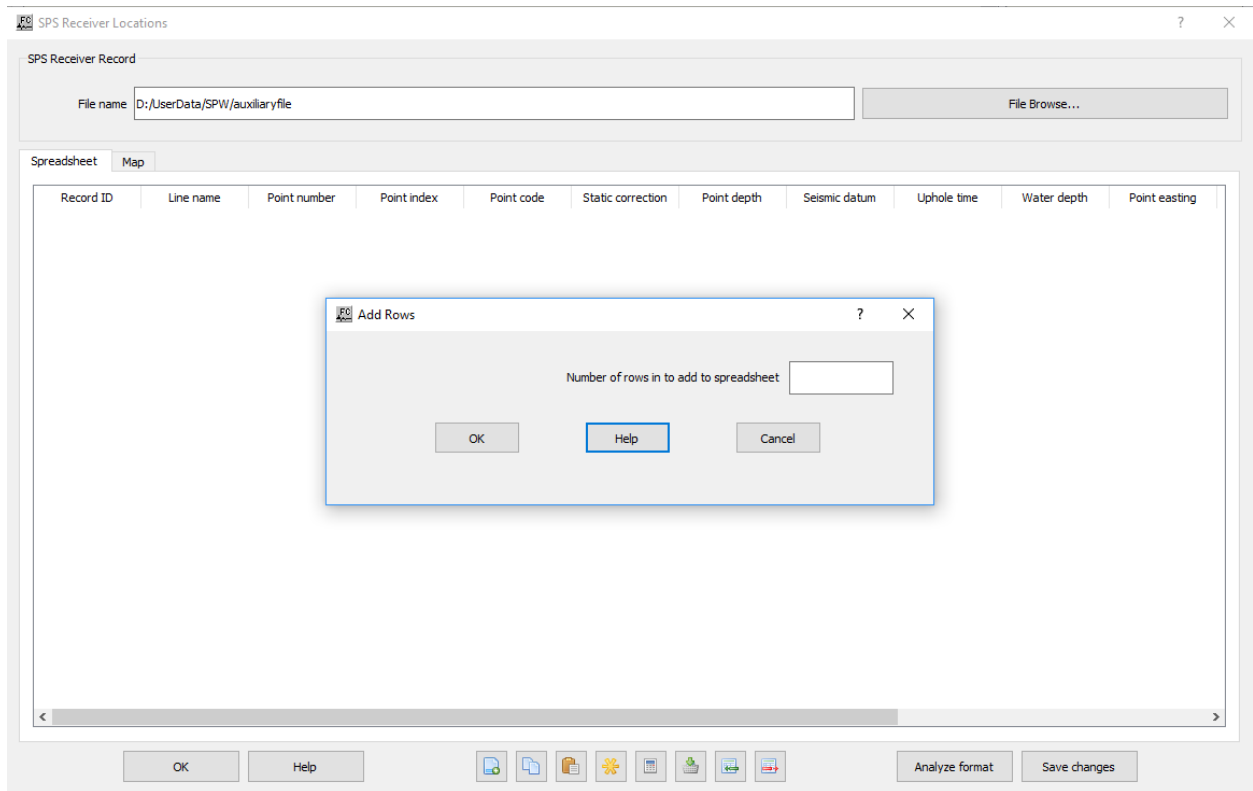
To receiver — Enter the corresponding maximum receiver for the record.

Receiver index — Enter the receiver index.

SPS Receiver Locations

Usage: The Receiver Locations – SPS Format card data item is used to store positional receiver location information. An example seismic survey with the corresponding source, receiver, and observer SPS files is illustrated in the Geometry Definition step (p. 243).

Step Parameter Dialog: The Receiver Locations – SPS Format does not require any specific sort order.



Example Card Data:

SPS Receiver Locations

SPS Receiver Record

File name: D:/UserData/SPW/auxiliaryfile File Browse...

Spreadsheet Map

Record ID	Line name	Point number	Point index	Point code	Static correction	Point depth	Seismic datum	Uphole time	Water depth	Point easting
1	R		0		0	0.0	0	0	0	
2	R		0		0	0.0	0	0	0	
3	R		0		0	0.0	0	0	0	
4	R		0		0	0.0	0	0	0	
5	R		0		0	0.0	0	0	0	

OK Help File Edit View Tools Database Help Analyze format Save changes

Parameter descriptions:

File Browse — Select to browse for existing **SPS Receiver Locations** file or to define the name of a new file to be saved.

Record ID — Enter the Record ID.

Line name — Enter the line name.

Point number — Enter the point number.

Point index — Enter the point index.

Point code — Enter point code.

Static correction — Enter static correction.

Point depth — Enter point depth.

Seismic datum — Enter seismic datum.

Uphole time — Enter uphole time.

Water depth — Enter water depth.

Point easting — Enter point easting.

Point northing — Enter point northing.

Surface elevation — Enter surface elevation.

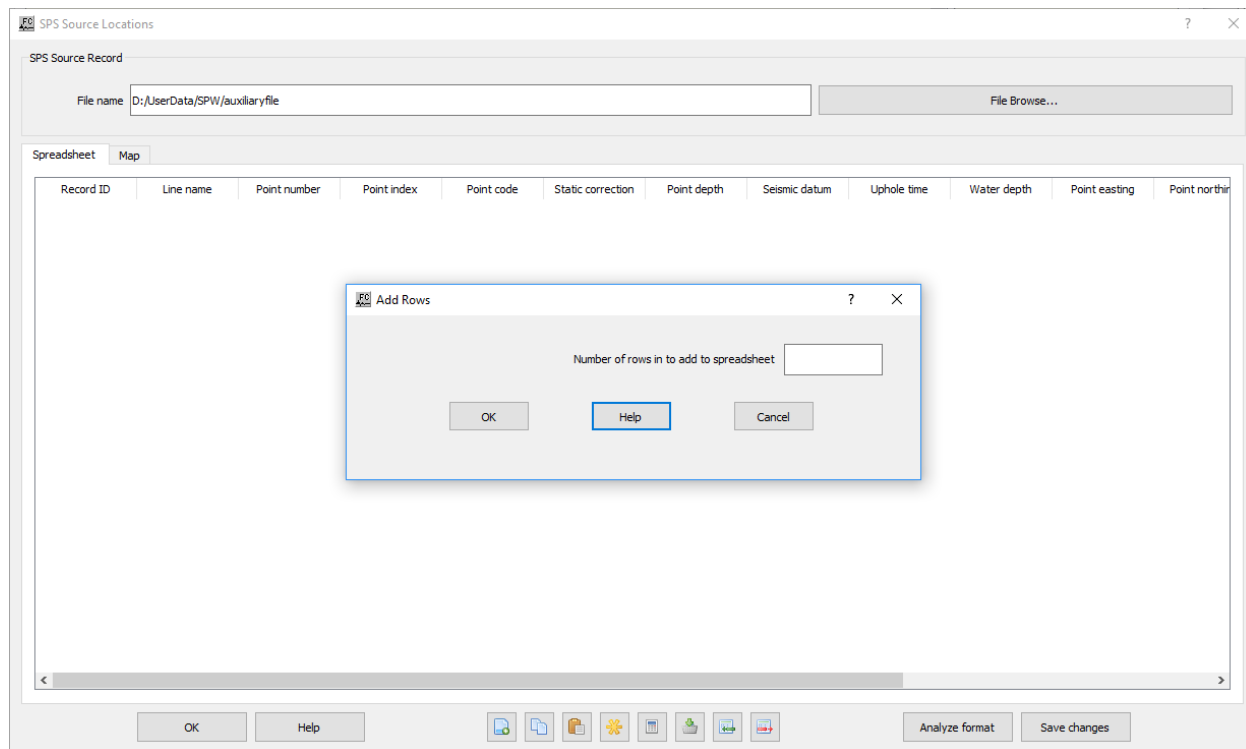
Day of year — Enter the day of the year.

Time of Day — Enter the time of the day...

SPS Source Locations

Usage: The Source Locations – SPW Format card data item is used to store source location geometry information. An example seismic survey with the corresponding source, receiver, and observer SPS files is illustrated in the Geometry Definition step (p. 243).

Step Parameter Dialog: The Receiver Locations – SPS Format does not require any specific sort order.



Example Card Data:

SPS Source Locations

SPS Source Record

File name: D:\UserData\SPW\auxiliaryfile File Browse...

Spreadsheet Map

Record ID	Line name	Point number	Point index	Point code	Static correction	Point depth	Seismic datum	Uphole time	Water depth	Point easting	Point northing	Surface elevation	Day of year	Time of day
1	S		0		0	0.0	0	0	0			0.0	0	0
2	S		0		0	0.0	0	0	0			0.0	0	0
3	S		0		0	0.0	0	0	0			0.0	0	0
4	S		0		0	0.0	0	0	0			0.0	0	0
5	S		0		0	0.0	0	0	0			0.0	0	0

OK Help

Analyze format Save changes

Parameter descriptions:

File Browse — Select to browse for existing **SPS Source Locations** file or to define the name of a new file to be saved.

Record ID — Enter the Record ID.

Line name — Enter the line name.

Point number — Enter the point number.

Point index — Enter the point index.

Point code — Enter point code.

Static correction — Enter static correction.

Point depth — Enter point depth.

Seismic datum — Enter seismic datum.

Uphole time — Enter uphole time.

Water depth — Enter water depth.

Point easting — Enter point easting.

Point northing — Enter point northing.

Surface elevation — Enter surface elevation.

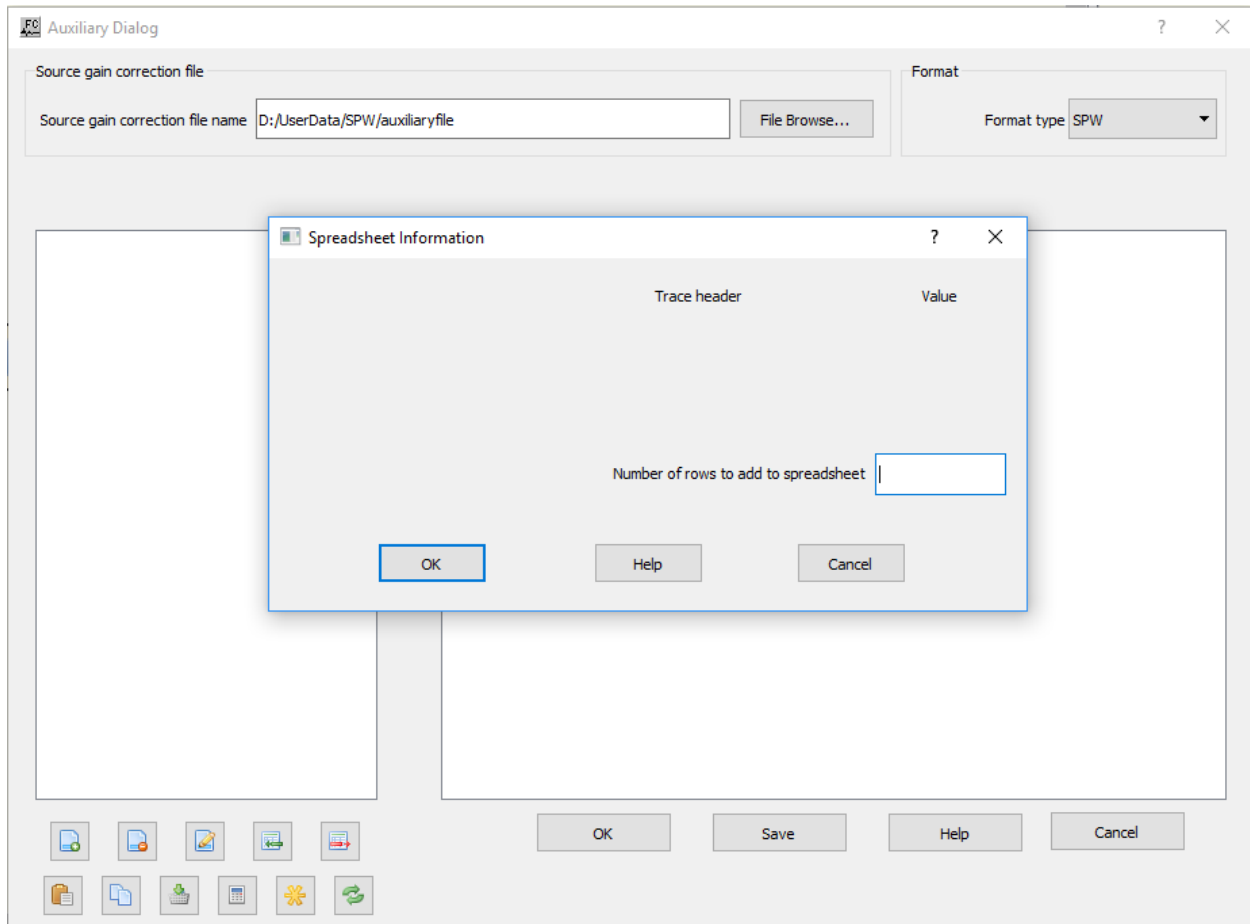
Day of year — Enter the day of the year.

Time of Day — Enter the time of the day.

Source Gain Corrections

Usage: The Source Gains card data item is used to store gains associated with source locations.

Step Parameter Dialog: Source Gains does not require any specific sort order.



Example Card Data:

Source gain correction file

Source gain correction file name:

Format

Format type:

	Source location	ExtraOne
1	0	0.00
2	0	0.00
3	0	0.00
4	0	0.00
5	0	0.00

Navigation:

Buttons:

Parameter descriptions:

File Browse — Select to browse for existing **Source Gain Corrections** file or to define the name of a new file to be saved.

Format Type — Select format type.

— Navigate through record.

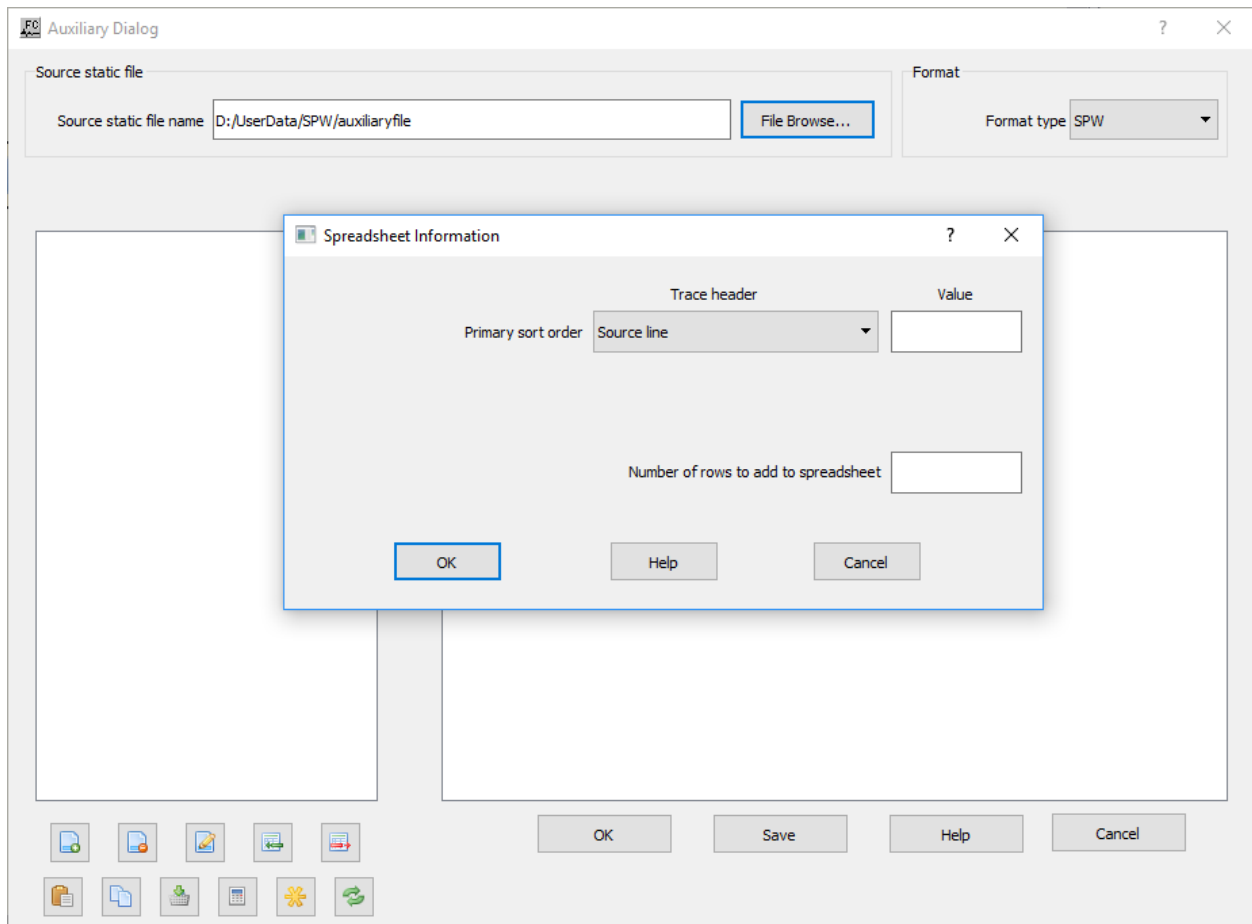
Source location — Enter the source location value.

ExtraOne — Enter the corresponding source gain correction.

Source Statics

Usage: The Source Statics card data item is used to store source statics information in units of milliseconds.

Step Parameter Dialog: Source Statics card data file may be sorted in CMP Line, Source Line, Receiver Line or Offset.



Example Card Data:

Source static file

Source static file name: D:/UserData/SPW/auxiliaryfile File Browse...

Format

Format type: SPW

Line-0

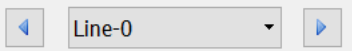
	Source location	ExtraOne
1	0	0.00
2	0	0.00
3	0	0.00
4	0	0.00
5	0	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing **Source Statics** file or to define the name of a new file to be saved.

Format Type — Select format type.

 — Navigate through record.

Source location — Enter the source location.

ExtraOne — Enter the corresponding source statics.

Surgical Mutes

Usage: The Surgical Mutes card data item is used to store surgical mute data. Mute times are in units of seconds. Surgical mutes may be defined interactively using the Pick Traces tool located in the Picking menu.

Step Parameter Dialog: Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.

The image shows a software interface with two overlapping dialog boxes. The background dialog is titled "Auxiliary Dialog" and contains a "Surgical mute file" section with a text field showing "D:/UserData/SPW/auxiliaryfile" and a "File Browse..." button. To the right is a "Format" section with a "Format type" dropdown menu set to "SPW". The foreground dialog is titled "Spreadsheet Information" and contains a table with two columns: "Trace header" and "Value". The table has two rows: "Primary sort order" with a dropdown menu set to "Source line" and an empty text field; "Secondary sort order" with a dropdown menu set to "Source location" and an empty text field. Below the table is a text field labeled "Number of rows to add to spreadsheet". At the bottom of the dialog are three buttons: "OK", "Help", and "Cancel". The "OK" button is highlighted with a blue border. The main window also has a toolbar at the bottom with various icons and a set of buttons: "OK", "Save", "Help", and "Cancel".

Trace header	Value
Primary sort order	Source line
Secondary sort order	Source location

Example Card Data:

Auxiliary Dialog

Surgical mute file

Surgical mute file name: D:/UserData/SPW/auxiliaryfile File Browse...

Format

Format type: SPW

Line-0 Location-0

	Time (ms)	Offset
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing ***Surgical Mutes*** file or to define the name of a new file to be saved.

Format Type — Select format type.

— Navigate through record.

Time (ms) — Enter the two-way-traveltime for the pick at the current record for a given ***Offset***.

Offset — Enter the value of the offset of the pick.

Tail Mutes

Usage: The Tail Mutes card data item is used to store tail or end mute data. Mute times are in units of seconds. Tail mutes may be interactively defined in Seismic viewer using the Pick Traces tool located in the Picking menu.

Step Parameter Dialog: The Tail Mutes card data Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.

Example Card Data:

The image shows two overlapping dialog boxes from a software application. The background dialog is titled "Auxiliary Dialog" and contains a "Tail mute file" section with a text field showing "D:/UserData/SPW/auxiliaryfile" and a "File Browse..." button. To the right is a "Format" section with a "Format type" dropdown menu set to "SPW". The foreground dialog is titled "Spreadsheet Information" and features a table with two columns: "Trace header" and "Value". The table has two rows: "Primary sort order" with a dropdown set to "Source line" and an empty text field; and "Secondary sort order" with a dropdown set to "Source location" and an empty text field. Below the table is a text field labeled "Number of rows to add to spreadsheet". At the bottom of the "Spreadsheet Information" dialog are "OK", "Help", and "Cancel" buttons. The "Auxiliary Dialog" also has "OK", "Save", "Help", and "Cancel" buttons at its bottom. A toolbar with various icons is visible at the very bottom of the "Auxiliary Dialog" window.

	Trace header	Value
Primary sort order	Source line	
Secondary sort order	Source location	

Number of rows to add to spreadsheet:

Parameter descriptions:

Auxiliary Dialog

Tail mute file

Tail mute file name: D:/UserData/SPW/auxiliaryfile File Browse...

Format

Format type: SPW

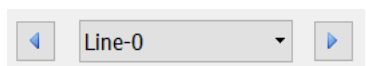
Line-0 Location-0

	Time (ms)	Offset
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00

OK Save Help Cancel

File Browse — Select to browse for existing *Tail Mutes* file or to define the name of a new file to be saved.

Format Type — Select format type.


 — Navigate through record.

Time (ms) — Enter the two-way-traveltime for the pick at the current record for a given *Offset*.

Offset — Enter the value of the offset of the pick.

UKOOA P1 90

Usage: The UKOOA P1/90 card data item is used import geometry based on UKOOA P1/P90 formats.

Step Parameter Dialog:

The screenshot shows a Windows-style dialog box titled "UKOOA P1\90 File". It has a standard title bar with a question mark and a close button. The dialog contains two radio buttons at the top: "Input a single P190 file" (which is selected) and "Input all P190 files from a directory". Below these is a section labeled "UKOOA P1\90 input" containing a "File name" text field and a "File Browse ..." button. A checkbox labeled "Read and display data locations" is positioned below the file input section. Underneath the checkbox is a label "Receiver point sampling: 1 in 250" with a small up/down arrow. At the bottom of the dialog, there are two tabs: "Spreadsheet" (selected) and "Map". To the right of the tabs is a radio button labeled "Begin data read and display". The main area of the dialog is a large, empty rectangular frame. At the very bottom, there are three buttons: "OK", "Help", and "Cancel".

Parameter descriptions:

Input a single P190 file — Select to input a single file with all the geometry parameters.

Input all P190 files from a directory — Select to input multiple geometry files at once.

UKOOA P1/P90 input — Browse file(s) to be imported.

Read and display data locations — If checked, read input files and display values and map.

Receiver point sampling: 1 in 250 — Enter the number of lines of the input file to be displayed.

Velocity Function

Usage: The Velocity Function card data item is used to store time-velocity pairs. Stacking velocities may be picked interactively using the Pick Traces tool located in the Picking menu.

Step Parameter Dialog: The Velocity Function card data Primary sort key may be ***CMP Line***, ***Source Line***, ***Receiver Line*** or ***Offset***. Secondary sort key may be ***CMP Line***, ***Source Line***, ***Receiver Line***. Select output velocity type from ***RMS (Stacking) velocity***, ***Interval velocity*** or ***Average Velocity***. Velocity field may be defined in the ***Two-way time*** or ***Depth*** domain.

The screenshot shows the 'RMS Velocitytwo-way-time' dialog box. The 'Velocity function file' section has a text field for 'Velocity function file name' containing 'D:/UserData/SPW/auxiliaryfile' and a 'File Browse...' button. The 'Format' section has a 'Format type' dropdown set to 'SPW'. Overlaid on this is the 'Spreadsheet Information' sub-dialog. It features a table with two columns: 'Trace header' and 'Value'. The table has two rows: 'Primary sort order' with 'CMP line' in the header and an empty value field, and 'Secondary sort order' with 'CMP location' in the header and an empty value field. Below the table is a text field for 'Number of rows to add to spreadsheet'. There are two sections of radio buttons: 'Output velocity type' with options 'RMS (Stacking) velocity' (selected), 'Interval velocity', and 'Average velocity'; and 'Output vertical domain' with options 'Two-way time' (selected) and 'Depth'. At the bottom of the sub-dialog are 'OK', 'Help', and 'Cancel' buttons. The main dialog also has a 'Cancel' button at the bottom right.

Trace header	Value
Primary sort order	CMP line
Secondary sort order	CMP location

Number of rows to add to spreadsheet:

Output velocity type:

- ☒ RMS (Stacking) velocity
- ☐ Interval velocity
- ☐ Average velocity

Output vertical domain:

- ☒ Two-way time
- ☐ Depth

Buttons: OK, Help, Cancel

Example Card Data:

Velocity function file

Velocity function file name: D:/UserData/SPW/auxiliaryfile File Browse...

Format

Format type: SPW

Line-0 Location-0

	Time (ms)	Attribute
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing **Velocity Function** file or to define the name of a new file to be saved.

Format Type — Select format type.

— Navigate through record.

Time (ms) — Enter the start column and the number of columns allocated to write the two-way travel time (in milliseconds) associated with a given velocity pick in the velocity file.

Attribute — Enter the start column and the number of columns allocated to write the RMS or interval velocity value associated with a given velocity pick in the velocity file.

Window Definition

Usage: The Window Definition card data item is used to store information about windows in space and time where given process will be applied.

Step Parameter Dialog: The Window Definition card data Primary sort key may be CMP Line, Source Line, Receiver Line or Offset. Secondary sort key may be CMP Line, Source Line, Receiver Line.

The image shows a software interface with two overlapping windows. The background window is titled "Auxiliary Dialog" and contains a "Window definition file" section with a text field showing "D:/UserData/SPW/auxiliaryfile.bak" and a "File Browse..." button. To the right is a "Format" section with a "Format type" dropdown menu set to "Rectangle". The foreground window is titled "Spreadsheet Information" and contains a table for defining spreadsheet data. The table has two columns: "Trace header" and "Value". It includes fields for "Primary sort order" (set to "Source line") and "Secondary sort order" (set to "Source location"). Below these is a field for "Number of rows to add to spreadsheet". At the bottom of the "Spreadsheet Information" window are "OK", "Help", and "Cancel" buttons. The bottom of the "Auxiliary Dialog" window also features a row of icons and a set of "OK", "Save", "Help", and "Cancel" buttons.

	Trace header	Value
Primary sort order	Source line	
Secondary sort order	Source location	
Number of rows to add to spreadsheet		

Example Card Data:

Auxiliary Dialog

Window definition file

File name: D:/UserData/SPW/auxiliaryfile.bak File Browse...

Format

Format type: Rectangle

Line-0 Location-0

	Time (ms)	Offset
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00

OK Save Help Cancel

Parameter descriptions:

File Browse — Select to browse for existing **Window Definition** file or to define the name of a new file to be saved.

Format Type — Select format type.

— Navigate through record.

Time (ms) — Enter the two-way-traveltime for the pick at the current record for a given **Offset**.

Offset — Enter the value of the offset of the pick.

Display Steps

This section documents the processing steps available for Display. Processing steps currently available are:

Display
 Processing Categories
Frequency Slices
Frequency Slices to Time Traces
Real Time Amplitude Spectrum Plot
Real Time Data Quality Analysis
Real Time Fly Stack Display
Real Time Near Trace Display
Real Time Quality Analysis Statistics Map
Real Time Quality Analysis Statistics Plot
Real Time Receiver Attribute Map
Real Time Receiver Spread
Real Time Seismic Display
Real Time Source Attribute Map
Real Time Trace Header Map
Seismic Display Plotter
Time Slices
Time Slices to Traces

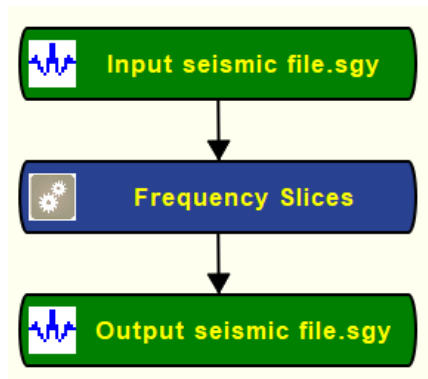
Frequency Slices

Usage: The Frequency Slices step creates frequency slices of the input seismic data. The output can be used for display purposes or as input for some specific frequency domain processes such as F-X-Y Median Filter and FKK Domain Spectral Shaping back into the standard time trace domain data.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Frequency Slices ? X

Purpose

☒ Processing ☐ Display

Binning (Offset gathers only)

☐ Use offset binning Offset Increment

Input time range selection

☒ All times ☐ Selected time range

Initial Time (ms.)
Final Time (ms.)

Frequency selection

☒ All frequencies in range ☐ Selected frequencies

Lowest Frequency (Hz.)
Highest Frequency (Hz.)
Frequency increment (Hz.)

Frequency density control

Density factor

Test impulse generation

☐ Impulse response test

Impulse wavelet

Impulse time
Ricker wavelet freq.

OK Help Cancel

Parameter Description:

The **Purpose** specifies if the output is for processing or display purposes.

Processing — If selected, considers the output of the processing step to be used as input for other frequency related processing step.

Display — If selected, considers the output for display purposes only.

The **Binning (Offset gathers only)** specifies offset binning parameters exclusively for input data sorted in the offset domain.

Use offset binning — If checked, bins the data in the offset domain before the calculation of the frequency slices.

Offset increment — Enter the offset increment to be considered for offset binning.

The **Input time range selection** specifies the time gate used to compute the frequency slices.

All times — If selected, considers the entire length of the seismic trace.

Selected time range — If selected, define the initial and final times of the time gate.

Initial Time (ms) — Enter the initial time of the time gate in milliseconds.

Final Time (ms) — Enter the final time of the time gate in milliseconds.

The **Frequency selection** specifies frequency range to compute the frequency slices.

All frequencies in range — If selected, considers the entire frequency range of the input data.

Selected frequencies — If selected, define a frequency range by the lowest, highest and frequency increment.

Lowest frequency (Hz) — Enter the lowest frequency to be considered in Hz.

Highest frequency (Hz) — Enter the highest frequency to be considered in Hz.

Frequency Increment (Hz) — Enter the frequency increment to be considered in Hz.

The **Frequency density control** specifies density factor.

Density factor — Enter the density factor.

The **Test impulse generation** specifies impulse response test parameters.

Impulse response test — If checked, considers an impulse response test.

Impulse time — Enter the impulse time in milliseconds.

Ricker wavelet freq. — Enter the Ricker wavelet frequency in Hz.

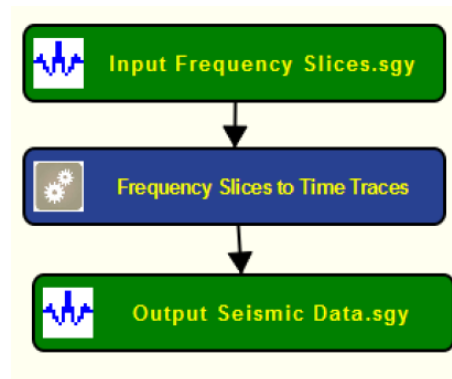
Frequency Slices to Time Traces

Usage: Frequency Slices to Time Traces is a process used to convert frequency slices required for some specific frequency domain processes such as F-X-Y Median Filter and FKK Domain Spectral Shaping back into the standard time trace domain data.

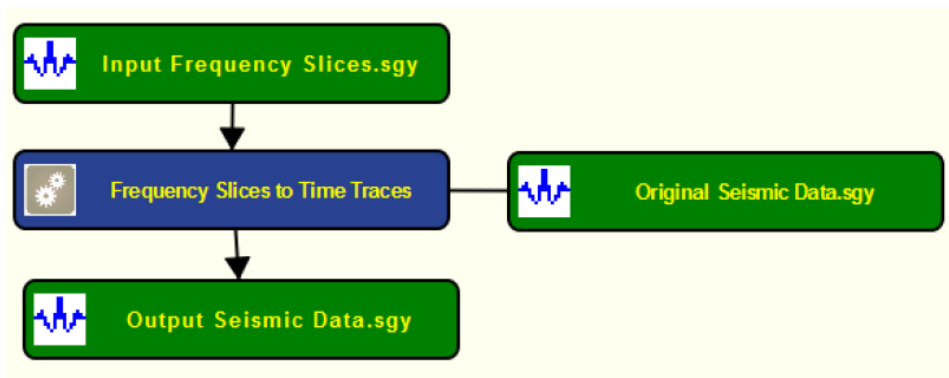
Input Links: 1) Seismic data in sorted by CMP Line (record key) and Slice Number (mandatory); 2) Original seismic data CMP Line (record key) and CMP Location (3D) or CMP (2D) (optional).

Output Links: 1) Seismic data (mandatory).

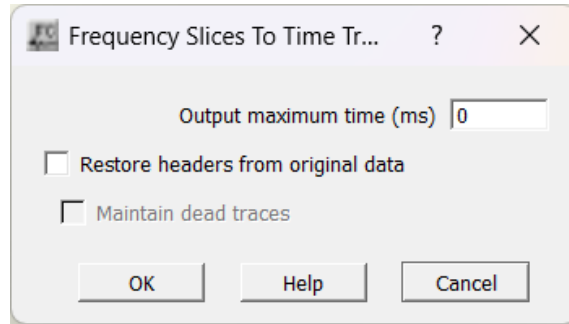
Example Flowchart a:



Example Flowchart b:



Step Parameter Dialog:



Parameter Description:

Output maximum time (ms) — Enter maximum time of the output in time $\{ \geq 0 \}$.

Restore headers from original data — If checked, a secondary input data will be required, sorted by CMP Line (record key) and CMP Location (3D) or CMP (2D). This secondary input data will be used to supply the headers to be attached to the output data, and the data extent must be set to match the extent of the output data.

Maintain dead traces — If Restore headers from original data is checked, dead traces are kept in the output data.

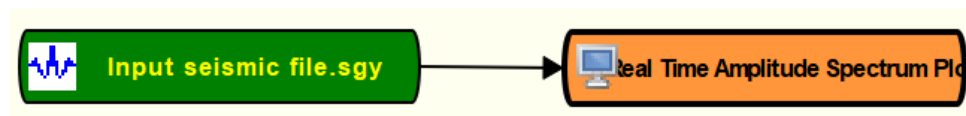
Real Time Amplitude Spectrum Plot

Usage: The Real Time Amplitude Spectrum Plot step is a real time plot of the amplitude spectrum for a group of traces as defined by the user. A display is automatically generated when running this step.

Input Links: 1) Seismic data in sorted by CMP Line (record key) and Slice Number (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Real Time Amplitude Spectrum" contains the following sections:

- Horizontal range:** Includes input fields for "Minimum frequency" and "Maximum frequency".
- Display tab:** Includes a checkbox "Add display to a tab" and a text field "Unique tab name".
- Map title:** Includes a text field.
- Spectra outputs:** Includes a text field "Output spectra file name:" with the value "C:/DATA/Documentation/Survey/" and a "File Browse..." button.

At the bottom are "OK", "Help", and "Cancel" buttons.

Parameter Description:

The **Horizontal range** specifies the minimum and maximum frequency values considered in the horizontal axis.

Minimum frequency — Enter the minimum frequency in Hz for the amplitude spectrum.

Maximum frequency — Enter the maximum frequency in Hz for the amplitude spectrum.

The **Display tab** specifies the tab where the display will be created.

Add display to a tab — If checked, add the display to a pre-existing tab.

Unique tab name — Enter the unique tab name where the display will be added.

Map title — Enter the map title.

The **Spectra outputs** specifies the location where the automatically generated images of spectra plots will be stored.

Output spectra file name — Enter the folder location where the spectra plots will be stored.

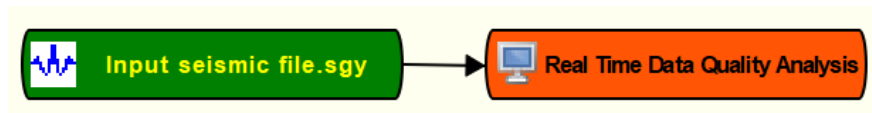
Real Time Data Quality Analysis

Usage: The Real Time Data Quality step is a real time display that allows plotting the information generated by the Spectral Comparison processing step (under Quality Analysis category). It generates a real time map using as horizontal axis the header value defined under the Trace header containing horizontal coordinate and as vertical axis the header value located under the Trace header containing vertical coordinate. The map is then colored by the values defined under the Trace header containing attribute for display. In the Spectral Comparison case, we can select the spectral semblance value of the dead/live flag.

Input Links: 1) Seismic file (mandatory). Normally this step is applied together with Spectral Comparison for real time quality control.

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Trace header containing horizontal coordinate** specifies the header value defined under the Trace header to be used as horizontal axis title.

Trace header — Select trace header to be used for the horizontal axis of the real time map.

The **Trace header containing vertical coordinate** specifies the header value defined under the Trace header to be used as vertical axis title.

Trace header — Select trace header to be used for the vertical axis of the real time map.

The **Display tab** specifies the tab where the display will be created.

Add display to a tab — If checked, add the display to a pre-existing tab.

Unique tab name — Enter the unique tab name where the display will be added.

The **Trace header containing attribute for display** specifies the header value defined under the Trace header to be used as attribute.

Trace header — Select trace header to be used as attribute for the real time map.

Set attribute range — If checked, select the minimum and maximum value of the attribute to be plotted. Attribute values outside these limits will be plotted with the color corresponding to the minimum and maximum of defined attribute range.

Minimum — Enter the minimum value of the attribute.

Maximum — Enter the maximum value of the attribute.

The **Attribute color scale** specifies the color scale used in the plot.

Select — Select the color scale to be used in the plot.

Map title — Enter real time map title.

Attribute label — Enter attribute label.

The **Split displays** specifies the source parameters to be considered for split display.

Set Split Display Per Source — If checked, set the split display per source number.

Trace header — Select the trace header word where the source number is stored.

Number of sources to split display — Enter the number of sources to be used as split.

Split display odd/even — If checked, set the split display per odd or even trace number.

Overwrite pixel size — If checked, overwrites the pixel size for each trace location.

Overwrite pixel size for each trace location — Enter the pixel size to be used for overwriting

The **Map outputs** specifies the output format of the map file.

Save output map to image (*.jpg) — If checked, save data quality analysis plot in jpeg format.

Save output SPW map format (*.baf) — If checked, save data quality analysis plot in internal SPW format (*.baf).

Save figure at each nth FFID — If checked, saves the plot at each nth FFID.

Each nth FFID — Enter the FFID increment to be used for save figure.

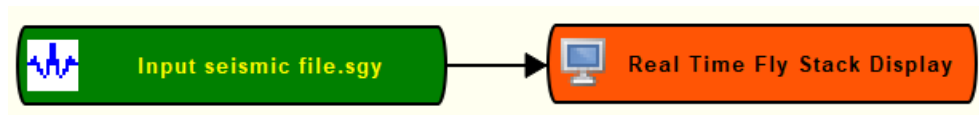
Real Time Fly Stack Display

Usage: The Real Time Fly Stack Display step generates a real time stack built from an input seismic file. The step allows applying a constant velocity NMO correction.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:



Real Time Fly CMP Stack Display



☒ Apply frequency bandpass

Initial freq. (Hz.)

250

dB/octave attenuation

6

Final freq. (Hz.)

3000

dB/octave attenuation

36

☒ Remove Sample Mean

Trace amplitude definition

☒ Use true amplitude traces

☐ Use relative amplitude traces

Stack Normalization exponent

1.00

☐ NMO correct

Stacking velocity

1500

☐ Apply front end mute

Apparent velocity

1500

☒ Limit trace offsets

Minimum Offset

0.00

Maximum Offset

0.00

☒ Stack 1 trace / offset

Offset interval

1.00

☐ Include flex traces

Display parameters

Trace type

Variable area wiggle

Horiz scale

20.0

1st horz anno

1

Polarity

Normal

Vert scale

30.0

2nd horz anno

50

Orientation

Right-to-left

Display gain

0.0

Vertical anno

50

Amplitudes

Gain control

AGC length (ms)

20.00

Major time lines

50

Reference

1.0

Excursion

2.0

Minor time lines

10

Maximum traces to display

200

Display color scale

Select



Display title

Display tab

☐ Add display to a tab

Unique tab name

OK

Help

Cancel

Parameter Description:

Apply frequency bandpass — If checked, it applies a frequency bandpass to the data prior to computing the stack.

Initial freq. (Hz.) — Enter the initial frequency of the bandpass filter in hertz.

dB/octave attenuation — Enter the filter slope in the initial frequency.

Final freq. (Hz.) — Enter the final frequency of the bandpass filter in hertz.

dB/octave attenuation — Enter the filter slope in the final frequency.

Remove sample mean — If checked, remove the mean amplitude of the samples.

Stack normalization exponent — Enter the stack normalization exponent.

The **Trace amplitude definition** specifies if the stack uses true or relative amplitude traces.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude traces will be summed in the stacking process. Relative amplitude traces are scaled independently of one another..

NMO correct — If checked, applies a NMO correction with constant stacking velocity.

Stacking velocity — Enter the stacking velocity value to be used in the NMO correction.

Apply front end mute — If checked, applies a top mute before stacking and after NMO correction.

Apparent velocity — Enter the apparent velocity value to define the top mute.

Limit trace offsets — If checked, limits the offsets used in the stack.

Minimum offset — Enter the minimum offset to be used (in project units).

Maximum offset — Enter the maximum offset to be used (in project units).

Stack 1 trace / offset — If checked, stack a single trace per offset considered.

Offset interval — Enter the offset interval to be used.

Include flex traces — If checked include flex traces in the offset for stack calculation.

The **Display parameters** defines the parameters related to the real time of the near offset trace.

Trace type — Select the type of the seismic display between Variable area wiggle or Variable density.

Polarity — Select the type of polarity for the seismic display between Normal or Reverse.

Orientation — Select the orientation of the seismic display between Right-to-left or Left-to-right.

Amplitudes — Select the amplitude type for the seismic display. The near offset record may be displayed in True amplitude, Relative amplitude or Gain.

Reference — Enter the amplitude value to be used as reference for AGC amplitude scaling.

Maximum traces to display — Enter the maximum traces to display in the stack.

Horizontal scale — Enter the horizontal scale for the seismic display, with the units as specified in Horizontal Units.

Vertical scale — Enter the vertical scale for the seismic display, with the units as specified in Vertical Units.

Display gain — Enter the display gain of the seismic display.

AGC length (ms) — Enter the length of the AGC operator.

Excursion — Enter the trace excursion gain of the seismic display

1st horz anno — Select the increment of the first horizontal annotation.

2nd horz anno — Select the increment of the second horizontal annotation.

Vertical anno — Select the increment of the vertical annotation.

Major time lines — Select the increment major time lines.

Minor time lines — Select the increment minor time lines.

The **Display color scale** specifies the color scale to be used in the stack display.

Select — Select the color scale.

Display title — Enter the display title.

The **Display tab** specifies the tab where the display will be created.

Add display to a tab — If checked, add the display to a pre-existing tab.

Unique tab name — Enter the unique tab name where the display will be added.

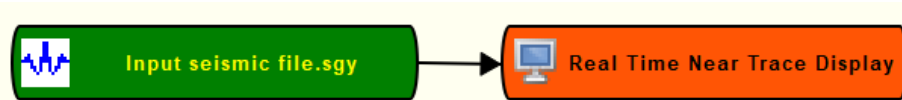
Real Time Near Trace Display

Usage: The Real Time Near Trace Display step is a real time display that allows plotting continuously the near offset trace, as defined under Channel number of the near offset group, of the current record from the input seismic data file.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled "Real Time Near Trace Display". It contains various settings for displaying seismic data. At the top, there is a text field for "Channel number of near offset group" with the value "1". Below this is a section titled "Display parameters" which includes several rows of controls: "Trace type" (Variable area wiggle), "Polarity" (Normal), "Orientation" (Right-to-left), "Amplitudes" (True), "Reference" (1.0), "Horiz scale" (24.0), "Vert scale" (4.0), "Display gain" (0.0), "AGC length (ms)" (1000.0), "Excursion" (2.0), "1st horz anno" (1), "2nd horz anno" (50), "Vertical anno" (500), "Major time lines" (500), and "Minor time lines" (100). There are also checkboxes for "Set display widthMaximum traces to display" (checked, value 200) and "Mark offsets" (unchecked, value 6). A "Display color scale" section has a "Select" button and a color wheel icon. A "Display title" text field is also present. At the bottom, there is a "Display tab" section with a checkbox for "Add display to a tab" and a text field for "Inique tab name". The dialog box has standard "OK", "Help", and "Cancel" buttons at the bottom.

Parameter Description:

Channel number of near offset group — Enter the number of the channel number corresponding to the near offset group to be plotted in real time.

The **Display parameters** specifies the display parameters used in the real time near trace display.

Trace display type — Select the type of the seismic display between Variable area wiggle or Variable density.

Polarity — Select the type of polarity for the seismic display between Normal or Reverse.

Orientation — Select the orientation of the seismic display between Right-to-left or Left-to-right.

Amplitudes — Select the amplitude type for the seismic display. The near offset record may be displayed in True amplitude, Relative amplitude or Gain control.

Reference — Enter the amplitude value to be used as reference for AGC amplitude scaling.

Maximum traces to display — Enter the maximum traces to display in the stack.

Horizontal scale — Enter the horizontal scale for the seismic display, with the units as specified in Horizontal Units.

Vertical scale — Enter the vertical scale for the seismic display, with the units as specified in Vertical Units.

Display gain — Enter the display gain of the seismic display.

AGC length (ms) — Enter the length of the AGC operator.

Excursion — Enter the trace excursion gain of the seismic display

1st horz anno — Select the increment of the first horizontal annotation.

2nd horz anno — Select the increment of the second horizontal annotation.

Vertical anno — Select the increment of the vertical annotation.

Major time lines — Select the increment for major time lines.

Minor time lines — Select the increment for minor time lines.

Set display width — If checked, sets manually the display defined by the maximum number of traces to display

Maximum traces to display — If Set display width is checked, enters the maximum number of traces to be displayed in the plot.

Mark offsets — If checked, marks the offsets on top of the seismic.

Marker size — Select the marker size for offset plot

Velocity — Enter the constant velocity to be considered in the offset calculation to be plotted.

The **Display color scale** specifies the color scale to be used in the stack display.

Select — Select the color scale.

Display title — Enter the display title.

The **Display tab** specifies the tab where the display will be created.

Add display to a tab — If checked, add the display to a pre-existing tab.

Unique tab name — Enter the unique tab name where the display will be added.

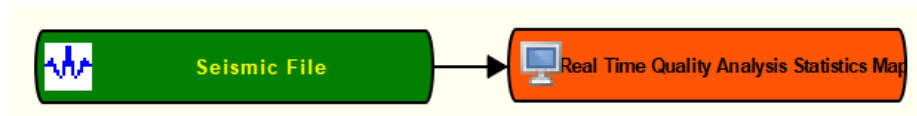
Real Time Quality Analysis Statistics Map

Usage: The Real Time Quality Analysis Statistics Map step is a real time display that allows plotting the information generated by the Signal-to-Noise Attribute (under Quality Analysis). It generates a real time map like a bar chart where the signal-to-noise ratio and dead/live flags can be plotted simultaneously for the three different signal-to-noise ratio estimates with the Signal-to-Noise Attribute.

Input Links: 1) Seismic file (mandatory). Normally this step is applied together with Signal-to-Noise Attribute for real time quality control.

Output Links: -

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled 'Real Time Data Quality Analysis'. It contains several sections for configuring the real-time display:

- Horizontal range:** Includes checkboxes for 'Manually set horizontal range' (checked) and 'Set range from SPS file(s)'. A 'Select file' button is next to the second option. Below are input fields for 'Horizontal axis min.' and 'Horizontal axis max.'.
- Trace header containing attribute for display:** Three dropdown menus are shown for 'S/N ratio average power header' (User defined 4), 'S/N ratio average RMS header' (User defined 5), and 'S/N ratio average absolute header' (User defined 6).
- Attribute color scale:** A 'Select' button followed by an empty input field.
- Map outputs:** An 'Output map file name' field containing 'C:/DATA/Documentation/Survey/' and a 'File Browse...' button.
- Display tab:** A checkbox for 'Add display to a tab' and a 'Unique tab name' input field.
- Map scale:** Four radio button options: 'Scale to fit view' (selected), 'Scale to fit dimesions', 'Scale to fit horizontal', and 'Scale to fit vertical'. To the right are input fields for 'Height (pixels)' (960) and 'Width (pixels)' (1200).
- Map title:** An empty text input field.
- Attribute label:** An empty text input field.

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

The **Horizontal range** defines the horizontal range of the map either by using user-defined minimum and maximum values or by using an auxiliary SPS geometry file.

Manually set horizontal range — If checked, the minimum and maximum horizontal ranges are user-defined and set as specified under Horizontal axis min. and Horizontal axis max. The maximum value for the horizontal coordinate will be automatically updated if the current horizontal trace header value is larger than what is pre-defined.

Horizontal axis min. — Enter minimum value of the horizontal coordinate to be displayed.

Horizontal axis max. — Enter maximum value of the horizontal coordinate to be displayed.

Set range from SPS file(s) — If checked, the minimum and maximum horizontal ranges are specified by an auxiliary SPS geometry file selected under browse button.

The **Trace header containing attribute for display** selects the trace header with the information to be colored in the real time map. With the Signal to Noise Attribute step, the user can select between the Signal-to-Noise ratio computed with the average power, average RMS and average absolute.

S/N ratio average power header — Select the trace header where the corresponding type of S/N ratio was stored by the Signal to Noise Attribute step.

S/N ratio average RMS header — Select the trace header where the corresponding type of S/N ratio was stored by the Signal to Noise Attribute step.

S/N ratio average absolute header — Select the trace header where the corresponding type of S/N ratio was stored by the Signal to Noise Attribute step.

Attribute color scale — The map of the real time display is displayed with the color scale bar as defined using the select button. By default, the information is plotted with the default color bar (rainbow).

The **Display tab** this real time display allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Map scale** defines the different types of display.

Scale to fit view — If selected, the map is automatically scaled to fit the current view.

Scale to fit dimensions — If selected, the map is automatically scaled to fit the dimensions defined by the user.

Height (in pixels) — Enter the height of the map in number of pixels.

Width (in pixels) — Enter the width of the map in number of pixels.

Scale to fit horizontal — If selected, the map is automatically scaled to fit the current view horizontally.

Scale to fit vertical — If selected, the map is automatically scaled to fit the current view horizontally.

Map title — Enter map title to be displayed in the display tab.

Attribute label — Enter attribute label.

Output map file name — Enter, or browse, the name of the file where the map is going to be saved. The map final map will be stored in a *.baf format.

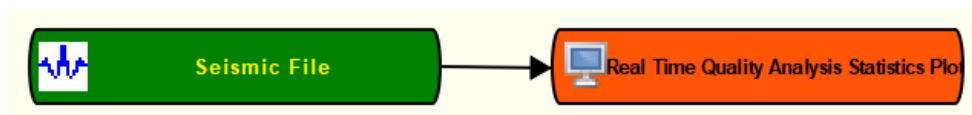
Real Time Quality Analysis Statistics Plot

Usage: The Real Time Quality Analysis Statistics Plot step is a real time display that allows plotting the information generated by the Signal to Noise Attribute step (under Quality Analysis). It generates a real time map like a line plot where the three different signal-to-noise ratio estimates, calculated with the Signal to Noise Attribute step, can be plotted simultaneously considering the nth previous records as defined in the Number of records within the moving window.

Input Links: 1) Seismic file (mandatory). Normally this step is applied together with Signal to Noise Attribute step for real time quality control.

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Real Time Data Quality Analysis Line Plot

Horizontal range

☒ Manually set horizontal range
☐ Set range from SPS file(s) Select file

Horizontal axis min. Horizontal axis max.

Display tab

☐ Add display to a tab Unique tab name

Map scale

☒ Scale to fit view Height (pixels)
☐ Scale to fit dimesions Width (pixels)
☐ Scale to fit horizontal
☐ Scale to fit vertical

Trace header containing attribute for display

S/N ratio header
S/N ratio average RMS header
S/N ratio average absolute header

Map title

Attribute color scale

Select

Attribute label

Plot statistics

☐ Plot average S/N ratio
☐ Plot median S/N ratio
☒ Plot mode S/N ratio umber of records in moving widow

Map outputs

Output map file name: File Browse...

OK Help Cancel

Parameter Description:

The **Horizontal range** defines the horizontal range of the map either by using user-defined minimum and maximum values or by using an auxiliary SPS geometry file.

Manually set horizontal range — If checked, the minimum and maximum horizontal ranges are used-defined and set as specified under Horizontal axis min. and Horizontal axis max.. The maximum value for the horizontal coordinate will be automatically updated if the current horizontal trace header value is larger than what is pre-defined.

Horizontal axis min. — Enter minimum value of the horizontal coordinate to be displayed.

Horizontal axis max. — Enter maximum value of the horizontal coordinate to be displayed.

Set range from SPS file(s) — If checked, the minimum and maximum horizontal ranges are specified by an auxiliary SPS geometry file selected under browse button.

The **Trace header containing attribute for display** selects the trace header with the information to be colored in the real time map. With the Signal to Noise Attribute step, the user can select between the Signal-to-Noise ratio computed with the average power, average RMS and average absolute.

S/N ratio header — Select the trace header where the corresponding type of S/N ratio was stored by the Signal to Noise Attribute step.

S/N ratio average RMS header — Select the trace header where the corresponding type of S/N ratio was stored by the Signal to Noise Attribute step.

S/N ratio average absolute header — Select the trace header where the corresponding type of S/N ratio was stored by the Signal to Noise Attribute step.

Map title — Enter map title to be displayed in the display tab.

Attribute color scale — The map of the real time display is displayed with the color scale bar as defined using the select button. By default, the information is plotted with the default color bar (rainbow).

The **Display tab** allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Map scale** the real time map can be plotted using different types of display.

Scale to fit view — If selected, the map is automatically scaled to fit the current view.

Scale to fit dimensions — If selected, the map is automatically scaled to fit the dimensions defined by the user.

Height (in pixels) — Enter the height of the map in number of pixels.

Width (in pixels) — Enter the width of the map in number of pixels.

Scale to fit horizontal — If selected, the map is automatically scaled to fit the current view horizontally.

Scale to fit vertical — If selected, the map is automatically scaled to fit the current view vertically.

The **Plot statistics** specifies the current signal to noise attribute along with the selected statistical measurement of the nth previous records as defined in the Number of records in moving window.

Plot average S/N ratio — If selected, plot the average of the S/N ratio in the records moving window.

Plot median S/N ratio — If selected, plot the median of the S/N ratio in the records moving window.

Plot mode S/N ratio — If selected, plot the mode of the S/N ratio in the records moving window.

Number of records in moving window — Enter the number of records in the moving window considered to compute the attribute.

Attribute label — Enter attribute label.

Output map file name — Enter, or browse, the name of the file where the map is going to be saved. The map final map will be stored in a *.baf format.

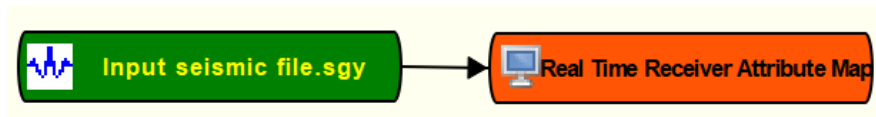
Real Time Receiver Attribute Map

Usage: The Real Time Receiver Attribute Map step builds a real time map of the locations of receivers colored by a given receiver attribute for each record. Often this step is used with Amplitude Analysis step (under Quality Analysis).

Input Links: 1) Seismic file (mandatory). Normally this step is applied together with Amplitude Analysis step for real time quality control.

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Trace header containing attribute** specifies the header value defined under the Trace header to be plotted where the attribute is stored.

Trace header — Select trace header to be used as colored attribute for the real time map.

The **Display tab** this real time display allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Coordinate reference system** defines the coordinate systems to be used for the real time map.

Acquisition — If selected, use relative coordinates from the acquisition geometry.

Geographic — If selected, use real world coordinates.

The **Multichannel attribute composition** specifies the attribute to be plotted regarding the data received at each active channel group.

RMS amplitude — If selected, plots the RMS amplitude as defined in the Amplitude Analysis step.

Median magnitude — If selected, plots the median magnitude as defined in the Amplitude Analysis step.

Average magnitude — If selected, plots the average magnitude as defined in the Amplitude Analysis step.

Maximum magnitude — If selected, plots the maximum magnitude as defined in the Amplitude Analysis step.

The **Map scale** defines the different types of display.

Scale to fit view — If selected, the map is automatically scaled to fit the current view.

Scale to fit dimensions — If selected, the map is automatically scaled to fit the dimensions defined by the user.

Height (in pixels) — Enter the height of the map in number of pixels.

Width (in pixels) — Enter the width of the map in number of pixels.

Fixed scale — Enter the fixed scale of the map to be display.

Scale to fit vertical — If selected, the map is automatically scaled to fit the current view vertically.

Scale to fit horizontal — If selected, the map is automatically scaled to fit the current view horizontally.

Map title — Enter map title to be displayed in the display tab.

Attribute label — Enter attribute label.

The **Reference locations** specify the reference spatial location in order to plot the location of each channel group. These reference locations are updated if during the survey the objects to be displayed are outside the pre-defined area.

Initialize receiver locations from SPS file(s) — If checked, the reference locations are loaded directly from a SPS geometry file. More than one SPS files may be used to define the reference locations.

Add file — Select to browse for a SPS file to be used as reference locations. The SPS file will automatically be scanned and added to the nearby box. The reference location may be defined with more than one file. In this case Horizontal axis min, Horizontal axis max, Vertical axis min, Vertical axis max are automatically filled in according to the SPS files.

Remove file — The SPS file highlighted in the nearby box is going to be removed and the reference locations updated accordingly.

Horizontal axis min — Enter minimum value of the horizontal coordinate to be displayed.

Horizontal axis max — Enter maximum value of the horizontal coordinate to be displayed.

Vertical axis min — Enter minimum value of the vertical coordinate to be displayed.

Vertical axis max — Enter maximum value of the vertical coordinate to be displayed.

The **Background image** specifies the background image with cultural data.

Display background image on receiver spread — If checked the real time map uses a background image of the area.

Load image — Select to browse for the image file to be used as background image. The image file is automatically loaded and added to the box nearby.

Configure — Select to configure the coordinates of the background image.

Unload image — Select if you want to unload the background image from the real time map.

Loaded — Automatically checked if the background image was loaded successfully.

Configured — Automatically checked if the background images was configured successfully.

Attribute Color scale — The map of the real time display is displayed with the color scale bar as defined using the Select button. By default, the information is plotted with the default color bar (rainbow).

Map Output file name — Enter, or browse, the name of the file where the map is going to be saved. The map final map will be stored in a *.baf format.

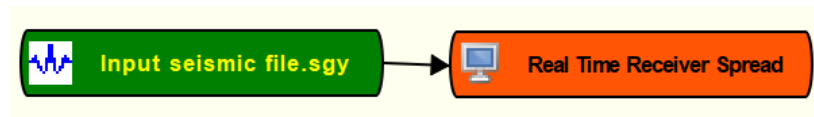
Real Time Receiver Spread

Usage: The Real Time Receiver Spread processing step is a real time map that allows plotting the location of each channel group color coded by an acceptance criterion (green if true, red if false) based on a trace header key. This real time map is normally used to plot active and dead receiver locations.

Input Links: 1) Seismic file (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Trace header to monitor containing receiver status** defines the trace header where the receiver status is being stored.

Monitor header — Select trace header to be used as monitor header.

The **Display tab** this real time display allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Receiver acceptance criteria** specifies the logical operator that you want to use as acceptance criteria. This logical operator is going to be applied to the selected monitor header.

Monitor header — Select the trace header key to monitor. Enter the value for the acceptance criteria.

The **Coordinate reference system** defines the coordinate systems to be used for the real time map.

Acquisition — Use relative coordinates from the acquisition geometry.

Geographic — Use real world coordinates.

The **Map scale** defines the different types of display.

Scale to fit view — If selected, the map is automatically scaled to fit the current view.

Scale to fit dimensions — If selected, the map is automatically scaled to fit the dimensions defined by the user.

Height (in pixels) — Enter the height of the map in number of pixels.

Width (in pixels) — Enter the width of the map in number of pixels.

Fixed scale — Enter the fixed scale of the map to be display.

Scale to fit vertical — If selected, the map is automatically scaled to fit the current view vertically.

Scale to fit horizontal — If selected, the map is automatically scaled to fit the current view horizontally.

Map title — Enter map title to be displayed in the display tab.

Attribute label — Enter attribute label.

The **Reference locations** specifies the reference spatial location in order to plot the location of each channel group. These reference locations are updated if during the survey the objects to be displayed are outside the pre-defined area.

Initialize receiver locations from SPS file(s) — If checked, the reference locations are loaded directly from a SPS geometry file. More than one SPS files may be used to define the reference locations.

Add file — Select to browse for a SPS file to be used as reference locations. The SPS file will automatically be scanned and added to the nearby box. The reference location may be defined with more than one file. In this case Horizontal axis min, Horizontal axis max, Vertical axis min, Vertical axis max are automatically filled in according to the SPS files.

Remove file — The SPS file highlighted in the nearby box is going to be removed and the reference locations updated accordingly.

Horizontal axis min — Enter minimum value of the horizontal coordinate to be displayed.

Horizontal axis max — Enter maximum value of the horizontal coordinate to be displayed.

Vertical axis min — Enter minimum value of the vertical coordinate to be displayed.

Vertical axis max — Enter maximum value of the vertical coordinate to be displayed.

The **Background image** specifies the background image with cultural data.

Display background image on receiver spread — If checked, the real time map uses a background image of the area.

Load image — Select to browse for the image file to be used as background image. The image file is automatically loaded and added to the box nearby.

Configure — Select to configure the coordinates of the background image.

Unload image — Select if you want to unload the background image from the real time map.

Loaded — Automatically checked if the background image was loaded successfully.

Configured — Automatically checked if the background images was configured successfully.

Ready for use — Automatically checked if the background images is ready for use.

Attribute Color scale — The map of the real time display is displayed with the color scale bar as defined using the Select button. By default, the information is plotted with the default color bar (rainbow).

Map Output file name — Enter, or browse, the name of the file where the map is going to be saved. The map final map will be stored in a *.baf format.

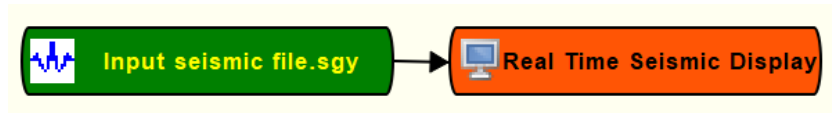
Real Time Seismic Display

Usage: The Real Time Seismic Display step is used to display seismic records during the processing flow. It also can output image files and automatically ftp these image files to a server on an active internet connection.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Real Time Seismic Display' and contains several sections of controls:

- Display increment:** A text field for 'Record increment between displays' with the value '1'. Below it are three checkboxes: 'Also display all records killed during processing', 'Only display records killed during processing', and 'Mark dead traces'.
- Display tab:** A checkbox 'Add display to a tab' followed by a text field 'Inique tab name'.
- Image output:** A checkbox 'Output image files' and a checkbox 'Send via ftp'. Below these are 'Image format' (JPG), 'Image increment' (1), 'Image quality' (Medium), and 'Output colorbar' (No).
- Display parameters:** A section with multiple controls:
 - Trace display type: Variable area wiggly
 - Trace polarity: Normal
 - Orientation: Right-to-left
 - Horizontal scale: 24.0, Horizontal units: Traces/in
 - Vertical scale: 4.0, Vertical units: In/sec
 - Display gain: 0.0, Amplitude type: True
 - Trace excursion: 2.0, Window (ms): 1000.00
 - 1st horz anno: 1.0, Major timing lines: 1000.0
 - 2nd horz anno: 20.0, Minor timing lines: 200.0
 - Vertical anno: 200.0
- Real time options:** Checkboxes for 'Plot signal and noise windows' and 'Mark offsets'. 'Marker size' is 6, and 'Velocity' is 1500. Below are two text fields for 'Select signal polygo' and 'Select noise polygo', each with a 'File Browse...' button.
- Display title:** A text field.
- Display color scale:** A 'Select' button, a text field, and a color wheel icon.

At the bottom are 'OK', 'Help', and 'Cancel' buttons.

Parameter descriptions:

The **Display increment** specifies if the real time display plots the input seismic data along with either killed records during the processing selecting, using a given increment between records, or the records killed by the processing.

Record increment between displays — Enter the increment between records to be plotted in the real time display. If **Only display records killed during processing** is selected this option is disabled.

Also display records killed during processing — If checked, plot with the input seismic file the records killed during the processing.

Only display records killed during processing — If checked, plot only records that have been killed by the processing.

Mark dead traces — If checked, plot dead traces in red.

The **Display tab** this real time display allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Image output** specifies if plots are automatically saved and the format.

Output image files — If checked, the display of the real time display is stored in an image file.

Send via ftp — If checked, the image output is sent directly via FTP.

Image format — Select the image format. The image may be stored in BMP, JPG or PNG.

Image quality — Select the quality of the output image. The output image may be saved with Low, Medium or High quality.

Image increment — Select, from 1 to 10, the increment between records that is going to be used to save the image.

Output colorbar — Select if the colorbar is saved within the image.

The **Display parameters** define the parameters related to the real time of the near offset trace.

Trace display type — Select the type of the seismic display. The user can select between Variable area wiggle or Variable density.

Trace polarity — Select the type of polarity for the seismic display. The user can select between Normal or Reverse.

Orientation — Select the orientation of the seismic display. The user can select between Right-to-left or Left-to-right.

Horizontal scale — Enter the horizontal scale for the seismic display, with the units as specified in Horizontal Units.

Horizontal units — Select the horizontal units to be used for the Horizontal scale. Units can be defined in Traces per inch or Traces per cm.

Vertical scale — Enter the vertical scale for the seismic display, with the units as specified in Vertical Units.

Vertical units — Select the horizontal units to be used for the Vertical scale. Units can be defined in inch per second or centimeter per second.

Display gain — Enter the display gain of the seismic display.

Trace excursion — Enter the trace excursion gain of the seismic display.

1st horz anno — Select the increment of the first horizontal annotation.

2nd horz anno — Select the increment of the second horizontal annotation.

Vertical anno — Select the increment of the vertical annotation.

Amplitude type — Select the amplitude type for the seismic display. The near offset record may be displayed in True amplitude, Relative amplitude or Gain control with a window size defined in Window.

Window (ms) — Enter the window size in ms for Gain control.

Major timing lines — Select the increment major time lines.

Minor timing lines — Select the increment minor time lines.

The **Real time options** specify a noise and/or signal window, represented by a rectangle, may be plotted overlaying the current seismic record.

Plot signal and noise windows — If checked, plot overlaying the real time seismic display a polygon representing signal and noise windows. Signal window is plotted in green while noise window is plotted in red.

Mark offsets — If checked, plot offsets.

Marker size — Select the marker size used for offset plotting.

Velocity — Enter velocity to plot offsets.

Select signal polygon — Enter signal polygon card file location.

Select noise polygon — Enter noise polygon card file location.

Display title — Enter the display title.

The **Display color scale** specifies the color scale to be used in the stack display.

Select — Select the color scale.

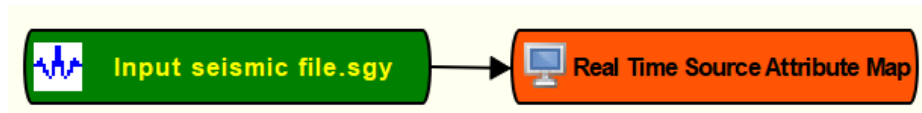
Real Time Source Attribute Map

Usage: The Real Time Source Attribute Map step is used to display maps of source attributes (e.g., amplitudes) during the processing flow.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Real Time Attribute Map

Trace header containing attribute
Trace header: User defined 1

Display tab
☐ Add display to a tab
Unique tab name:

Coordinate reference system
☐ Acquisition ☒ Geographic

Multichannel attribute composition
☒ RMS amplitude ☐ Average magnitude
☐ Median magnitude ☐ Maximum magnitude

Map scale
☒ Scale to fit view Height (pixels): 960
☐ Scale to fit dimensions Width (pixels): 1200
☐ Scale to fit vertical Fixed scale: 10
☐ Scale to fit horizontal

Map title:

Attribute label:

Map output
Output file name: C:/DATA/Documentation/Survey/ File Browse...

Reference locations
☐ Initialize source locations from SPS file(s)
Add file Remove file
File name
Horizontal axis min Horizontal axis max
Vertical axis min Vertical axis max

Background image
☐ Display background image on receiver spread
Load image Configure Unload image
☐ Loaded ☐ Configured

Attribute color scale
Select [Color bar] [Color selection icon]

OK Help Cancel

Parameter descriptions:

The **Trace header containing attribute** specifies the header value defined under the Trace header be used as horizontal axis.

Trace header — Select trace header to be used as colored attribute for the real time map.

The **Display tab** this real time display allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Coordinate reference system** defines the coordinate systems to be used for the real time map.

Acquisition — If selected, use relative coordinates from the acquisition geometry.

Geographic — If selected, use real world coordinates.

The **Multichannel attribute composition** specifies the attribute to be plotted regarding the data received at each active channel group.

RMS amplitude — If selected, plots the RMS amplitude as defined in the Amplitude Analysis step.

Median magnitude — If selected, plots the median magnitude as defined in the Amplitude Analysis step.

Average magnitude — If selected, plots the average magnitude as defined in the Amplitude Analysis step.

Maximum magnitude — If selected, plots the maximum magnitude as defined in the Amplitude Analysis step.

The **Map scale** defines the different types of display.

Scale to fit view — If selected, the map is automatically scaled to fit the current view.

Scale to fit dimensions — If selected, the map is automatically scaled to fit the dimensions defined by the user.

Height (in pixels) — Enter the height of the map in number of pixels.

Width (in pixels) — Enter the width of the map in number of pixels.

Scale to fit horizontal — If selected, the map is automatically scaled to fit the current view horizontally.

Scale to fit vertical — If selected, the map is automatically scaled to fit the current view vertically.

Map title — Enter map title to be displayed in the display tab.

Attribute label — Enter attribute label.

The **Reference locations** specifies the reference spatial location in order to plot the location of each channel group. These reference locations are updated if during the survey the objects to be displayed are outside the pre-defined area.

Initialize source locations from SPS file(s) — If checked, the reference locations are loaded directly from a SPS geometry file. More than one SPS files may be used to define the reference locations.

Add file — Select to browse for a SPS file to be used as reference locations. The SPS file will automatically be scanned and added to the nearby box. The reference location may be defined with more than one file. In this case Horizontal axis min, Horizontal axis max, Vertical axis min, Vertical axis max are automatically filled in according to the SPS files.

Remove file — The SPS file highlighted in the nearby box is going to be removed and the reference locations updated accordingly.

Horizontal axis min — Enter minimum value of the horizontal coordinate to be displayed.

Horizontal axis max — Enter maximum value of the horizontal coordinate to be displayed.

Vertical axis min — Enter minimum value of the vertical coordinate to be displayed.

Vertical axis max — Enter maximum value of the vertical coordinate to be displayed.

The **Background image** specifies the background image with cultural data.

Display background image on source spread — If checked the real time map uses a background image of the area.

Load image — Select to browse for the image file to be used as background image. The image file is automatically loaded and added to the box nearby.

Configure — Select to configure the coordinates of the background image.

Unload image — Select if you want to unload the background image from the real time map.

Loaded — Automatically checked if the background image was loaded successfully.

Configured — Automatically checked if the background images was configured successfully.

Attribute Color scale — The map of the real time display is displayed with the color scale bar as defined using the Select button. By default, the information is plotted with the default color bar (rainbow).

Map Output file name — Enter, or browse, the name of the file where the map is going to be saved. The map final map will be stored in a *.baf format.

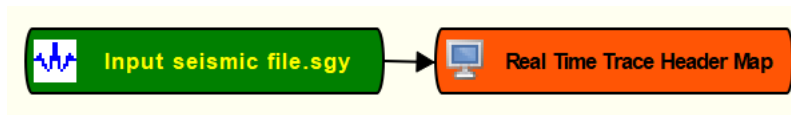
Real Time Trace Header Map

Usage: The Real Time Trace Header Map step creates a real time map with the trace location colored by an user-defined attribute as stored in each trace header.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Real Time Trace Header Map

Trace header containing horizontal coordinate
Trace header: Field file

Horizontal range
☐ Manually set horizontal range
☐ Set range from SPS file(s) Select file
Horizontal axis min. Horizontal axis max.

Trace header containing vertical coordinate
Trace header: Channel

Vertical range
☐ Manually set vertical range
☐ Set range from SPS file(s) Select file
Vertical axis min. Vertical axis max.

Attribute color scale
Select

Trace header containing attribute
Trace header: User defined 1

Display tab
☐ Add display to a tab Unique tab name

Map scale
☒ Scale to fit view Width (pixels)
☐ Scale to fit horizontal Height (pixels)
☐ Scale to fit dimenions
☐ Scale to fit vertical

Map title

Attribute label

Map output
Output file name: File Browse...

OK Help Cancel

Parameter Description:

The **Trace header containing horizontal coordinate** specifies the header value defined under the Trace header be used as horizontal axis.

Trace header — Select trace header to be used as horizontal coordinate.

The **Horizontal range** defines the horizontal range of the map either by using user-defined minimum and maximum values or by using an auxiliary SPS geometry file.

Manually set horizontal range — If checked, the minimum and maximum horizontal ranges are used-defined and set as specified under Horizontal axis min. and Horizontal axis max.. The maximum value for the horizontal coordinate will be automatically updated if the current horizontal trace header value is larger than what is pre-defined.

Set range from SPS file(s) — If checked, the minimum and maximum horizontal ranges are specified by an auxiliary SPS geometry file selected under browse button.

Horizontal axis min. — Enter minimum value of the horizontal coordinate to be displayed.

Horizontal axis max. — Enter maximum value of the horizontal coordinate to be displayed.

The **Trace header containing vertical coordinate** specifies the header value defined under the Trace header be used as vertical axis.

Trace header — Select trace header to be used vertical coordinate.

The **Vertical range** defines the vertical range of the map either by using user-defined minimum and maximum values or by using an auxiliary SPS geometry file.

Manually set vertical range — If checked, the minimum and maximum vertical ranges are used-defined and set as specified under Vertical axis min. and Vertical axis max. The maximum value for the vertical coordinate will be automatically updated if the current vertical trace header value is larger than what is pre-defined.

Set range from SPS file(s) — If checked, the minimum and maximum vertical ranges are specified by an auxiliary SPS geometry file selected under browse button.

Vertical axis min. — Enter minimum value of the vertical coordinate to be displayed.

Vertical axis max. — Enter maximum value of the vertical coordinate to be displayed.

Attribute color scale — The map of the real time display is displayed with the color scale bar as defined using the Select button. By default, the information is plotted with the default color bar (rainbow).

The **Trace header containing attribute for display** selects the trace header with the information to be colored in the trace header map. For example, with the Spectral Comparison step, we can select either the spectral semblance value of the dead/live flag.

Trace header — Select trace header to be used as attribute (color).

The **Display tab** this real time display allows plotting simultaneously more than one map within the same tab view. This is a useful option to plot, for example, the value of the spectral semblance along with the dead/live flag.

Add display to a tab — If checked, the map is added to a display tab already open.

Unique tab name — Enter unique tab name where the map is going to be displayed.

The **Map scale** the real time map can be plotted using different types of display.

Scale to fit view — If selected, the map is automatically scaled to fit the current view.

Scale to fit horizontal — If selected, the map is automatically scaled to fit the current view horizontally.

Scale to fit dimensions — If selected, the map is automatically scaled to fit the dimensions defined by the user.

Height (in pixels) — Enter the height of the map in number of pixels.

Width (in pixels) — Enter the width of the map in number of pixels.

Scale to fit vertical — If selected, the map is automatically scaled to fit the current view vertically.

Map title — Enter the map title to be displayed in the display tab

Attribute label — Enter attribute label.

Output map file name — Enter, or browse, the name of the file where the map is going to be saved. The map final map will be stored in a *.baf format.

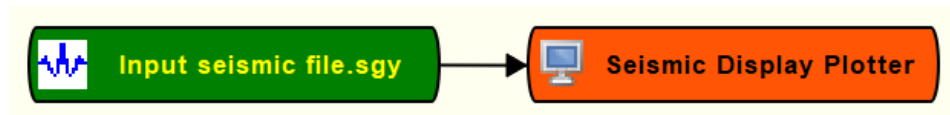
Seismic Display Plotter

Usage: The Seismic Display Plotter step is a real time display that allows plotting continuously seismic data in different sort order.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: -

Example Flowchart:



Step Parameter Dialog:

Seismic Plotter
?
×

Trace type
Variable area wiggle
Polarity
Normal
Orientation
Right-to-left
Amplitudes
True
Dead Traces
UnMarked

Horiz scale
24.0
Vert scale
4.0
Display gain
0.0
AGC length (ms)
1000.0
Excursion
2.0

1st horz anno
1
2nd horz anno
20
Vertical anno
200
Major time lines
1000
Minor time lines
200

Color scale
grayscale.xml
Suffix

☐ Sort Data By
None
☐ Limit Data By
None
Accepted Value
0
☐ Record Plotting interval
1

☐ Time Limit
0
0
☐ Offset Limit
0
0
☐ Apply LMO/Shift
1500
0
☐ Remove DC Bias

☐ Plot trace headers on top of the seismic
-
+

Trace header	Type	Color	size

OK
Help
Cancel

Parameter Description:

Trace type — Select the type of the seismic display between Variable area wiggle or Variable density.

Polarity — Select the type of polarity for the seismic display between Normal or Reverse.

Orientation — Select the orientation of the seismic display between Right-to-left or Left-to-right.

Amplitudes — Enter the amplitude value to be used as reference for AGC amplitude scaling.

Dead Traces — Select if seismic traces flagged as dead are marked or unmarked in the plot.

Horiz scale — Enter the horizontal scale for the seismic display.

Vert scale — Enter the vertical scale for the seismic.

Display gain — Enter the display gain of the seismic display.

AGC length (ms) — Enter the length of the AGC operator.

Excursion — Enter the trace excursion gain of the seismic display

1st horz anno — Select the increment of the first horizontal annotation.

2nd horz anno — Select the increment of the second horizontal annotation.

Vertical anno — Select the increment of the vertical annotation.

Major time lines — Select the increment major time lines.

Minor time lines — Select the increment minor time lines.

Color scale — Select the color scale.

Suffix — Enter a suffix to be used in image storage and tab name.

Sort data by — If checked, sort data into a specific domain before plotting.

Limit data by — If checked, limit plotting by a trace header word and the accepted value.

Accepted Value — Enter the value to be used to limit the input data.

Record Plotting interval — If checked, enter the record interval to be used in the plotting.

Time Limit — If checked, limit the start and end time of the data to be displayed.

Offset Limit — If checked, limit the start and end offset of the data to be displayed.

Apply LMO/Shift — If checked, enter a constant velocity to be used as linear moveout and a value in ms to define a bulk shift.

Remove DC Bias — If checked, apply a remove DC bias filter.

Plot trace headers on top of the seismic — If checked, allows selecting trace header words to be plotted on top of the seismic during the real time display.

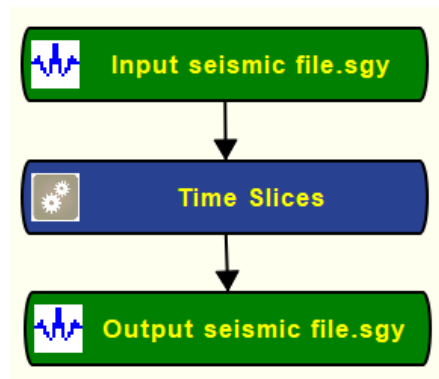
Time Slices

Usage: Time Slices is a process used for either display of selected time slices as a display option, or as a tool to convert the data into a form suitable for specific processing.

Input Links: 1) Seismic data in sorted by CMP Line (record key) and CMP Location (mandatory).

Output Links: 1) Seismic data sorted by Slice Number and CMP Line (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a 'Time Slices' dialog box with the following settings:

- Data selection:**
 - ☒ All input data
 - ☐ Selected time slices
- Time Slice selection:**
 - Time of first slice (ms): 100
 - Time of last slice (ms): 2000
 - Time slice increment (ms): 100
- Attribute slices:**
 - ☐ Create RMS amplitude slices
 - Samples above slice: 0
 - Samples below slice: 0

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Data selection** specifies the type of input data for time slice calculation.

All input data — If checked, time slices will be made from all the data. This is likely to be the most suitable option for further processing of the data.

Selected time slices — If checked, those time slices specified by the following parameter values will be output. This is likely to be the best data display option.

Time of first slice (ms) — The first slice output will be drawn from the data samples at the specified time.

Time of last slice (ms) — The last slice output will be drawn from the data samples at the specified time.

Time slice increment (ms) — Time slices will be output with the specified time increment (to the nearest sample).

Create RMS amplitude slices — If checked, each output time slice sample value will be the root mean square value of all the specified samples above and below that sample.

Samples above slice — The number of samples above each output slice sample that will be used to calculate the RMS amplitude.

Samples below slice — The number of samples below each output slice sample that will be used to calculate the RMS amplitude.

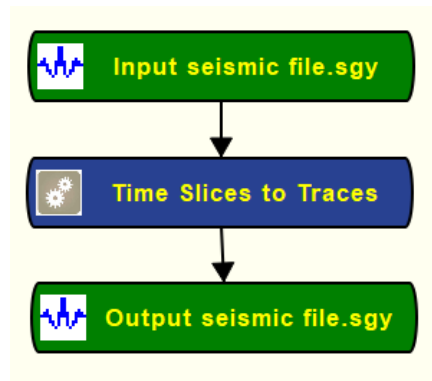
Time Slices to Traces

Usage: Time Slices to Traces is a process used to convert time slices required for some specific processes such as PSPI Migration and Footprint Filter back into the standard time trace domain data.

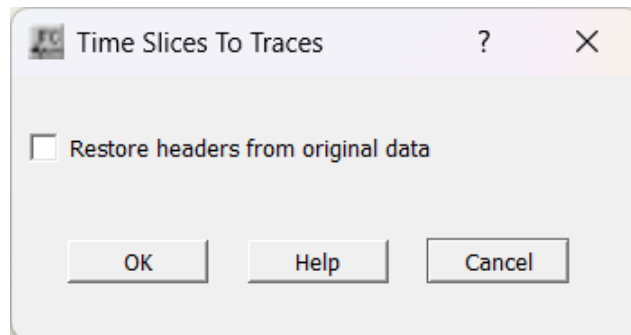
Input Links: 1) Seismic data in sorted by CMP Line (record key) and Slice Number (mandatory); 2) 'Original' seismic data CMP Line (record key) and CMP Location (3D) or CMP (2D) (optional).

Output Links: 1) Seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Restore headers from original data — If checked, a secondary input data stream will be required, sorted by CMP Line (record key) and CMP Location (3D) or CMP (2D) (example flowchart b). This secondary input data will be used to supply the headers to be

attached to the output data, and the data extent must be set to match the extent of the output data.

Editing Steps

This section documents the processing steps available in the Editing Steps category.

Processing steps currently available are:

	Phase Rotation
Editing	Real Time Gathers
↑ Processing Categories	Remove DC Bias
3D Missing Data Interpolation	Remove Reverberation
Automatic Amplitude Edit	Resample Seismic
Automatic Trace Edit	Reverse Traces
Coherent Noise Attenuation	Revive Dead Traces
Dataset Compare	S/N Based Record Edits
Dataset Math	Trace Header Averaging
Despike	Trace Header Calculation
Dominant Frequency Edits	Trace Header Logic
F-X Trace Interpolation	Trace Header Math
Frequency Trace Edits	Trace Header Resequencing
Interpolate Dead Traces	Trace Sample Math
Kill Traces	Vibroseis Correlation

3D Missing Data Interpolation

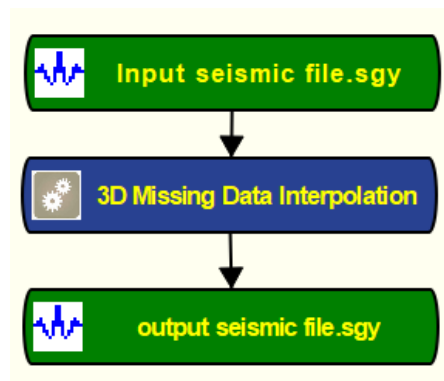
Usage: 3D Missing Data Interpolation is a fast and pragmatic way to fill missing traces by means of inverse-distance weighted interpolation from near traces.

For 3D pre-stack interpolation of missing data, the data should be ordered as 3D common offset gathers, so that (binned) Offset is the primary key, CMP Line the secondary and record key, and CMP location the tertiary key.

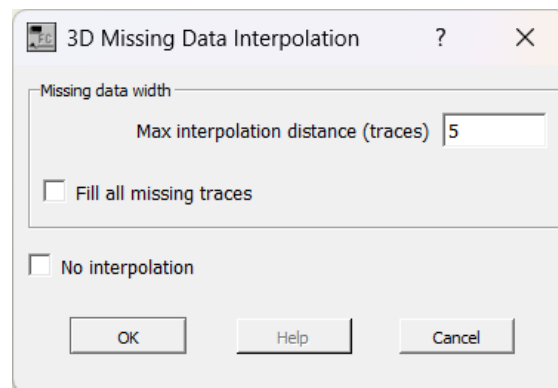
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Missing data width** defines the maximum distance, in m or ft, for interpolation and what happens to traces outside the region of interest.

Max interpolation distance (traces) — Enter the maximum distance in traces for the near-neighbors of a missing trace to be located.

Fill all missing traces — If checked, any traces that are outside the specified Max interpolation distance from live traces will be filled by using the values of the nearest trace.

No interpolation — If checked, no interpolation of missing data will be performed.

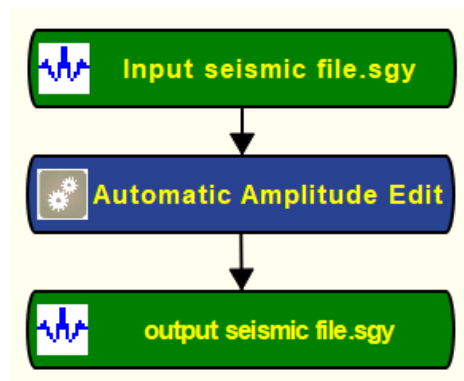
Automatic Amplitude Edit

Usage: The Automatic Amplitude Edit step allows to flag traces dead or alive based on the RMS amplitude content of a group of traces.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Automatic edit using amplitude'. It contains two input fields: 'Number of traces in running average' with the value '7' and 'Percentage change in RMS amplitude' with the value '50'. Below these is a section titled 'Editing action' with three radio button options: 'Only mark low amplitude traces as dead' (selected), 'Only mark high amplitude traces as dead', and 'Mark both low and high amplitude traces as dead'. At the bottom are 'OK', 'Help', and 'Cancel' buttons.

Parameter Description:

Number of traces in running average — Enter the number of traces in the moving window where the RMS amplitude is going to be computed.

Percentage change in RMS amplitude — Enter the percentage change in RMS amplitude to consider the traces dead of live.

The **Editing action** allows selecting how seismic traces are marked based on the RMS amplitude content of a group of traces within a moving window.

Only mark low amplitude traces as dead — If selected, low RMS amplitude traces are marked as dead.

Only mark high amplitude traces as dead — If selected, high RMS amplitude traces are marked as dead.

Mark both low and high amplitude traces as dead — If selected, both low and high RMS amplitude traces are marked as dead.

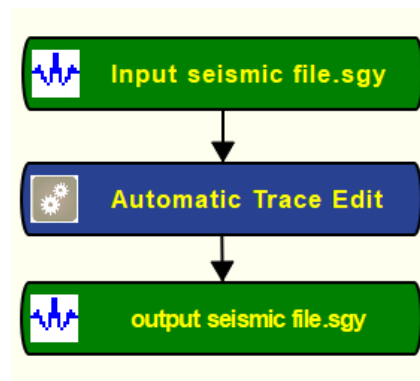
Automatic Trace Edit

Usage: The Automatic Trace Edit step allows to automatically remove invalid or noisy traces from the seismic data set based on user-defined criteria.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Automatic Trace Edit

Trace edit method

☒ Spectral semblance ☐ Power ratio

☐ Both methods ☐ Either method

Spectral semblance cutoff value (percent)

Use header location to output spectral semblance

☐ Calculate spectral semblance on receiver line basis

☐ Calculate spectral semblance using a time window

Spectral semblance window

Start time in ms of the window

End time in ms of the window

Filtering

☐ Apply low-cut filter

Low-cut corner frequency (Hz)

Low-cut rolloff rate (dB/oct)

☐ Apply high-cut filter

High-cut corner frequency (Hz)

High-cut rolloff rate (dB/oct)

Power ratio decay cutoff (dB)

☐ Define top window for power ratio

Top window power ratio parameters

Start time in ms of the top window

End time in ms of the top window

☐ Apply moveout velocity

☐ Define bottom window for power ratio

Bottom window power ratio parameters

Start time in ms of the bottom window

End time in ms of the bottom window

☐ Apply moveout velocity

☐ Output kills to Trace Edit auxiliary file

Parameter Description:

The **Trace edit method** selects the analysis method(s) to be used to determine if a trace will be killed.

Spectral semblance — The spectral semblance method uses the semblance between a single trace's power spectrum and the average power spectrum of the gather as the basis for killing a trace.

Power ratio — The power ratio method uses the ratio of trace energy in the upper part of a trace to that in the lower part of a trace as the basis for killing a trace. This is often an effective means of editing traces that are contaminated with 60 Hz powerline noise, which does not decay as a function of record time.

Both methods — Traces will be killed only if they fail BOTH the power ratio test AND the spectral semblance test.

Either method — Traces will be killed if they fail EITHER the power ratio test OR the spectral semblance test.

Spectral semblance cutoff value (percent) — Enter the percentage threshold in the spectral semblance to consider a dead/live trace.

Trace header location to output spectral semblance — Select the location of the trace header word to store the computed spectral semblance value.

Calculate spectral semblance on receiver line basis — If checked, the spectral semblance will be calculated on a receiver line basis.

Calculate spectral semblance using a time window — If checked, spectral semblance is computed within a time gate defined by its top and base in ms.

The **Spectral semblance window** defines the start and end time of the time window where the spectral semblance is calculated.

Start time in ms of the window — Enter the start time of the window to compute the spectral semblance. Time in ms.

End time in ms of the window — Enter the end time of the window to compute the spectral semblance. Time in ms.

The **Filtering** defines a filter applied before the calculation

Apply low-cut filter – If checked, applies a low-filter to the data.

Low-cut corner frequency (Hz) – Enter the low-cut corner frequency of the filter.

Low-cut rolloff rate (dB/oct) – Enter the slope of the low-cut filter.

Apply High-cut filter – If checked, applies a high-filter to the data.

High-cut corner frequency (Hz) – Enter the high-cut corner frequency of the filter.

High-cut rolloff rate (dB/oct) – Enter the slope of the high-cut filter.

Power ratio decay cutoff (dB) — If the power ratio method is selected, enter the expected minimum decay of trace energy in decibels between the first and second half of the trace.

Define top window for power ratio — Enabled if Power ratio option is selected. If checked, select parameters to define the top window where the calculation is done.

The **Top window power ratio parameters** define the start and end time of the top time window where the power ratio is calculated.

Start time in ms of the top window — Enter the start time of the window in milliseconds to compute the power ratio. {>=0}

End time in ms of the top window — Enter the end time of the window in milliseconds to compute the power ratio. {>=0}

Apply moveout velocity — If selected, the normal moveout correction with a constant velocity is applied to the record before computing the power ratio. Enter the velocity for the normal moveout correction. {>=0}

Define bottom window for power ratio — Enabled if Power ratio option is selected. If checked, select parameters to define the bottom window where the calculation is done.

The **Bottom window power ratio parameters** defines the start and end time of the bottom time window where the power ratio is calculated.

Start time in ms of the bottom window — Enter the start time of the window in milliseconds to compute the power ratio. {>=0}

End time in ms of the bottom window — Enter the end time of the window in milliseconds to compute the power ratio. {>=0}

Apply moveout velocity — If selected, the normal moveout correction with a constant velocity is applied to the record before computing the power ratio. Enter the velocity for the normal moveout correction.

Output kills to Trace Edit auxiliary file — If selected outputs killed traces based on the selected measurement to an auxiliary file.

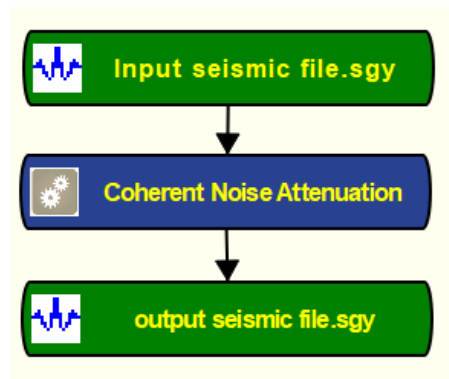
Coherent Noise Attenuation

Usage: The Coherent Noise Attenuation step edit coherent noise between adjacent traces based on variations (in percentage) of the seismic amplitudes within a time trace window.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 2) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Coherent Noise Attenuation'. It features three input fields: 'Trace window length (ms.)' with a value of 50, 'Maximum trace amplitude variation (%)' with a value of 300, and 'Gap between traces to compare' with a value of 2. Below these fields is a section titled 'Outlier replacement options' containing two radio buttons: 'Set to average of adjacent samples' (which is selected) and 'Set to zero'. At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Trace window length (ms) — Enter the length of the window, in milliseconds , where the estimation of the reference amplitude is calculated.

Maximum trace amplitude variation (%) — Enter the maximum trace amplitude variation, in percentage, to consider a given sample noise.

Gap between traces to compare — Enter the number of traces to skip for trace comparison.

The **Outlier replacement options** defines what happens to seismic samples considered noise.

Set to average of adjacent samples — If selected, the values of the seismic samples considered noise are replaced by the average value of adjacent samples.

Set to zero — If selected, the value of the seismic samples considered noise are set to zero.

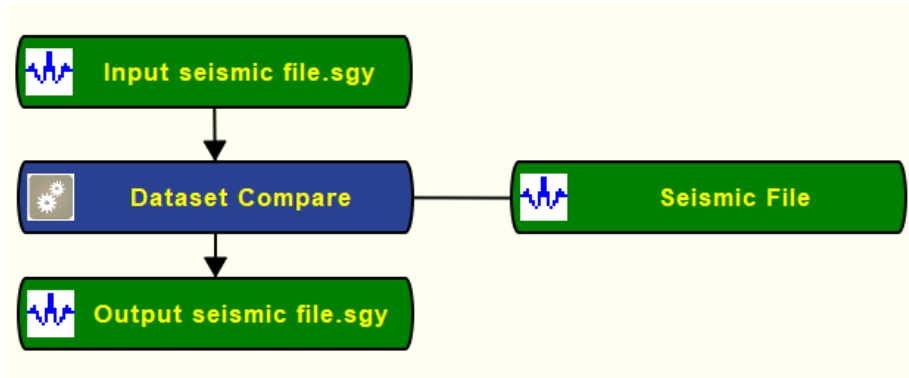
Dataset Compare

Usage: The Dataset Compare step compares two seismic data files in terms of header and data information.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data in any sort order (mandatory) – must match the first dataset.

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Dataset Compare' dialog box contains the following parameters:

- ☐ Check data values: Maximum records to check
- ☐ Check All Headers: Max trace % variation
- ☐ Check a specific trace header: Trace header to check
- ☐ Save differences to output header: Maximum value variation

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Maximum records to check — Enter the number of records to be compared.

Check data values — If checked, data are compared in terms of amplitude values.

Max trace % variation — If Check data values is checked, enter the threshold for maximum variation allowed in percentage.

Check All headers — If checked, all headers are compared.

Check a specific trace header — If checked, a single trace header is compared.

Trace header to check — Select trace header word to be compared.

Maximum value variation — To enter the maximum value variation allowed.

Save differences to output header — If checked, the difference between headers will be stored in the selected trace header location.

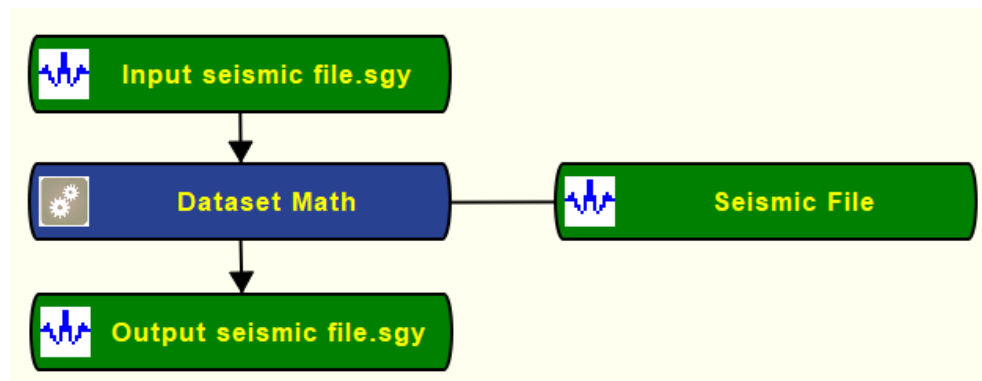
Dataset Math

Usage: The Dataset Math step will add, subtract, multiply, divide or do adaptive subtraction between the samples of one data file from the corresponding samples of a second data file and output the result to a seismic file.

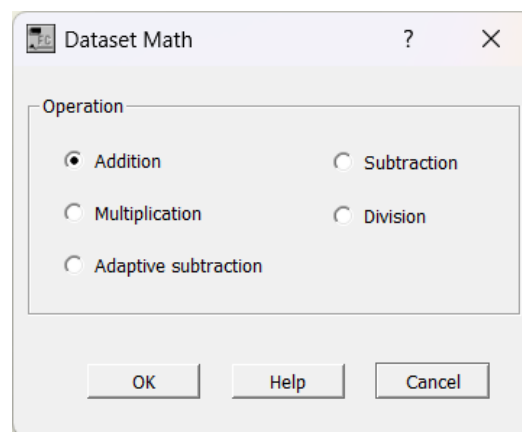
Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data in any sort order (mandatory) – must match the first dataset.

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Operation** specifies the math operation to perform between the samples of the two datasets.

Addition — If selected, perform addition between the samples of the two datasets.

Subtraction — If selected, perform subtraction between the samples of the two datasets.

Multiplication — If selected, perform multiplication between the samples of the two datasets.

Division — If selected, perform division between the samples of the two datasets.

Adaptive subtraction — If selected, perform adaptive subtraction between the samples of the two datasets.

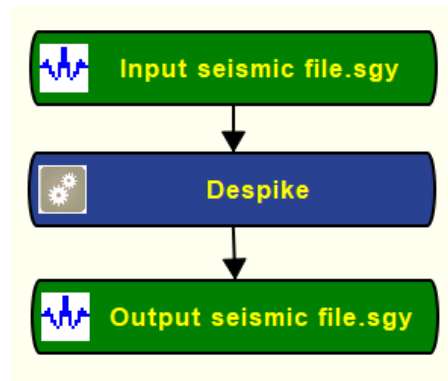
Despique

Usage: The Despique step removes spikes of amplitude related to bursts of energy based on the variance estimate of a given seismic sample when compared against its neighbors.

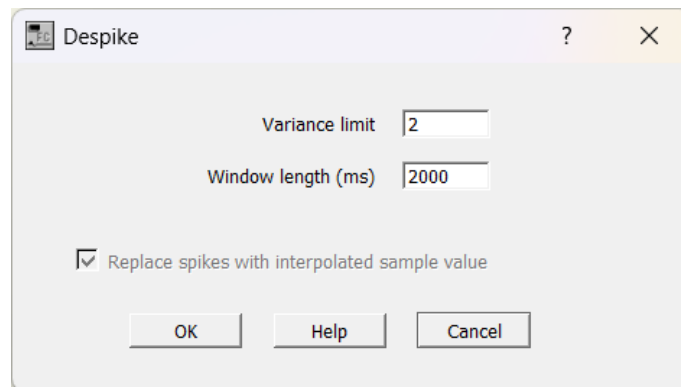
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Variance limit — Enter the number of variance allowed for a seismic sample be considered signal.

Window length (ms) — Enter the window length, in milliseconds, where the statistical measures (variance) are going to be computed and used as reference to detect spikes.
{>=0}

Replace spikes with interpolated sample value — If checked, seismic samples marked as noise are going to be replaced by an interpolated sampled value from its neighbors. If unchecked, marked seismic samples are replaced by zero.

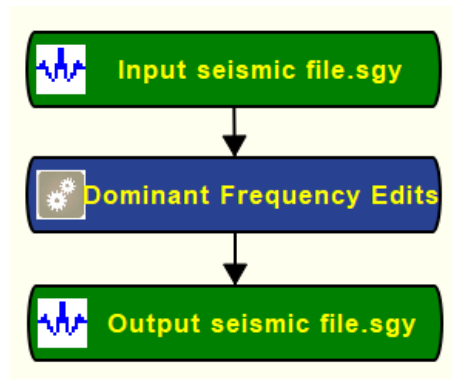
Dominant Frequency Edits

Usage: The Dominant Frequency Edits step marks dead records based on an estimate of its dominant frequency computed within a user-defined window on a trace-by-trace or record-by-record basis. More than one window is allowed, and the failing criteria may be defined taking into consideration simultaneously all windows or each window separately. A report file is automatically generated.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Report file

File Browse... C:/DATA/Documentation/Report/DominantFrequencyReport.txt

☐ Send file via ftp ☐ Append to existing file ☐ Display report in separate window

Calculation method

☒ Record basis ☐ Trace by trace

Window definition method

☒ Use all data (no window) ☐ Enter rectangle ☐ Import rectangle ☐ Import polygon

Spatial application

☒ Apply to all data ☐ Reference exclusion zone file

☐ Apply inside exclusion zones ☒ Apply outside exclusion zones

Record edit criteria

☒ Fails all windows ☐ Analysis only ☐ Fails any window

Window	Start time (ms)	End time (ms)	Start offset	End offset	Min dominant frequency	Max dominant frequency	Output header
1	0.00	0.00	0.00	0.00	0.00	0.00	None

Add window Delete window View window Export window

Minimum live traces per analysis window 5 OK Help Cancel

Parameter Description:

The **Report file** defines the parameters related to the report file automatically generated by this processing step.

File Browse — Browse for the file where the report file is going to be written. By default, existing report files are overwritten.

Send file via FTP — If checked, send the report file automatically via FTP.

Append to existing file — If checked, append current report file to an existing file.

Display report in separate window — If checked, the report file is shown in real time in a pop-up window.

The **Spatial application** defines the spatial extent where the processing step is going to be applied.

Apply to all data — If selected, this step is applied to the entire input seismic data.

Reference exclusion zone file — If selected, the application of this step is constrained spatially as defined by an auxiliary exclusion zone data file, the input seismic data is not considered entirely.

Apply inside exclusion zone — If checked, only the data inside the exclusion zone is considered for the calculations.

Apply outside exclusion zone — If checked, only the data outside the exclusion zone is considered for the calculations.

The **Calculation method** allows to apply the processing step either on a record basis or trace-by-trace basis.

Record basis — If selected, the dominant frequency is computed for the entire record as a whole.

Trace by trace — If selected, the dominant frequency is computed considering each trace individually.

The **Window definition method** defines how the estimates are computed within a user-defined window, or windows, defined by its start and end time and offset. Seismic samples outside these windows are not considered.

Use all data (no window) — If selected, all seismic samples are considered. There are no constraints in terms of time or offset.

Enter rectangle — If selected, enables the table below where the user can define the top, bottom, start and end offset of each window considered.

Import rectangle — If selected, the windows are defined by an auxiliary rectangle data file.

Import polygon — Not yet available.

The **Record edit criteria** defines the criteria to consider a good or bad record.

Fails all windows — If selected, the record is considered dead if it fails in all the defined windows simultaneously.

Analysis only — If selected, any recorded is marked as dead. This processing step is considered just an analysis tool.

Fails any window — If selected, the record is considered dead if it fails in on of the defined windows.

The **Window** defines the extent of each window where the estimate of the dominant frequency is computed.

Start time (ms) — Enter the start time, in milliseconds, for each window. {>=0}

End time (ms) — Enter the end time, in milliseconds, for each window. {>=0}

Start offset — Enter the start offset for each window.

End offset — Enter the end offset for each window.

Min dominant frequency — Enter the minimum dominant frequency, in Hz, that a given window must have for the record to be considered good. {>=0}

Max dominant frequency — Enter the maximum dominant frequency, in Hz, that a given window must have for the record to be considered good. {>=0}

Output header — Select the header location where the flag for good/bad records is stored.

Add window — Select if more than one window per record is going to considered.

Delete window — Select to remove an existing window.

View window — Not yet available.

Export window — Not yet available.

Minimum live traces per analysis window — Enter the minimum number of live traces that must exit within each window for the estimation.

F-X Trace Interpolation

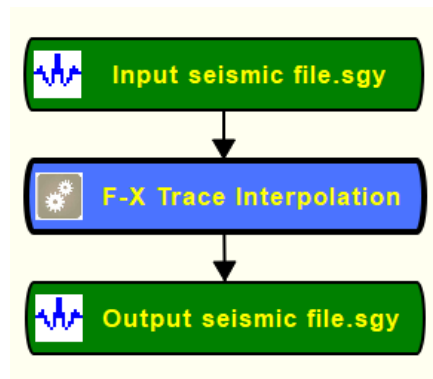
Usage: The F-X Trace Interpolation step performs a 2-to-1 f-x domain interpolation of the input gather. Trace headers of the interpolated traces are equal to the average of their two neighbors. The Trace Flag header field of the interpolated traces will be equal to 28 on output.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data with interpolated traces.

Reference: Spitz, S., 1991 Seismic trace interpolation in the f-x domain, Geophysics, 56, p. 785.

Example Flowchart:



Step Parameter Dialog:

The dialog box titled 'F-X Trace Interpolation' contains the following settings:

- Design window length:** ☐ Specify length (Length (ms) is 500) and ☐ Use whole trace.
- Design window width:** ☒ Specify width (Width (traces) is 31) and ☐ Use entire rec.
- Prediction filter:** Width (traces) is 9.

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Design window length** parameterizes the window length.

Specify length — If selected, uses a fixed design width as defined in Length (ms).

Length (ms) — Enter the length of the design window in milliseconds. {>=0}

Use whole trace — If selected, the design length is equal the record length.

The **Design window width** parameterizes the window width.

Specify width — If selected, allows the window width to vary with changes in fold for pre-stack trace interpolation.

Width (traces) — Use this option to enter a fixed design width. {>=0}

Use entire record — If selected, uses the entire record.

The **Prediction filter** specifies the number of traces used in the prediction filter.

Width (traces) — enter the number of traces to be used by the prediction filter.

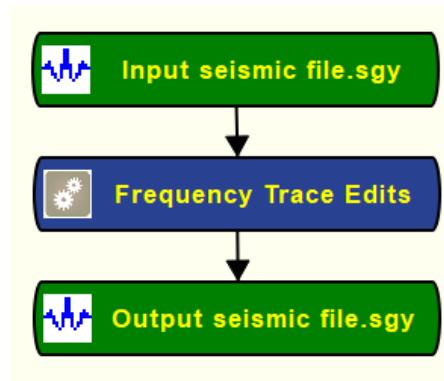
Frequency Trace Edits

Usage: The Frequency Trace Edits step marks dead records based on an estimate of its frequency content computed within a user-defined window on a trace-by-trace or record-by-record basis. More than one window is allowed and the failing criteria may be defined taking into consideration simultaneously all windows or each window separately. A report file is automatically generated.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Frequency Trace Edits

Report file:

☐ Send file via ftp ☒ Append to existing file ☐ Display report in separate window

Calculation method: ☒ Record basis ☐ Trace by trace

Window definition method: ☐ Use full trace ☒ Enter rectangle ☐ Import rectangle ☐ Import polygon

Spatial application: ☒ Apply to all data ☐ Reference exclusion zone file
☐ Apply inside exclusion zones ☒ Apply outside exclusion zones

Record edit criteria: ☒ Fails all windows ☐ Fails any window

Ratio	Start time (ms)	End time (ms)	Start offset	End offset	Minimum frequency	Maximum frequency	Minimum frequency output header	Maximum frequency output header
1	0.00	0.00	0.00	0.00	0.00	0.00	None	None

Minimum live traces per analysis window:

Parameter Description:

The **Report file** defines the parameters related to the report file automatically generated by this processing step.

File Browse — Browse for the file where the report file is going to be written. By default, existing report files are overwritten.

Send file via FTP — If checked, send the report file automatically via FTP.

Append to existing file — If checked, append current report file to an existing file.

Display report in separate window — If checked, the report file is shown in real time in a pop-up window.

The **Spatial application** defines the spatial extent where the processing step is going to be applied.

Apply to all data — If selected, this step is applied to the entire input seismic data.

Reference exclusion zone file — If selected, the application of this step is constrained spatially as defined by an auxiliary exclusion zone data file, the input seismic data is not considered entirely.

Apply inside exclusion zone — If checked, only the data inside the exclusion zone is considered for the calculations.

Apply outside exclusion zone — If checked, only the data outside the exclusion zone is considered for the calculations.

The **Calculation method** allows to apply the processing step either on a record basis or trace-by-trace basis.

Record basis — If selected, the dominant frequency is computed for the entire record as a whole.

Trace by trace — If selected, the dominant frequency is computed considering each trace individually.

The **Window definition method** defines how the estimates are computed within a user-defined window, or windows, defined by its start and end time and offset. Seismic samples outside these windows are not considered.

Use full trace — If selected, all seismic samples are considered. There are no constraints in terms of time or offset.

Enter rectangle — If selected, enables the table below where the user can define the top, bottom, start and end offset of each window considered.

Import rectangle — If selected, the windows are defined by an auxiliary rectangle data file.

Import polygon — Not yet available.

The **Record edit criteria** defines the criteria to consider a good or bad record.

Fails all windows — If selected, the record is considered dead if it fails in all the defined windows simultaneously.

Fails any window — If selected, the record is considered dead if it fails on any defined windows.

The **Window** defines the extent of each window where the estimate of the dominant frequency is computed.

Start time (ms) — Enter the start time, in milliseconds, for each window. $\{ \geq 0 \}$

End time (ms) — Enter the end time, in milliseconds, for each window. $\{ \geq 0 \}$

Start offset — Enter the start offset for each window.

End offset — Enter the end offset for each window.

Minimum frequency — Enter the minimum dominant frequency, in Hz, that a given window must have for the record to be considered good. $\{ \geq 0 \}$

Maximum frequency — Enter the maximum dominant frequency, in Hz, that a given window must have for the record to be considered good. $\{ \geq 0 \}$

Minimum frequency output header — Select the header location where the minimum frequency is stored.

Maximum frequency output header — Select the header location where the maximum frequency is stored.

Add window — Select if more than one window per record is going to be considered.

Delete window — Select to remove an existing window.

View window — Not yet available.

Export window — Not yet available.

Minimum live traces per analysis window — Enter the minimum number of live traces that must exit within each window for the estimation.

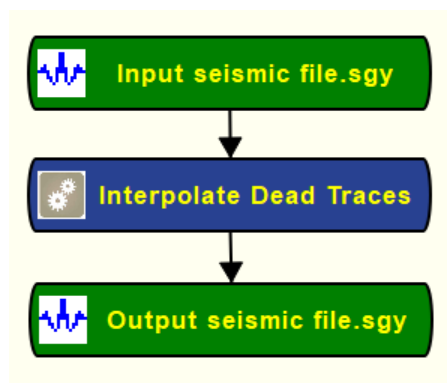
Interpolate Dead Traces

Usage: The Interpolate Dead Traces step interpolates traces marked as dead based on a simple arithmetic average of the neighbor traces not marked as dead.

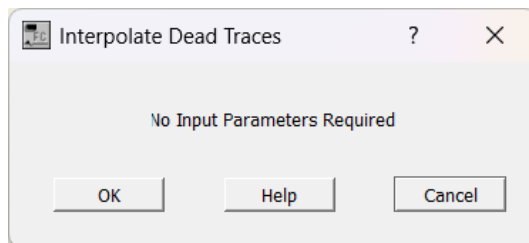
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

This processing step does not require any parameterization since dead traces are automatically interpolated with an arithmetic average.

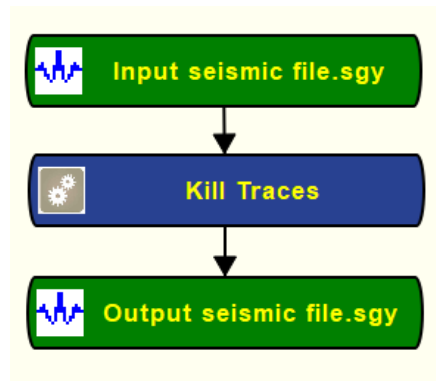
Kill Traces

Usage: The Kill Traces step kills traces according to specified trace header values and ranges.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box, titled 'Kill Traces', features a table with nine columns: Primary header, Primary start, Primary stop, Secondary header, Secondary start, Secondary stop, Tertiary header, Tertiary start, and Tertiary stop. Below the table is a large empty text area. At the bottom, there are buttons for 'Import', 'Export', 'Add row', 'Delete row', and 'Fill Column...'. To the right of these buttons is a checkbox labeled 'Set dead trace amplitudes to zero', which is currently checked. Further right are 'OK', 'Help', and 'Cancel' buttons.

Parameter Description:

Primary header — Select the first trace header field to use for killing traces. This is combined with the other selected header key values to determine the set of traces to kill.

Primary start — Enter the start value for the first selected header field.

Primary stop — Enter the end value for the first selected header field.

Secondary header — Select the second trace header field to use for killing traces. This is combined with the other selected header key values to determine the set of traces to kill.

Secondary start — Enter the start value for the second selected header field.

Secondary stop — Enter the end value for the second selected header field.

Tertiary header — Select the third trace header field to use for killing traces. This is combined with the other selected header key values to determine the set of traces to kill.

Tertiary start — Enter the start value for the third selected header field.

Tertiary stop — Enter the end value for the third selected header field.

Import — Import a set of picked trace kills from a Trace Kills auxiliary dataset.

Export — Export the entered trace kills into a Trace Kills auxiliary dataset.

Add Row — Add a row to dialog.

Delete Row — Delete a row from the dialog.

Set dead trace amplitude to zero — If checked, fill dead traces with zeros.

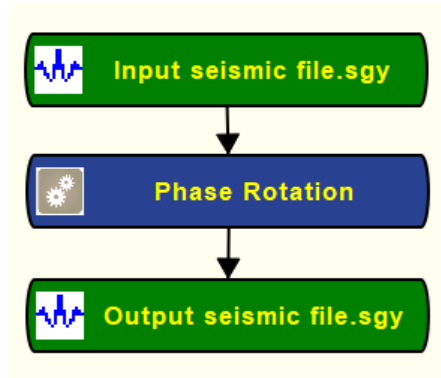
Phase Rotation

Usage: The Phase Rotation step allows to rotate the seismic traces by a constant phase angle from -180 to $+180$ degrees. Values outside this range will be wrapped back into this range (i.e. 240 degrees is equivalent to -60 degrees).

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Phase Rotation'. It contains two main sections. The first section, 'Rotate based on header value', is currently unchecked. It includes a dropdown menu for 'Component trace header' set to 'Receiver comp', followed by a comparison operator dropdown set to '==' and a text input field containing '0.00'. The second section, 'Rotate by angle stored in trace header value', is also unchecked. It features a dropdown menu for 'Rotation angle in trace header' set to 'None'. Below these sections is a text input field for 'Phase rotation angle (degrees)' containing '-90.0'. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Rotate based on header value — If checked, the phase rotation is only applied to some traces in the dataset, then a trace header value may be used to control which traces are rotated. An example of where this is useful is transition zone seismic where some

receivers in a line are geophones and some are hydrophones. Rotating the hydrophone by -90 matches the data from the geophone.

If Component trace header — If Rotate based on header value is checked, select the trace header to be used for controlling the operation. Also, select the logic operator (<, <=, ==, >, >= or !=) to be used in determining the traces used in the operation and enter the value of the logical condition.

Rotate by angle stored in trace header value — If checked, does a constant phase rotation, a header value (degrees) may be used.

Rotation angle in trace header — If Rotate by angle stored in trace header value is checked, select the trace header word containing the rotation angle (degrees).

Phase rotation angle (degrees) — Enter the constant phase rotation angle to apply to all the seismic data traces, unless Rotate by angle stored in trace header value is checked.

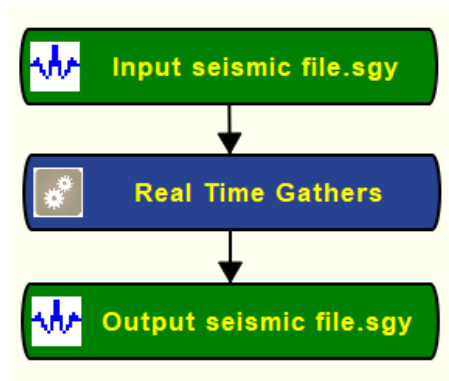
Real Time Gathers

Usage: The Real Time Gathers step create channel gathers from the input seismic data based on the source identification.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Real Time Gathers' dialog box contains the following sections and controls:

- Marine configuration:**
 - Number of sources: 1
 - I/p Source number trace header: User defined 7
 - Number of streamers: 1
 - Number of channels/streamer: 1
- Gathers' width:**
 - Traces per channel gather: 9
- Apply frequency bandpass:** (checked)
 - Initial freq. (Hz.): 400
 - Final freq. (Hz.): 2000
 - dB/octave attenuation: 18
 - dB/octave attenuation: 18
- Output gather segy files:** (unchecked)
 - Multi-source gathers (selected)
 - Single source gathers
 - Output segy file frequency: Every 'n' field files: 20
- Display gathers in real time:** (unchecked)
- Buttons:** OK, Help, Cancel

Parameter Description:

The **Marine Configuration** specifies the acquisition parameters of the survey used to acquire the data.

Number of sources — Enter the of source in the marine acquisition configuration.
{>=0}

Number of streamers — Enter the of streamers in the marine acquisition configuration. {>=0}

/p Source number trace header — Select the seismic trace header word where the source number is stored.

Number of channels/streamer — Enter the number of receivers/channels per streamer in the marine acquisition configuration.

The **Gather's width** specifies the per gather.

Traces per channel gather — Enter the number of traces per channel gather to be considered.

Apply Frequency bandpass — If checked, applies a frequency bandpass to the data.

Initial freq. (Hz) — Enter the low pass frequency of the frequency bandpass filter in Hertz.

Final freq. (Hz) — Enter the high pass frequency of the frequency bandpass filter in Hertz.

dB/octave attenuation — Enter the low pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

dB/octave attenuation — Enter the high pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

Output gather segy files — If checked, output the real time gathers as SEG-Y files.

Multi-source gahters — If selected, build channel gathers based on traces from different sources.

Single source gathers — If selected, build channel gathers based on traces from a single source.

The **Output segy file frequency** specifies how many segy files are written as output.

Every 'n' field files — Enter the step used to store the real time gathers as SEG-Y files.

Display gathers in real time — If checked, a new display tab is created and the real-time gathers are display.

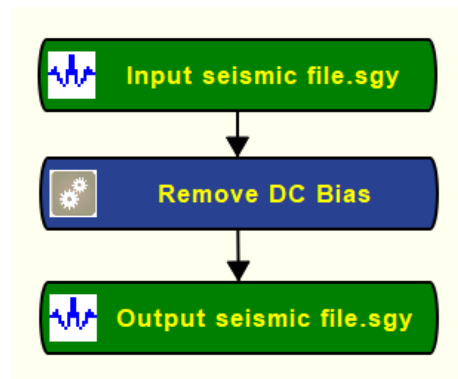
Remove DC Bias

Usage: The Remove DC Bias step removes the average, median or mean DC bias on a trace-by-trace basis or based on a moving average window which may run per channel or gather. The calculation window may be limited within a user-defined time gate.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Remove DC Bias' dialog box contains the following settings:

- DC calculation method:**
 - ☐ Mean
 - ☒ Media
 - ☐ (Min+Max)_i
- Channel average:**
 - ☐ Use running average across channels
 - Number of channels to average:
- Gather average:**
 - ☐ Use running average across prior gathers
 - Minimum number of gathers to average:
- DC calculation window:**
 - ☐ Calculate DC in a window
 - Start time (ms):
 - End time (ms):

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **DC calculation method** selects the method to estimate the DC bias.

Mean — If selected, estimates the DC bias as the mean of the seismic samples considered.

Median — If selected, estimates the DC bias as the median of the seismic samples considered.

(Min+Max)/2 — If selected, estimates the DC bias as central value between the min and max of the seismic samples considered.

The **Chanel Average** sets how the DC bias is estimated. The DC bias might be estimated using a moving window running through channels in order to increase the reliability of the estimate.

Use running average across channels — If checked, the DC bias is estimate taking into account a moving window computed across channels.

Number of channels to average — Enter the number of channels that belong to the moving window.

The **Gather Average** estimates DC bias be estimated using a moving window running through gathers (or records) in order to increase the reliability of the estimate.

Use running average across prior gathers — If checked, the DC bias is estimate taking into account a moving window computed across prior gathers.

Maximum number of gathers to average — Enter the maximum number of gathers that belong to the moving window.

The **DC calculation window** defines the time gate where the calculation is going to be computed.

Calculate DC in a window — If checked, only the entered window of each trace will be used to calculate the DC.

Start time (ms) — Enter the start time of the window to be used for calculating the DC value.

End time (ms) — Enter the ending time of the window to be used for calculating the DC value.

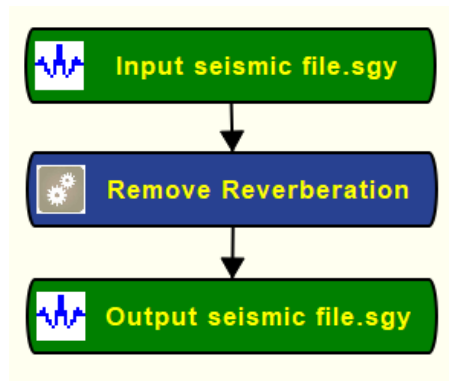
Remove Reverberation

Usage: The Remove Reverberation step searches for reverberations in the signal and attempts to remove these using an adaptive filtering technique.

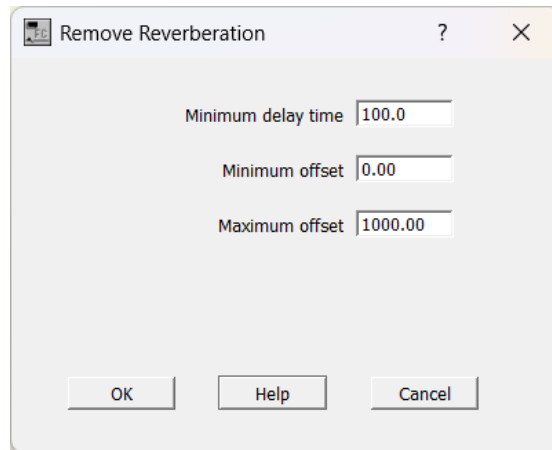
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Minimum delay time — Enter the minimum delay time to use in searching for the reverberation. {>=0}

Minimum offset — Enter the minimum offset to use in searching for the reverberation.

Maximum offset — Enter the maximum offset to use in searching for the reverberation.

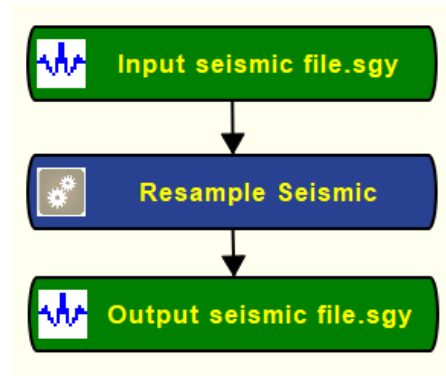
Resample Seismic

Usage: The Resample Seismic step creates a copy of a data set with options to (1) resample to a specified sample interval, and (2) change the start time and trace length of the data on the fly.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the 'Resample Seismic' dialog box with the following settings:

- Sample interval:**
 - ☒ Change sample interval
 - Output sample interval (ms): 2.00
- Anti-alias filter:**
 - ☒ Apply anti-alias filter
 - Cutoff frequency (Hz): 50
 - Rolloff (dB/octave): 36
- Trace length:**
 - ☐ Change length
 - Start time (ms): 0.00
 - Output trace length (ms): 4000.00

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Sample interval** modifies the sample interval of the input seismic data.

Change sample interval — If checked, the traces will be resampled to the specified sample interval.

Output sample interval (ms) — Enter the new sampling interval in milliseconds. {>=0}

The **Anti-alias filter** applies an anti-alias filter to the data after the resampling.

Apply anti-alias filter — If checked, apply an anti-alias filter after the resampling.

Cutoff frequency (Hz) — Enter the percentage of the cutoff frequency at which an anti-alias filter is applied.

Rolloff (db/Octave) — Enter the rolloff of the filter in dB/Octave.

The **Trace length** modifies the original length of the input seismic traces.

Change length — If checked, the traces will be truncated or extended to the specified length.

Start time (ms) — Enter the start time of the trace to output in milliseconds. {>=0}

Output trace length (ms) — Enter the length of the trace to output in milliseconds. {>=0}

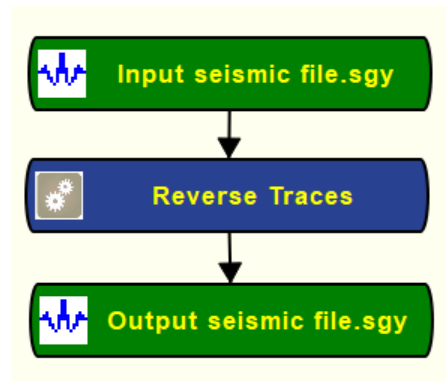
Reverse Traces

Usage: The Reverse Traces step allows to invert the polarity of traces according to specified trace header values and ranges.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a window titled 'Reverse Traces' with a standard Windows-style title bar (minimize, maximize, close buttons). The window contains a table with the following headers: Primary header, Primary start, Primary stop, Secondary header, Secondary start, Secondary stop, Tertiary header, Tertiary start, and Tertiary stop. The table body is currently empty. Below the table is a horizontal scrollbar. At the bottom of the window, there are several buttons: 'Import', 'Export', 'Add row', 'Delete row', 'Fill Column...', 'OK', 'Help', and 'Cancel'.

Parameter Description:

Primary header — Select the first trace header field to use for reversing traces. This is combined with the other selected header key values to determine the set of traces to reverse.

Primary start — Enter the start value for the first selected header field.

Primary stop — Enter the end value for the first selected header field.

Secondary header — Select the second trace header field to use for reversing traces. This is combined with the other selected header key values to determine the set of traces to reverse.

Secondary start — Enter the start value for the second selected header field.

Secondary stop — Enter the end value for the second selected header field.

Tertiary header — Select the third trace header field to use for reversing traces. This is combined with the other selected header key values to determine the set of traces to reverse.

Tertiary start — Enter the start value for the third selected header field.

Tertiary stop — Enter the end value for the third selected header field.

Import — Import a set of picked trace reversals from a Trace Reversals auxiliary dataset.

Export — Export the entered trace reversals into a Trace Reversals auxiliary dataset.

Add Row — Add a row to dialog.

Delete Row — Delete a row from the dialog.

Fill column... — Select a column and fill it with a constant value, a series or pattern.

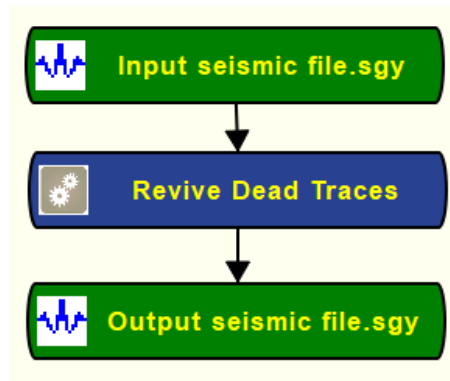
Revive Dead Traces

Usage: The Revive Dead Traces step modifies marked seismic traces into live traces given a minimum number of adjacent dead traces.

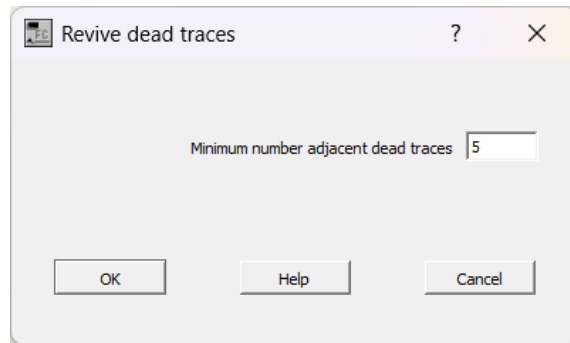
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Minimum number adjacent dead traces — Enter the minimum number of adjacent dead traces that must exist to be modified into live traces.

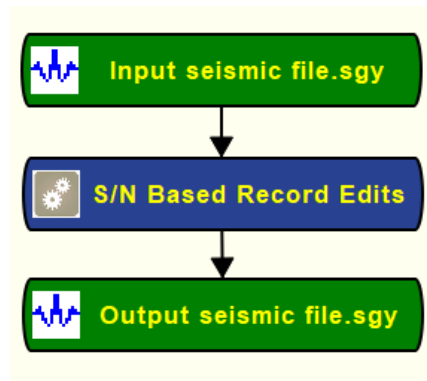
S/N Based Record Edits

Usage: The S/N Based Record Edits step marks dead records based on an estimate of its signal-to-noise ratio computed within a user-defined window on a trace-by-trace basis or considering the entire records as a whole. More than one window is allowed, and the failing criteria may be defined taking into consideration simultaneously all windows or each window separately. A report file is automatically generated.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

S/N Based Record Edits

Report file: C:/DATA/Documentation/Report/SignalToNoiseReport.txt

☐ Send file via ftp ☒ Append to existing file ☐ Display report in separate window

Amplitude definition: ☒ Average power ☐ Average RMS ☐ Average absolute value

Calculation method: ☒ Record basis ☐ Trace by trace

Signal definition method: ☒ Enter signal rectangle ☐ Import signal rectangle ☐ Import signal polygon

Noise definition method: ☒ Enter noise rectangle ☐ Import noise rectangle ☐ Import noise polygon

Spatial application: ☒ Apply to all data ☐ Reference exclusion zone file
☐ Apply inside exclusion zones ☒ Apply outside exclusion zones

Record edit criteria: ☒ Fails all windows ☐ Analysis only ☐ Fails any window

Ratio	Signal start time (ms)	Signal end time (ms)	Signal start offset	Signal end offset	Noise start time (ms)	Noise end time (ms)	Noise start offset	Noise end offset	S/N minimum	S/N output header
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000000	None

Minimum live traces per analysis window:

Parameter Description:

The **Report file** define parameters related to the report file automatically generated by this processing step.

File Browse — Browse for the file where the report file is going to be written. Be default, existing report files are overwritten.

Send file via FTP — If checked, send the report file automatically via FTP.

Append to existing file — If checked, append current report file to an existing file.

Display report in separate window — If checked, the report file is shown in real time in a pop-up window.

The **Spatial application** defines the spatial extent where the processing step is going to be applied.

Apply to all data — If selected, this step is applied to the entire input seismic data.

Reference exclusion zone file — If selected, the application of this step is constrained spatially as defined by an auxiliary exclusion zone data file, the input seismic data is not considered entirely.

Apply inside exclusion zone — If checked, only the data inside the exclusion zone is considered for the calculations.

Apply outside exclusion zone — If checked, only the data outside the exclusion zone is considered for the calculations.

The **Amplitude definition** selects the type of amplitude to be computed during this editing processing step.

Average power — If selected, compute the average power of the input seismic amplitudes.

Average RMS — If selected, compute the average RMS of the input seismic amplitudes.

Average absolute value — If selected, compute the average of the absolute value of the input seismic amplitudes.

The **Calculation method** allows to apply the processing step either on a record basis or trace-by-trace basis.

Record basis — If selected, the signal-to-noise ratio is computed for the entire record as a whole.

Trace by trace — If selected, the signal-to-noise ratio is computed considering each trace individually.

The **Signal definition method** defines how the signal estimates are computed within a user-defined window, or windows, defined by its start and end time and offset.

Enter signal rectangle — If selected, enables the table below where the user can define the signal top, bottom, start and end offset of each window considered.

Import signal rectangle — If selected, the windows are defined by an auxiliary rectangle data file.

Import signal polygon — Not yet available.

The **Noise definition method** defines how the noise estimates are computed within a user-defined window, or windows, defined by its start and end time and offset.

Enter noise rectangle — If selected, enables the table below where the user can define the noise top, bottom, start and end offset of each window considered.

Import noise rectangle — If selected, the windows are defined by an auxiliary rectangle data file.

Import noise polygon — Not yet available.

The **Record edit criteria** defines the criteria to consider a good or bad record.

Fails all windows — If selected, the record is considered dead if it fails in all the defined windows simultaneously.

Analysis only — If selected, any recorded is marked as dead. This processing step is considered just an analysis tool.

Fails any window — If selected, the record is considered dead if it fails on the defined windows.

The **Window** defines the extent of each window where the signal-to-noise ratio is computed.

Ratio — Window index where the calculation will happen.

Signal start time (ms) — Enter the signal start time, in milliseconds, for each window. {>=0}

Signal end time (ms) — Enter the signal end time, in in milliseconds, for each window. {>=0}

Signal start offset — Enter the signal start offset for each window.

Signal end offset — Enter the signal end offset for each window.

Noise start time (ms) — Enter the noise start time, in in milliseconds, for each window. {>=0}

Noise end time (ms) — Enter the noise end time, in in milliseconds, for each window. {>=0}

Noise start offset — Enter the noise start offset for each window.

Noise end offset — Enter the noise end offset for each window.

S/N minimum — Enter a minimum signal-to-noise ratio.

S/N output header — Select the header location where the flag for good/bad records is stored.

Add window — Select if more than one window per record is going to considered.

Delete window — Select to remove an existing window.

View window — Not yet available.

Export window — Not yet available.

Minimum live traces per analysis window — Enter the minimum number of live traces that must exit within each window for the estimation.

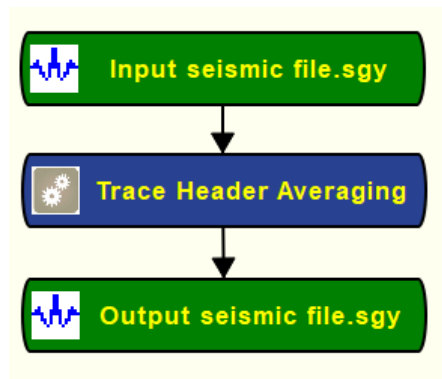
Trace Header Averaging

Usage: The Trace Header Averaging step applies a moving average window to seismic trace header values of a consecutive number of traces defined by the user and store the corresponding value at another trace header location.

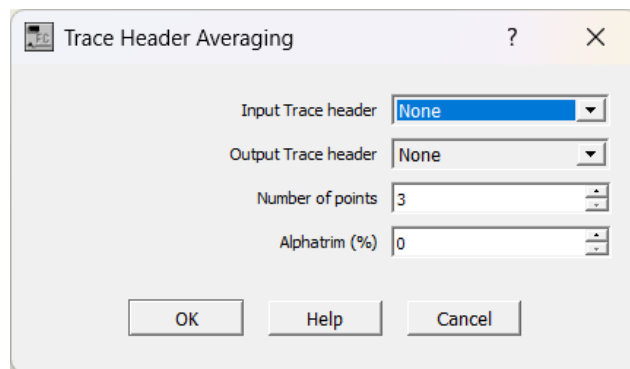
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Input Trace header — Enter the input trace header to be average.

Output Trace header — Enter the output trace header where the averaging results will be stored.

Number of points — Defines how many adjacent traces to be averaged together at each position.

Alphatrim (%) — Percentage of extreme values (highest and lowest) to trim before averaging to reduce outlier influence. Use 0 for standard averaging.

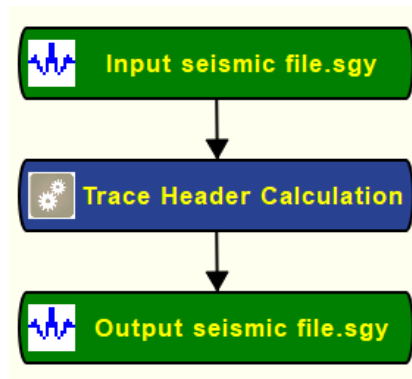
Trace Header Calculation

Usage: The Trace Header Calculation step allows calculate a selected trace header from existing trace headers.

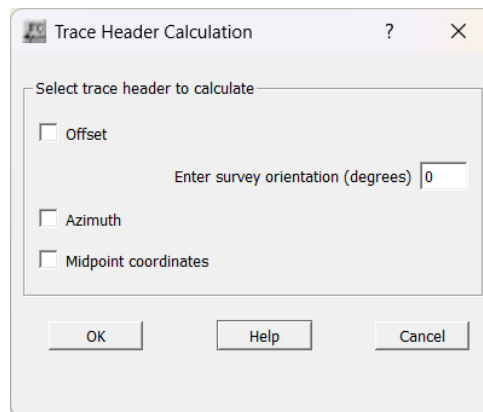
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Select trace header to calculate** selects the trace header to be calculated.

Offset — If checked, calculates the offset and updates the corresponding trace header.

Enter survey orientation (degrees) — Enter survey azimuth angle in degrees.

Azimuth — If checked, calculates the azimuth and updates the corresponding trace header.

Midpoint coordinates — If checked, calculates the midpoint coordinates and updates the corresponding trace header.

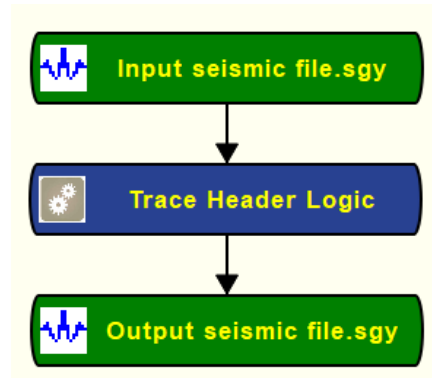
Trace Header Logic

Usage: The Trace Header Logic step allows to modify the trace header values of a seismic trace using the relational operators and logic conditions characteristic of an If - Then – Else statement.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

Trace Header Logic

if-then-else logic

if	None	==	Constant	0.00000
then	None	=	Constant	0.00000
else	None	=	Constant	0.00000

OK Help Cancel

Parameter Description:

if — Select the relational and logic conditions for which the then statement will be executed.

Header Field — Select the primary trace header field to be tested.

Relation — Select the primary relational operator

Header Field — If selected, the primary trace header field will be evaluated against the chosen header field using the primary relational operator.

Constant — If selected, the primary trace header field will be evaluated against the user-supplied constant using the primary relational operator.

Logic — If checked, the Logic option allows selection of a secondary header field using and/or logic.

Header Field — Select the secondary trace header field to be tested.

Relation — Select the secondary relational operator

Header Field — If selected, the primary trace header field will be evaluated against the chosen header field using the secondary relational operator.

Constant — If selected, the primary trace header field will be evaluated against the-user-supplied constant using the secondary relational operator.

then — Define the trace header operation to be performed in the case that the if conditions are satisfied.

Header Field — Select the trace header field to be modified in the case that the if conditions are satisfied.

Header Field — If selected, the header field selected above will be set equal to the chosen header field.

Constant — If selected, the header field selected above will be set equal to the user-supplied constant.

else — Define the trace header operation to be performed in the case that the if conditions are not satisfied.

Header Field — Select the trace header field to be modified in the case that the if conditions are not satisfied.

Header Field — If selected, the header field selected above will be set equal to the chosen header field.

Constant — If selected, the header field selected above will be set equal to the user-supplied constant.

Example: If the source-receiver azimuth is greater than or equal to zero, set the User Def 1 field equal to +1. Otherwise, set the User Def 1 field equal to -1.

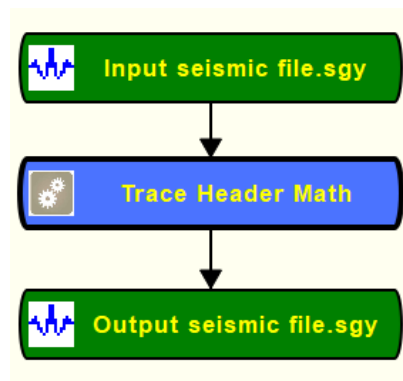
Trace Header Math

Usage: The Trace Header Math step allows to modify the trace header values of a seismic trace using standard mathematical operations.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Trace Header Math" contains the following elements:

- A dropdown menu labeled "Trace header value to modify" with "None" selected.
- A checkbox labeled "Add to index" which is currently unchecked.
- A numeric keypad with buttons for digits 0-9, a decimal point, and a sign toggle (+/-).
- A row of mathematical constants and functions: pi, X⁻¹, X², and √X.
- A row of arithmetic operators: +, -, x, /, and a question mark (?) button.
- A row of trigonometric and logarithmic functions: (, log 10, sin, asin,), ln, cos, acos, !, sign, tan, atan.
- A row of advanced functions: fractional part, integer part, abs, rem, and mod.
- A "Value of" dropdown menu with "None" selected.
- An equals (=) button.
- A large text input field at the bottom.
- OK, Help, and Cancel buttons at the very bottom.

Parameter Description:

Trace header value to modify — Select trace header location to be modified.

Add to index — I checked, changed trace header is automatically updated in the index file.

The rest of the parameters are just like a regular calculator.

Example: Add 40 to the existing value of the *Uphole time* = *Uphole Time* + 40

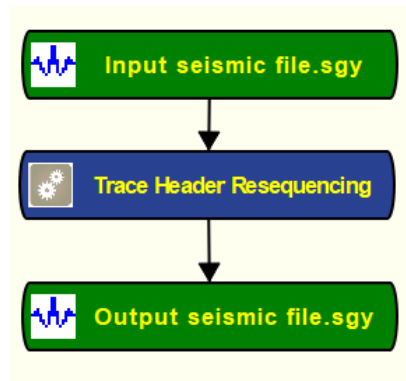
Trace Header Resequencing

Usage: The Trace Header Resequencing step is used to modify trace header values based on changes in other trace header values.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data file containing the duplicated trace (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the 'Trace Header Resequencing' dialog box. It has a title bar with a question mark and a close button. Inside, there are two dropdown menus: 'Trace header to modify' and 'Trace header to monitor', both currently set to 'None'. Below these are two text input fields: 'Restart value' and 'Increment value', both containing the value '1.00'. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Trace header to modify — Select the trace header field that will be modified.

Trace header to monitor — Select the monitor trace header field. A change in value of the **Trace header to monitor** will result in a change in value of the **Trace header to modify** based on the following two values:

Restart value — This value will be placed in the **Trace header to modify** whenever there is a change in the **Trace header to monitor**.

Increment value — This value will be added to the Restart value for each trace header in which the **Trace header to modify** does not change.

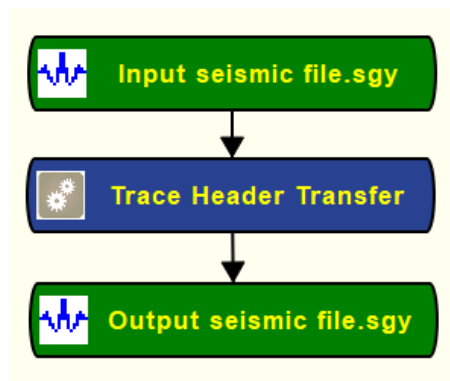
Trace Header Transfer

Usage: The Trace Header Transfer step is used to transfer trace header information from an input SEG-Y file into an output seismic file based on a series of trace header keys.

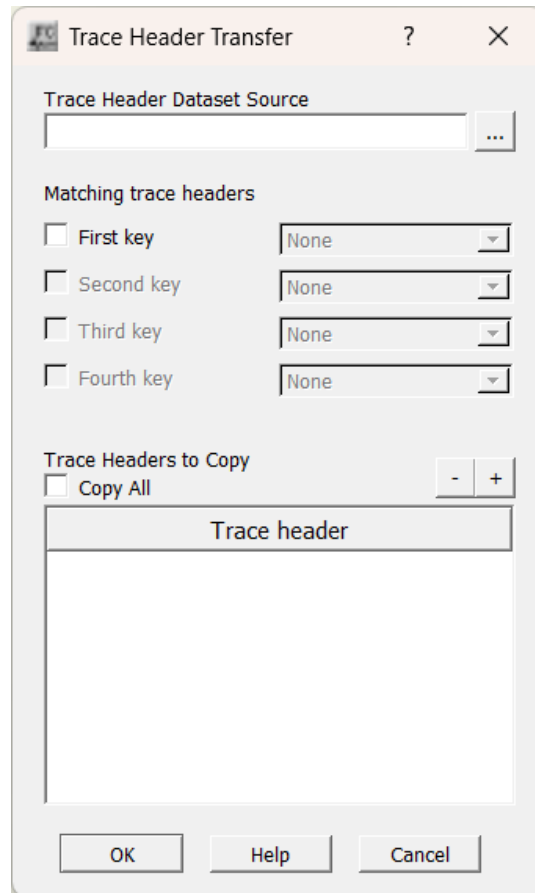
Input Links: -

Output Links: 1) Seismic data file containing the duplicated trace (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Trace header data source — Select the input SEG-Y file from where the header information will be transferred.

First key — Select the first sort key to match between input seismic and SEG-Y files.

Second key — Select the second sort key to match between input seismic and SEG-Y files.

Third key — Select the third sort key to match between input seismic and SEG-Y files.

Fourth key — Select the fourth sort key to match between input seismic and SEG-Y files.

The **Trace Headers to Copy** specifies the trace header locations to copy from the SEG-Y file into the seismic file

Copy all — If checked, copy all seismic trace headers.

Trace header — Add the trace headers to be transferred.

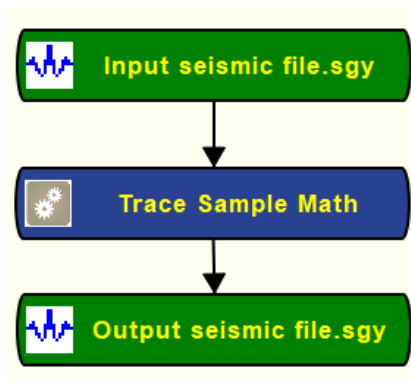
Trace Sample Math

Usage: The Trace Sample Math step allows to operate at the trace seismic samples using some pre-defined mathematical operations and two user-defined values.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Trace Sample Math" contains a "Math operation" section with the following options:

- ☒ $Y[t] = X[t]**a + b$ (retain sign)
- ☐ $Y[t] = X[t]**a + b$
- ☐ $Y[t] = (a * X[t]) + b$
- ☐ $Y[t] = a * (X[t] + b)$
- ☐ $Y[t] = \ln((a * X[t]) + b)$
- ☐ Remove gather average from each trace
- ☐ $Y[t] = \exp((a * X[t]) + b)$
- ☐ $Y[t] = X[t+1] - X[t]$
- ☐ $Y[t] = X[t+1] + X[t]$
- ☐ Running sum integration
- ☐ Absolute value

Below the options, there are input fields for "Value of a" and "Value of b", both set to 0.000000. At the bottom are buttons for "OK", "Help", and "Cancel".

Parameter Description:

The **Math operation** selects pre-defined mathematical operations to be applied to the trace seismic samples of the input seismic file.

Value of a — Enter a value to be used in the selected mathematical operation replacing a.

Value of b — Enter a value to be used in the selected mathematical operation replacing b.

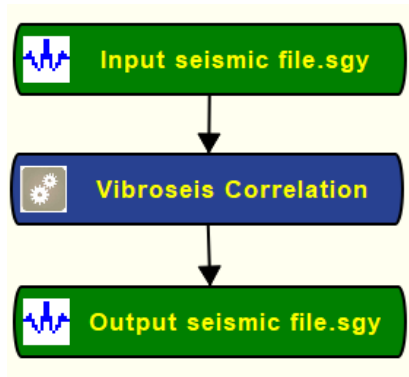
Vibroseis Correlation

Usage: The Vibroseis Correlation step cross correlates uncorrelated seismic data acquired with the Vibroseis™ method with the corresponding vibroseis sweep. The correlated output data should be considered zero phase.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data — Vibroseis™ pilot sweeps (optional).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

Vibroseis Correlation

Signature Input Options

- ☐ One pilot per dataset from auxiliary seismic file
- ☐ One pilot per record from auxiliary seismic file
- ☐ One pilot per trace from auxiliary seismic file
- ☐ Read pilot from auxiliary seismic using trace header
- ☒ One pilot per record from input data file

Trace header:

Sweep trace number:

First trace to kill:

Last trace to kill:

Correlation options

- ☐ Minimum phase compensate data
- ☐ Extended correlation
- ☐ Use a sweep library

Pre-whitening (%):

Output trace length (ms):

Pilot length (ms):

OK Help Cancel

Parameter Description:

The **Signature Input Options** selects the method of accessing the Vibroseis pilot sweep.

One pilot per dataset from auxiliary seismic file — Select the seismic file that contains the Vibroseis pilot.

One pilot per record from auxiliary seismic file — This option inputs one pilot trace in sequential order from an auxiliary file and cross correlates that pilot signature with the respective sequential record. Therefore, the number of pilot traces should equal the number of input records.

One pilot per trace from auxiliary seismic file — This option inputs one pilot trace in sequential order from an auxiliary file and cross correlates that pilot signature with the respective sequential trace. Therefore, the number of pilot traces should equal the number of input traces.

Read pilot from auxiliary seismic using trace header — This option inputs one pilot trace based on the selected traced header from an auxiliary file and cross

correlates that pilot signature with the respective sequential trace. Therefore, the number of pilot traces should equal the number of input traces.

Trace header — Select trace header to be used to select the pilot.

One pilot per record from input data file — This option uses one trace from the each of the uncorrelated input records as the pilot trace for that record.

Sweep trace number — Enter the trace number to use as the pilot sweep.

First trace to kill — If the data set is demultiplexed with the auxiliary traces to recover the pilot sweep, the step allows to kill these auxiliary traces so that do not appear on output. Enter the first trace number to kill.

Last trace to kill — If the data set is demultiplexed with the auxiliary traces to recover the pilot sweep, the step allows to kill these auxiliary traces so that do not appear on output. Enter the last trace number to kill.

The **Correlation options** specifies the parameters used during the correlation.

Minimum phase compensate data — If checked, a minimum phase compensation filter will be calculated and applied so that the correlated data will be minimum phase on output.

Pre-whitening (%) — Enter the percentage of pre-whitening for the minimum phase compensation filter.

Extended correlation — If checked, an extended correlation will be done using the entered trace output length.

Output trace length (ms) — Enter the output length of the result of the cross correlation. {>=0}

Use a sweep library — not implemented.

Pilot length (ms) — Enter the length of the pilot sweep in milliseconds. {>=0}

Filtering Steps

This section documents the processing steps available in the Filtering Steps category.

The processing steps currently available are:

Filtering	
Processing Categories	F-X-Y Median Filter
2D Damped Least Squares Filter	Footprint Filter
2D Median Filter	Groundroll Attenuation
2D Surface Related Multiple Elimination	Horizontal Median Filter
3D Diffusion Filter	Integration
3D Median Filter	Lateral Coherence Filter
Adaptive Radon Demultiple	Notch Filter
Apply F-K Filter	POCS 2D Interpolation
Apply F-K Velocity Filter	POCS 3D Frequency Interpolation
Butterworth Dip Filtering	Quadrature Filter
Butterworth Filtering	Radial Transform Filter
Coherence Enhancement Filter	Radon Demultiple
Convolution	Ricker Filter
Cross Correlation	Slant Stack
Derivative	Tau-P Inverse Transform
Diffusion Filter	Tau-P Transform
F-K Spectrum	Time Variant Bandpass
F-X Deconvolution	Time Variant Butterworth
F-X Median Filter	Velocity-Guided Butterworth Filter
F-X Noise Attenuation	Velocity-Guided Noise Rejection Filter

2D Damped Least Squares Filter

Usage: The 2D Damped Least Squares Filter step minimizes the weighted sum of (1) the deviation between the smooth velocity and the original one, and (2) the first derivative of the given signal. This minimization is equivalent to a second-order differential equation that can be solved very efficiently.

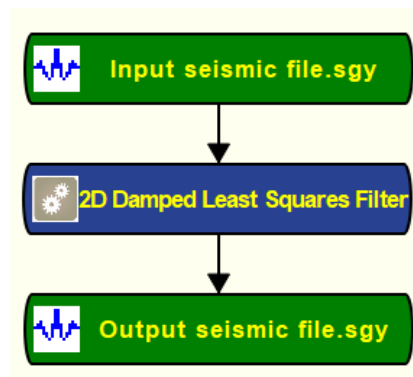
Unlike conventional smoothing techniques (convolutional type) this method is independent of length of the smoothing operator, thus very efficient with long smoothing operators. This filter is very suitable for smoothing a 2D/3D velocity model before being used in migration or ray tracing. This step is multi-thread enabled.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

References: Zhenyue L., A Velocity Smoothing Technique Based on Damped Least Squares, Colorado school of mines.

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

Apply spatially — If checked, the filter is applied in the horizontal direction.

Spatial smoothing operator — Enter the degree of the smoothing operator in the horizontal direction.

Apply temporally (or in depth) — If checked, the filter is applied in the vertical direction defined either in time or depth domain.

Temporal smoothing operator — Enter the degree of the smoothing operator in the vertical direction, either in time or depth domain.

Define a window — If checked, the smoothing will be applied only within the specified window

Window smoothing parameter — Enter the smoothing operator value between the window and the rest of the record.

First trace — Enter first trace defining the window. {>=0}

Last trace — Enter last trace defining the window. {>=0}

First sample — Enter first sample defining the window. {>=0}

Last sample — Enter last sample defining the window. {>=0}

2D Median Filter

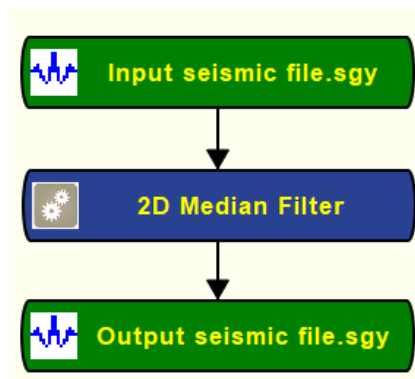
Usage: The 2D Median Filter step is a single channel filter that may be used to remove spikes from the seismic data or any other features, such as the wow in radar, which may be filtered by a median operator.

The step allows to enter the side-length in samples and traces of the square window used for calculating the median value.

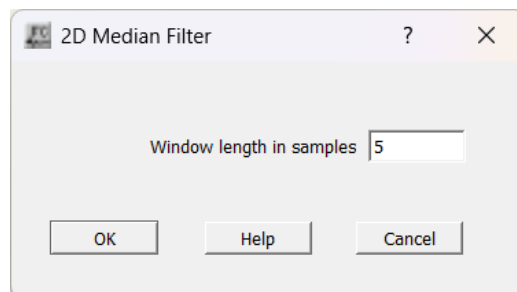
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Window length in samples — Enter the number of samples in the window over which the median will be calculated. The sample at the windows center will be replaced by the calculated median value. {>=0}

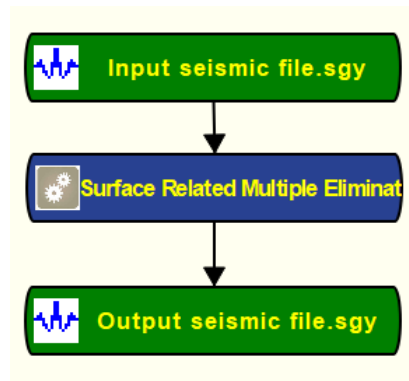
2D Surface Related Multiple Elimination

Usage: The 2D Surface Related Multiple Elimination step applies a multiple attenuation filter based on the surface modelling

Input Links: 1) Seismic data in any sort order (required).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

2D Surface Related Multiple Elimination

Data geometry

Nominal shot spacing: 0.50

Number of offsets: 48

Maximum offset: 50.0

Sea Velocity: 1500

☒ Mute above seabed

Downward Reflection Points

Minimum DRPs: 20

Maximum DRPs: 100

Generation of DRP data

☐ Use nearest offset

☒ Interpolate

Seabed time definition

☒ Use input header: User defined 5

☐ Use constant time: 0.0

Spherical Divergence

☒ Pre apply correction

☒ Post-remove correction

☐ UseFreqFilter

Output

☐ Initial multiple model

☐ Matched multiple model

☒ Data, surface-related multiples attenuated

Frequency filtering

Minimum frequency (Hz): 0

Minimum full amplitude frequency (Hz): 400

Maximum full amplitude frequency (Hz): 1500

Maximum frequency (Hz): 2500

Multiple matching

Match ensemble

☒ Shot gathers

☐ Constant offset windows

Matching filter length (samples): 20

Width (traces): 100

Spatial overlap (%): 20

OK Help Cancel

Parameter Description:

The **Data geometry** specifies the shot and offset relationship to be considered.

Nominal shot spacing — Enter the nominal shot spacing. This will be used to determine the spacing of the Downward Relocation Points.

Number of offsets — Enter the number of data offset. This will be used along with the shot spacing to determine the number of Downward Reflection Points that a shot will contribute to.

Maximum offset — Enter the maximum data offset. This will be used along with the shot spacing to determine the number of Downward Reflection Points that a shot will contribute to.

Sea Velocity — Enter the seawater velocity that will be used to estimate the direct arrival time for muting.

Mute above seabed — If checked, mute data up to and including the direct arrivals before deriving the multiples.

The **Downward Reflection Points** specify the downward reflection points (DRPs) to be used.

Minimum DRPs — Enter the minimum number of contributing downward reflection points (DRP) from any individual data trace. This minimum will typically apply to low offset traces.

Maximum DRPs — Enter the maximum number of contributing downward reflection points (DRP) from any individual data trace. This maximum will typically limit the number of DRPs to which a high offset trace contributes.

The **Generation of DRP data** specify how downward reflection points (DRP) are generated.

Use nearest offset — If checked, use the nearest offset for the generation of DRP data.

Interpolate — If checked, interpolate the offsets for the generation of DRP data.

The **Spherical Divergence** specify the spherical divergence correction to be applied.

Pre apply correction — If checked, pre apply a spherical divergence correction to the data before the step application.

Post-remove correction — If checked, remove the spherical divergence correction after applying the step. If checked, the output seismic file will have no spherical divergence correction.

Sph div exponent — Select the exponent of the spherical divergence correction.

Use Freq Filter — If checked, use a frequency filtering in the multiple elimination.

Maximum frequency (Hz) — Select the maximum frequency (in Hz) for the frequency filtering.

Minimum full amplitude frequency (Hz) — Select the minimum full amplitude frequency (in Hz) for the frequency filtering.

Maximum full amplitude frequency (Hz) — Select the maximum full amplitude frequency (in Hz) for the frequency filtering.

The **Output** specify the type of output.

Initial multiple model — If selected, output the initial multiple model.

Matched multiple model — If selected, output the matched multiple model.

Data, surface-related multiples attenuated — If selected, output the surface related multiples.

Maximum frequency (Hz) — To select the maximum frequency, in Hz, to performer the elimination of multiple.

The **Multiple matching** specify the multiple matching parameters.

Matching filter length (samples) — To select the number of samples of the matching filter.

The **Match ensemble** specifies the domain where the matching filter will be applied.

Shot gathers — If checked, use shot gathers for matching.

Constant offset windows — If checked, use constant offset windows.

Width (traces) — If selected, enter the number of traces for the constant offset window.

Spatial overlap (%) — If selected, enter the spatial overlap between windows.

3D Diffusion Filter

Usage: The 3D Diffusion Filter step is an anisotropic diffusion filter which performs edge-preserving smoothing in three dimensions. It is intended to be used to enhance post-stack 3D data. Anisotropic diffusion is applied following structure in three dimensions using the Kuwahara filter. For this reason, estimation of the dip field is a required integral initial step. Parameters to control dip estimation are therefore required in addition to the diffusion parameters.

The input data in the form of time traces does not require prior slicing or transformation.

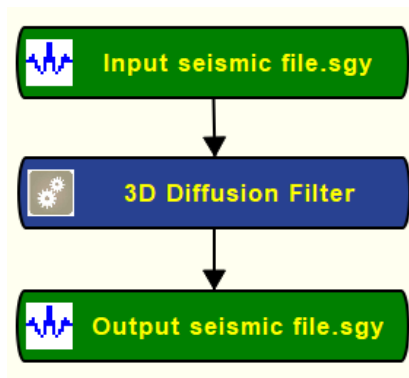
Due to parallel data handling, the output from 3D Diffusion Filter must be written directly to disk using Seismic File without further processes in that job flow.

Input Links: 1) 3D seismic data ordered by CMP Line and CMP Location (mandatory).

Output Links: 1) 3D seismic data ordered by CMP Line and CMP Location (mandatory).

Reference: Fehmers, G.C, and Hocker, C.F.W., 2003, Fast structural interpretation with structure-oriented filters, Geophysics, vol. 68, no. 4, p. 1286-1293.

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Dip Estimation Parameters** defines the parameters for dip estimation that is used for the edge preserving filter.

Maximum Dip (ms/trace) — Enter the maximum dip to be considered in the filter.

Correlation window length (ms) — Enter the correlation window length for the dip scanning. An initial stage of dip estimation is cross-correlation of adjacent traces. This length should be sufficient to obtain stable dip estimates without being so long as to lose local structure changes. $\{ \geq 0 \}$

Threshold coherency (%) — Enter a normalized correlation values must exceed this % for the estimated dip at a point to be considered valid.

Use quadratic interpolation — If checked, the dips are better estimated using a quadratic estimation formula.

The **Diffusion Parameters (Tukey)** defines parameters that allow distinguishing noise from signal.

Sigma (%) — Enter the noise threshold as a percentage of standard deviations.

Lambda (%) — Enter the percentage of new values to add on each filter iteration.

Number of iterations — Enter the number of filter iteration to apply to the input data.

Output dip field only — If checked, only the estimated inline or cross-line dip field will be output. This is for diagnostic use: If the estimated dip field output is not smooth and contains spikes then the diffusion process will not be optimal. In this case the dip estimation parameters should be modified until a reasonable dip field is output.

The **Dip field diagnostic output** defines parameters related to dip field where the diagnostic is performed.

In-line dip field (ms/trace) — If selected, the dip field output will be the estimated in-line dip field.

Crossline dip field (ms/trace) — If selected, the dip field output will be the estimated crossline dip field.

3D Median Filter

Usage: The 3D Median Filter step is a filter with multiple uses which may be used for both single and multi-channel processing.

The input data in the form of time traces does not require prior slicing or transformation.

In 'Apply' mode, 3D Median Filter replaces the input data samples with the median value of the surrounding values as specified by the filter size. In this mode the filter may be used to enhance post-stack 3D, common offset or pre-stack data by the application of short length median filters. For example, for post-stack 3D data the default filter 3-3-3 will replace the value of every sample with the median of its 27 surrounding samples.

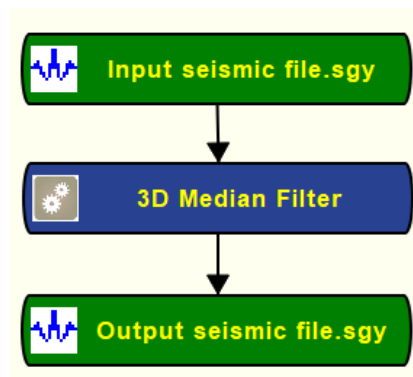
In 'Remove' mode, 3D Median Filter subtracts from the input data samples the median value of the surrounding values as specified by the filter size. In this mode the filter may be used to remove low frequency noise. For example the filter 1-1-41 will act as a trace independent low frequency removal filter, or 1-1-5 as a high frequency removal filter.

One- and two-dimensions median filters in any orientation (using a length of one in the other dimension(s)) will be quite fast. Filters which are long in all three dimensions are not recommended.

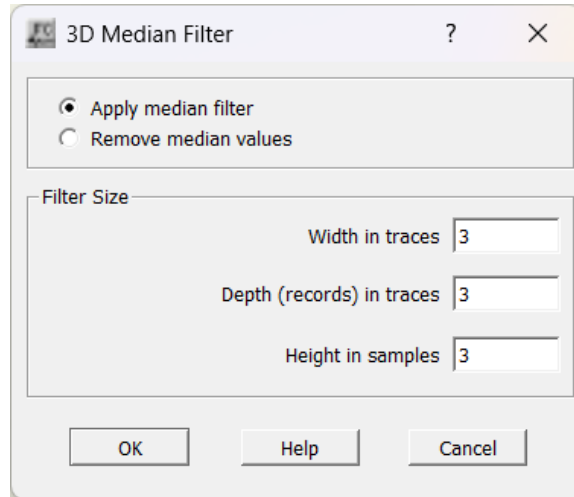
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Apply median filter — If checked, the data will be replaced by the median values as calculated by the specified filter. Use to enhance the data by removing random noise with a short filter in two or three dimensions.

Remove median filter — If checked, the median values as calculated by the specified filter will be subtracted from the input data. Use to remove low frequency noise with a long filter in one or two dimensions

The **Filter Size** defines the size of the filter to be applied.

Width in traces — Enter the number of traces within each record used to estimate median values. {>=0}

Depth (records) in traces — Enter the number of neighboring records used to estimate median values. Note: this assumes sufficient similarity of adjacent records such as use in post-stack 3d data. {>=0}

Height in samples — Enter the median filter length in the trace direction. {>=0}

Adaptive Radon Demultiple

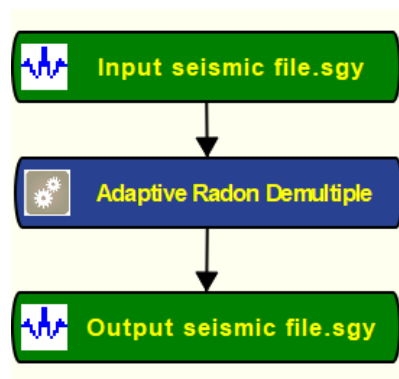
Usage: The Adaptive Radon Demultiple step performs parabolic radon demultiple through a modeling of primaries, multiples, and noise in the parabolic radon domain followed by subtraction of multiples and noise in the time domain. The step allows to specify the transform type, the range of ray parameters in the output transform, a percentage of multiples plus noise to subtract, and the spatial and temporal taper lengths used to generate the transform.

Input Links: 1) Seismic data in any sort order (required).

Output Links: 1) Seismic data in any sort order (required).

Reference: Hampson, D., 1991, Inverse velocity stacking for multiple elimination, Journal of the Canadian Society of Exploration Geophysics, 22, p. 44-55.

Example Flowchart:



Step Parameter Dialog:

Adaptive Radon Demultiple

Time window

☐ Limit application time

☒ Start time referenced to horizon

Multiplier for time horizon

☒ Use constant start time

Start time (ms)

Length of taper zone (ms)

Ray parameters

☒ Set number of ray parameters

Number of ray parameters

Bandpass filter

Low cut (Hz)

Low pass (Hz)

High pass (Hz)

High cut (Hz)

Model moveout

☒ Use differential moveout

Minimum

Maximum

Minimum multiple

☐ Define maximum reference offset

Maximum reference offset

☐ Use velocity

Minimum moveout

Maximum moveout

Minimum multiple moveout

Reference time (sec)

Additional parameters

Percent add-back

Percent pre-whitening

Minimum live traces

AGC window

☐ Apply and remove AGC

AGC operator length (ms)

Type of output

☒ Estimated primaries

☐ Multiple model

OK Help Cancel

Parameter Description:

The **Time window** specifies the time parameters used in the radon demultiple.

Limit application time — If checked, the application time for the filter may be limited by using an input horizon or by using a constant time.

Start time referenced to horizon — If selected, reference start time to a horizon for the filter.

Multiplier for time horizon — Enter the multiplier for be applied to the horizon to define the time window.

Use constant start time — If selected, use a constant time for limiting the application zone for the filter.

Start time (ms) — Enter the start time in milliseconds for the application window of the filter. {>=0}

Length of taper zone (ms) — Enter the taper length for the transition zone for the windows. A Hanning taper is used. {>=0}

The **Ray parameters** specifies the ray parameters.

Set number of ray parameters — If checked, the number of ray parameters to be calculated will be the number entered below. If not checked, the number of ray parameters will be equal to the number of traces in the input gather.

Number of ray parameters — Enter the constant number of ray parameters to calculate for each gather.

The **Bandpass filter** specify bandpass filter parameters.

Low-cut (Hz) — Enter the low-cut frequency, in Hertz, for the bandpass filter.

Low pass (Hz) — Enter the low pass frequency, in Hertz, for the bandpass filter.

High pass (Hz) — Enter the high pass frequency, in Hertz, for the bandpass filter.

High cut (Hz) — Enter the high cut frequency, in Hertz, for the bandpass filter.

The **Model moveout** set the range of parabolas that will generate the primary and multiple models.

Use differential moveout — If selected, specify the radon parameters in terms of differential moveout at far offset.

Minimum — Enter the minimum differential moveout for calculation of the radon transform expressed in milliseconds on the far-offset trace. The primary model is generated with parabolas from the <minimum differential moveout> to the <minimum multiple moveout>.

Maximum — Enter the maximum differential moveout for the calculation of the radon transform expressed in milliseconds on the far-offset trace. The multiple model is generated with parabolas from the <minimum multiple moveout> to the <maximum differential moveout>.

Minimum multiple — Enter the minimum multiple differential moveout for the radon filter expressed in milliseconds on the far-offset trace. All data between the minimum multiple differential moveout and the maximum differential moveout will be removed by the filter. The multiple model is generated with parabolas from the <minimum multiple moveout> to the <maximum differential moveout>.

Use velocity — If selected, specify the radon filter parameterization using velocities.

Minimum moveout — Enter the minimum (negative usually) velocity for the radon transform calculation.

Maximum moveout — Enter the maximum velocity for the radon transform calculation.

Minimum multiple moveout — Enter the minimum multiple moveout velocity for the radon filter. The filter will remove data between the minimum multiple moveout velocity and the maximum multiple moveout velocity.

Define maximum reference offset — If checked, a constant maximum offset will be used for the calculation of the radon transform. The differential moveouts will be the delta times at this specified offset.

Maximum reference offset — Enter a constant maximum offset to be used for the calculation of the radon transform. The differential moveouts will be the delta times at this specified offset.

Reference time (sec) — Enter the reference time in seconds where the velocities are specified. This is used to convert the velocities to differential moveout for the radon algorithm.

The **Additional parameters** specify additional parameters.

Percent add-back — Enter the percentage of the original data to be blended with the output filtered data.

Percent pre-whitening — Enter the percentage of pre-whitening to apply to the data for stabilizing the algorithm.

Minimum live traces — Enter the minimum number of live traces per gather for applying the filter. Gathers with fewer traces will be passed through to the output with no filtering applied.

The **AGC window** set the parameters for an AGC window.

Apply and remove AGC — If checked, apply an AGC before the filter and remove the same AGC after the filter.

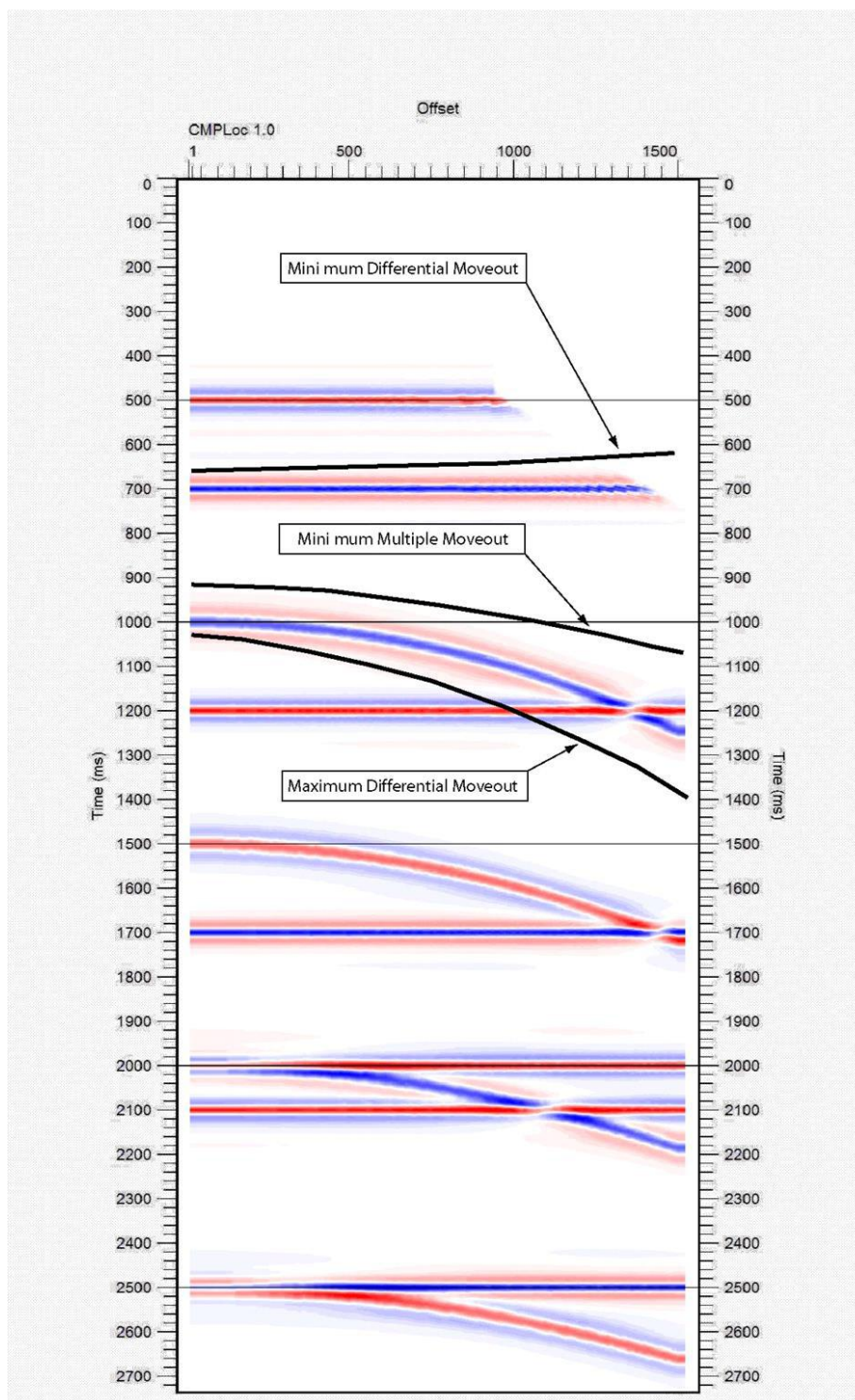
AGC operator length (ms) — Enter the AGC operator length in milliseconds.

The **Type of output** will selected the type of output desired.

Estimated primaries — If selected, output the estimated primaries.

Multiple model — Output the multiple data.

Example of Adaptive Radon Demultiple



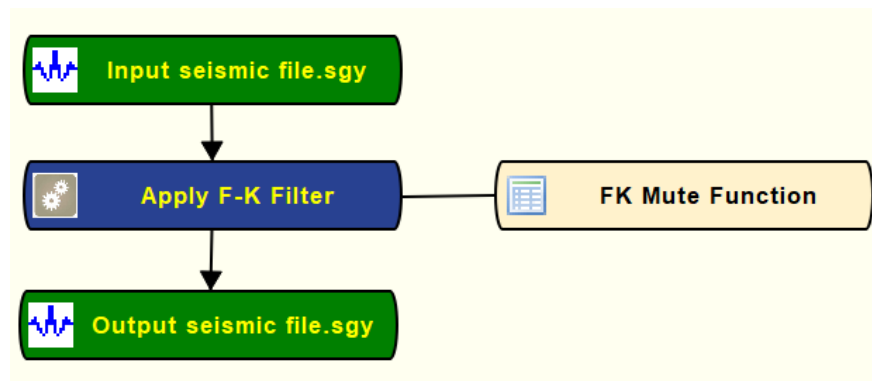
Apply F-K Filter

Usage: The Apply F-K Filter step transforms T-X domain data to the F-K domain, applies a specified F-K reject filter, and returns the data to the T-X domain. F-K Filters are picked interactively as Surgical Mutes using the Pick Traces tool located in the Picking menu.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Surgical Mutes cards (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Filter description** specify how the F-K filter is parameterized.

Apply fk mute picks — If selected, apply fk filter based on picked polygons.

Negative wavenumber — If selected, apply fk filter to all negative wavenumbers.

Positive wavenumber — If selected, apply fk filter to all positive wavenumbers.

The **Filter type** defines the type of F-K Filter.

Reject filter — If selected, the polygon area is rejected.

Pass filter — If selected, passes the polygon area.

The **Taper type** selects the type of taper to use when applying the F-K mute function.

Hanning — If selected, apply a Hanning taper is specified by the equation:

$$x(n) = 0.5 - 0.5 * \cos\left(2 * \pi * \frac{n}{N}\right)$$

Hamming — If selected, apply a Hamming taper is specified by the equation:

$$x(n) = 0.54 - 0.46 * \cos\left(2 * \pi * \frac{n}{N}\right)$$

Blackman — If selected, apply a Blackman taper is specified by the equation:

$$x(n) = 0.42 - 0.5 * \cos\left(2 * \pi * \frac{n}{N}\right) + 0.08 * \cos\left(4 * \pi * \frac{n}{N}\right)$$

No taper — If selected, no taper will be applied to the mute. This may result in problems in later processing steps due to Gibbs effect.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **AGC window** defines the AGC filter parameters before applying the F-K filter.

Apply and remove AFC — If checked, an AGC is applied to each trace before filtering. The AGC gain function is removed after filtering.

AGC operator length (ms) — Enter the length of the AGC filter in milliseconds. {>=0}

Specify trace spacing — If checked, specify manually the space between traces in record. Otherwise uses the trace spacing from headers. By default, the group interval is read from the seismic data and the trace-to-trace spacing is calculated from the group interval. If the Geometry Definition step has not been applied to the data, the seismic data will not contain information regarding the group interval and this option should be used.

Trace spacing (m or ft) — Enter the trace interval in m or ft, depending on the project units. {>=0}

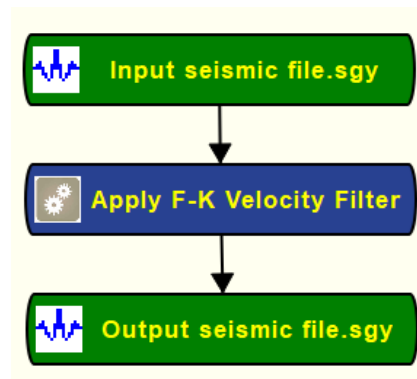
Apply F-K Velocity Filter

Usage: The Apply F-K Velocity Filter step transforms T-X domain data to the F-K domain, applies an F-K pass or reject filter, and returns the data to the T-X domain. A user-specified minimum and maximum velocity defines the pass or reject zone.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Apply F-K Velocity Filter

Minimum filter velocity

Maximum filter velocity

☐ Specify trace spacing

True trace spacing (m or ft)

Filter type

☒ Reject filter ☐ Pass filter

AGC window

☐ Apply and remove AGC

AGC operator length (ms)

Velocity type

☒ Double sided

☐ Single sided (positive offsets)

☐ Single sided (negative offsets)

Taper type

☒ Hanning ☐ Hamming

☐ Blackman ☐ No taper

Taper length (samples)

OK Help Cancel

Parameter Description:

Minimum filter velocity — Enter the minimum velocity of the pass or reject zone.

Maximum filter velocity — Enter the maximum velocity of the pass or reject zone.

Specify trace spacing — If checked, manual set the trace-to-trace spacing in the record to be filtered. By default, the group interval is read from the seismic data and the trace-to-trace spacing is calculated from the group interval. If the Geometry Definition step has not been applied to the data, the seismic data will not contain information regarding the group interval and this option should be used.

True trace spacing (m or ft) — Enter the trace interval in m or ft, depending on the project units. {>=0}

The **Velocity type** specify whether the applied F-K filter will be symmetrical or asymmetrical.

Double sided — If selected, the specified minimum and maximum velocities will be used to create a double-sided, or symmetrical F-K filter.

Single sided (positive offsets) — If selected, the specified minimum and maximum velocities will be used to pass or reject energy propagating in the direction of increasingly positive source-to-receiver offset.

Single sided (negative offsets) — If selected, the specified minimum and maximum velocities will be used to pass or reject energy propagating in the direction of increasingly negative source-to-receiver offset.

The **Filter type** specify whether the minimum and maximum velocity values specify a pass or a reject zone.

Reject filter — If selected, the portion of F-K space defined by the minimum and maximum velocities will be rejected.

Pass filter — If selected, the portion of F-K space defined by the minimum and maximum velocities will be passed.

The **AGC window** defines the AGC filter parameters before applying the F-K filter.

Apply and remove AGC — If checked, an AGC is applied to each trace before filtering. The AGC gain function is removed after filtering.

AGC operator length (ms) — Enter the length of the AGC filter in milliseconds.

The **Taper type** selects the type of taper to use when applying the F-K mute function.

Hanning — If selected, apply a Hanning taper is specified by the equation:

$$x(n) = 0.5 - 0.5 * \cos\left(2 * \pi * \frac{n}{N}\right)$$

Hamming — If selected, apply a Hamming taper is specified by the equation:

$$x(n) = 0.54 - 0.46 * \cos\left(2 * \pi * \frac{n}{N}\right)$$

Blackman — If selected, apply a Blackman taper is specified by the equation:

$$x(n) = 0.42 - 0.5 * \cos\left(2 * \pi * \frac{n}{N}\right) + 0.08 * \cos\left(4 * \pi * \frac{n}{N}\right)$$

No taper — If selected, no taper will be applied to the mute. This may result in problems in later processing steps due to Gibbs effect.

Taper length — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

Butterworth Dip Filtering

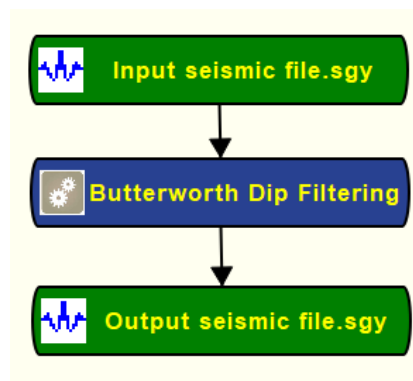
Usage: The Butterworth Dip Filtering step is a single channel filter that may be used to pass or reject dipping data. The data is transformed into the frequency domain, where the Butterworth dip filter is applied. Common usage includes suppression of dipping noise from pre-stack data.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Hale, D. and Claerbout, J.F., 1983, Butterworth dip filters, Geophysics, v. 48, p. 1033-1038.

Example Flowchart:



Step Parameter Dialog:

Butterworth Dip Filtering

Filter type

☒ Pass ☐ Reject

Dip specification

☒ Milliseconds per trace ☐ Velocity

Minimum dip Minimum velocity

Maximum dip Maximum velocity

Poles

Number of poles

Amplitude selection

☒ Relative amplitude ☐ True amplitude

Frequency range

Maximum frequency

OK Help Cancel

Parameter Description:

The **Filter type** defines if the filter is applied in the Pass or Reject mode.

Pass — If checked, the filter will pass dipping data over the specified range of dips.

Reject — If checked, the filter will reject dipping data over the specified range of dips.

The **Dip specification** specify parameters related to dip estimation.

Milliseconds per trace — If selected, the range of dips required must be input in terms of milliseconds per trace.

Minimum dip — Enter the minimum dip to be considered.

Maximum dip — Enter the maximum dip to be considered.

Velocity — If selected, the range of dips required must be input in terms of apparent velocity.

Minimum velocity — Enter the minimum velocity to be considered.

Maximum velocity — Enter the maximum velocity to be considered.

The **Poles** define number of poles in the filter.

Number of poles — Enter the number of poles for the Butterworth dip filter. A larger number of poles for a sharper cut-off of the pass or reject zone.

The **Amplitude selection** select type of amplitude.

Relative amplitude — If checked, the data is equalized to relative amplitude before application of the filter.

True amplitude — If checked, the filter is directly applied to the frequency domain data.

The **Frequency range** specifies the frequency range of the filter.

Maximum frequency — Enter the maximum frequency to be used. The greatest frequency to be maintained and dip filtered.

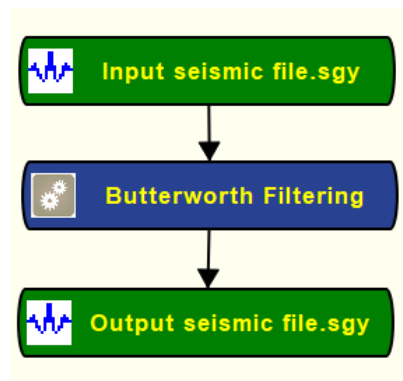
Butterworth Filtering

Usage: The Butterworth Filtering step allows to apply recursively a Butterworth filter to the seismic trace data in the time domain. You specify the low-pass, high-pass and high and low rolloff rates in decibels (dB) for the filter. The step allows to apply the filter as either a zero phase or minimum phase filter.

Input Links: 1) Seismic data in any sort order (mandatory);

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Butterworth Filtering'. It contains several sections for configuring the filter:

- Remove DC Bias (mean value):** A checkbox that is checked.
- Low-cut filtering:** A section with a checked 'Apply low-cut filter' checkbox. Below it are two input fields: 'Low-cut corner frequency (Hz)' with the value '9' and 'Low-cut rolloff rate (dB/oct)' with the value '18'.
- High-cut filtering:** A section with a checked 'Apply high-cut filter' checkbox. Below it are two input fields: 'High-cut corner frequency (Hz)' with the value '72' and 'High-cut rolloff rate (dB/oct)' with the value '18'.
- Phase type selection:** A section with two radio buttons: 'Zero-phase' (which is selected) and 'Minimum-phase'.

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Remove DC Bias (mean value) — If checked, applies a DC bias filter with the Butterworth filter.

The **Low-cut filtering** specifies the low-cut filter parameters.

Apply low-cut filter — If checked, a low-cut filter will be applied to the seismic data.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

The **High-cut filtering** specifies high-cut filter parameters.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

The **Phase type selection** selects the phase type of the filter.

Zero-phase — If selected, a zero-phase filter is applied.

Minimum-phase — If selected, a minimum-phase filter is applied.

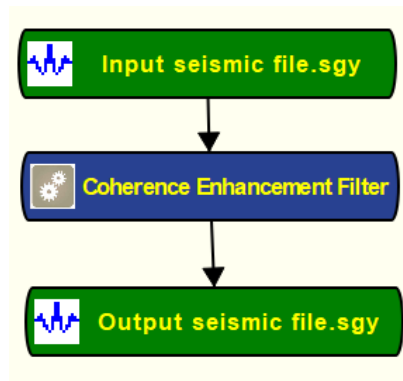
Coherence Enhancement Filter

Usage: The Coherence Enhancement Filter is used to accentuate the visual coherence of seismic events.

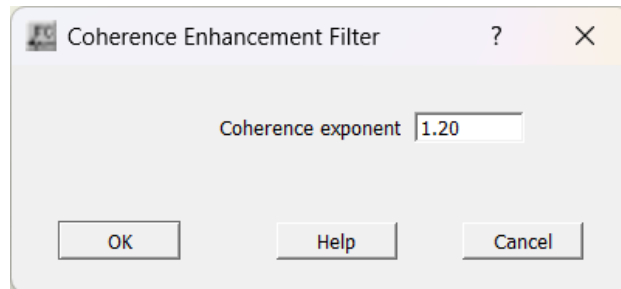
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Coherence exponent — Enter the coherency filter exponent. Values of 1 to 1.5 are usually used. A value of 1 does nothing. A value of 1.5 significantly increases coherency. The exponent is applied to the data in the F-K domain.

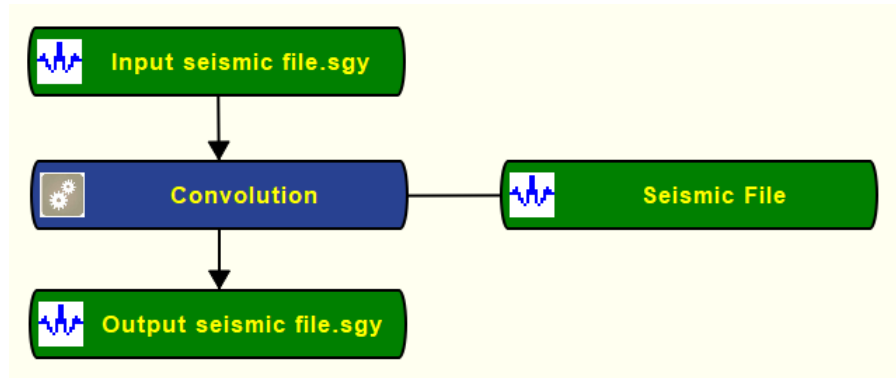
Convolution

Usage: The Convolution step is used to convolve traces in a seismic data file with a filter function specified in an auxiliary data set defined as seismic file or auxiliary text file.

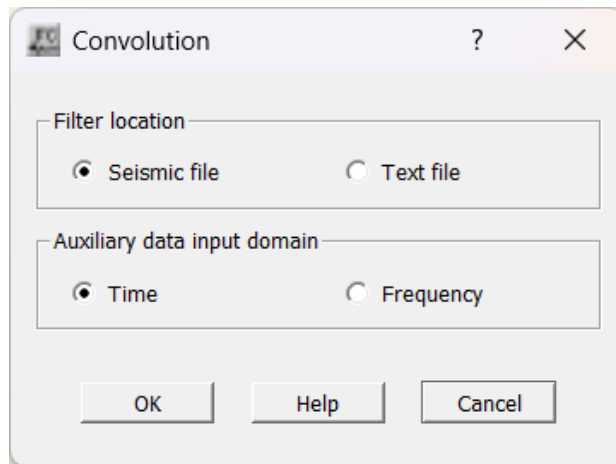
Input Links: 1) Seismic data in any sort order (mandatory); 2) Auxiliary file in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Filter location** specifies the filter location, which can be in the form of a seismic or text file.

Seismic file — If selected, the filter is defined in an auxiliary seismic file.

Text file — If selected, the filter is defined in an auxiliary text file.

The **Auxiliary data input domain** specifies domain of the input data.

Time — If selected, the input data domain is time.

Frequency — If selected, the input data domain is frequency.

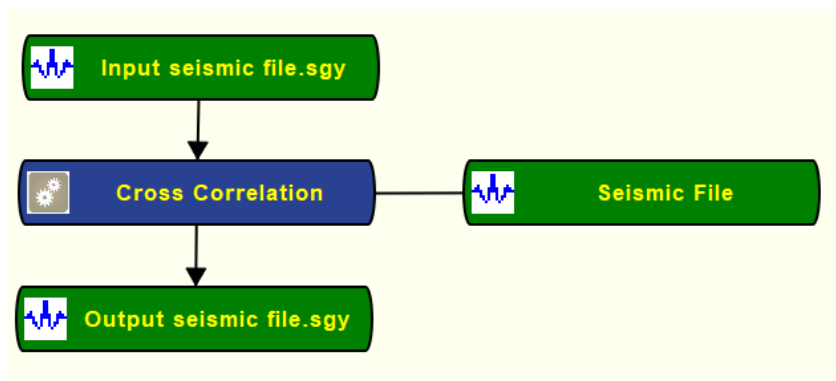
Cross Correlation

Usage: The Cross Correlation step computes the cross correlation between an input seismic data and an auxiliary seismic data.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Auxiliary Seismic data in any sort order (mandatory). Both input files must be in the same sort order.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The Cross Correlation dialog box contains the following parameters:

- Input data:**
 - Window start time: 0.00
 - Window end time: 1000.00
- Auxiliary data:**
 - Window start time: 0.00
 - Window end time: 0.00
 - ☐ One input trace per record
 - ☒ One input trace per dataset
- Zero lag time:** 500.00
- Output length (ms):** 1000.00
- Buttons:** OK, Help, Cancel

Parameter Description:

The **Input data** specifies the parameters for input seismic file.

Window start time — Enter the window start time for input seismic file in milliseconds. {>=0}

Window end time — Enter the window end time for input seismic file in milliseconds. {>=0}

The **Auxiliary data** specifies the parameters for auxiliary data file.

Window start time — Enter the window start time for auxiliary seismic file in milliseconds. {>=0}

Window end time — Enter the window end time for auxiliary seismic file in milliseconds. {>=0}

One input trace per record — If selected, the auxiliary data is considered to have one input trace per record.

One input trace per dataset — If selected, the auxiliary data is considered to have one input trace per dataset.

Zero lag time — Enter the zero-lag time for the cross correlation in milliseconds.

Output length (ms) — Enter the output length of the cross correlation in milliseconds.

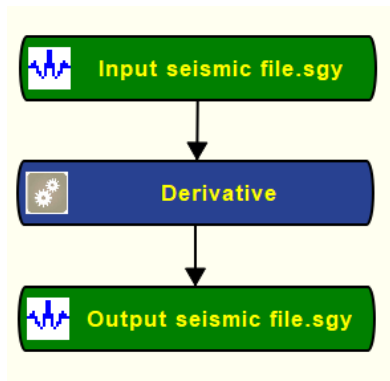
Derivative

Usage: The Derivative step computes the derivative of the data samples in each input seismic trace.

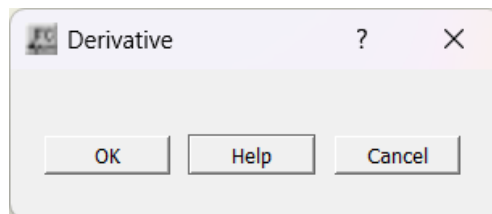
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description: There are no defined parameters for this step.

Diffusion Filter

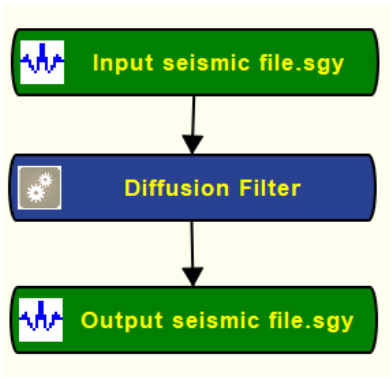
Usage: The Diffusion Filter is a noise reduction filter based on the diffusion equation. The filter performs both smoothing and edge preservation. The most common usage is to enhance post-stack 3D data by applying Diffusion Filter to time slices. Use Time Slice (Processing Category Display) in a prior job flow to convert such data to time slices for input to Diffusion Filter. After Diffusion Filter, use Time Slice to Trace (Processing Category Display) in a further job flow to revert the filtered data to normal order. An alternative to Diffusion Filter for enhancing post-stack 3D data is use of 3D Diffusion Filter.

Input Links: 1) Seismic data in any sort order (mandatory).

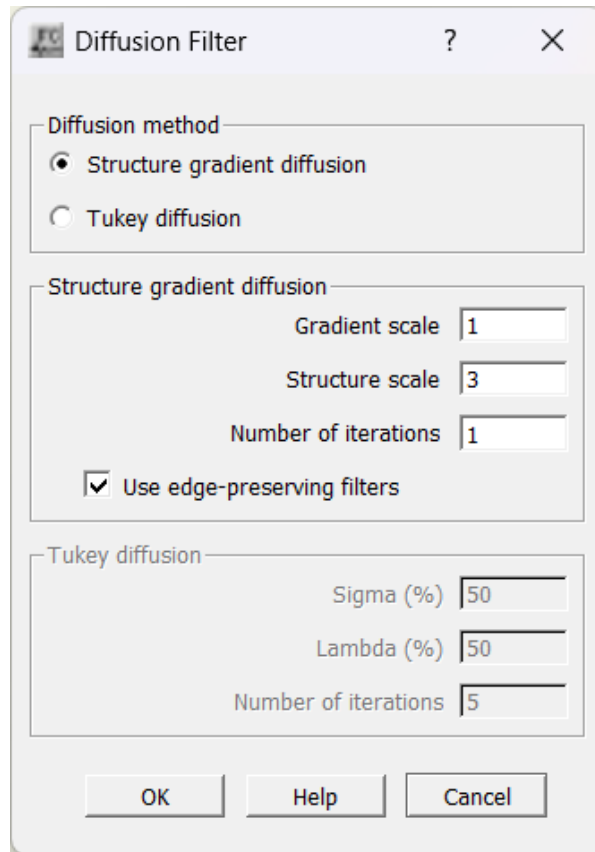
Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Fehmers, G.C, and Hocker, C.F.W., 2003, Fast structural interpretation with structure-oriented filters, Geophysics, vol. 68, no. 4, p. 1286-1293.

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Diffusion method** defines the type of diffusion filter to be used.

Structure gradient diffusion — If selected, use structure-oriented filtering (Fehmers & Hocker).

Tukey diffusion — If selected, use an anisotropic diffusion using the Kuwahara filter.

The **Structure gradient diffusion** specifies the structure gradient diffusion, if **Structure gradient diffusion** is selected.

Gradient scale — Enter the number of standard deviation of 2D Gaussian filter used for smoothing the input data prior to gradient calculation.

Structure scale — Enter the number of standard deviation of 2D Gaussian filter used for smoothing the gradient tensors prior to Eigen decomposition.

Number of iterations — Enter the number of filter iteration to apply to the input data.

Use edge-preserving filters — If checked, a continuity (coherence) factor is calculated that inhibits diffusion across edges.

The **Tukey diffusion** specifies the parameters of the Tukey filter, if Tukey diffusion is selected

Sigma (%) — Noise threshold as a percentage of standard deviations.

Lambda (%) — Percentage of new values to add on each filter iteration.

Number of iterations — Number of filter iteration to apply to the input data.

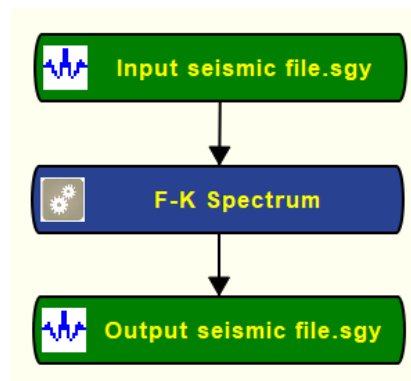
F-K Spectrum

Usage: The F-K Spectrum step allows to create F-K spectrum image plots of the seismic data for designing F-K filters.

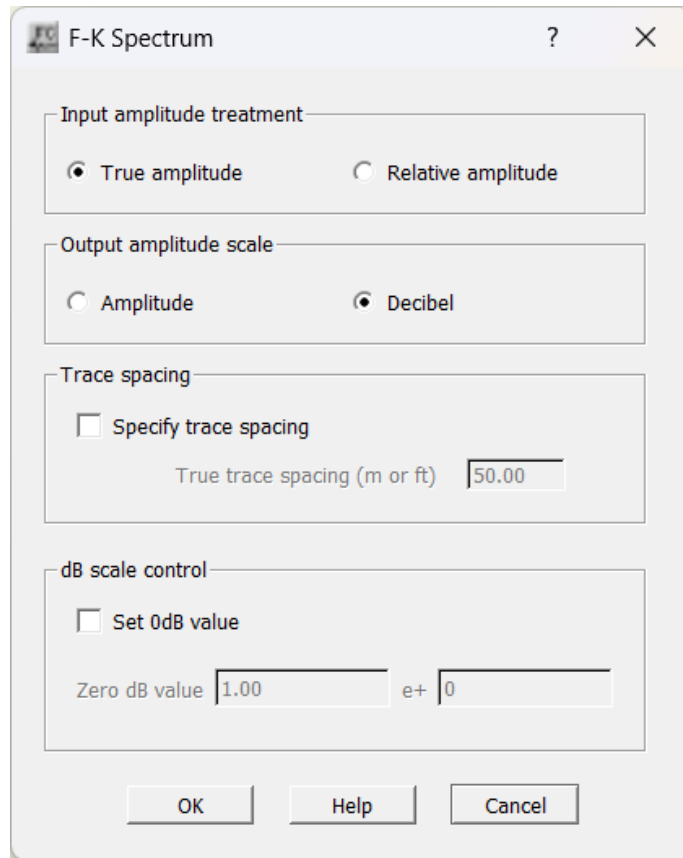
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data containing F-K spectrum (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "F-K Spectrum". It contains four main sections: "Input amplitude treatment" with radio buttons for "True amplitude" (selected) and "Relative amplitude"; "Output amplitude scale" with radio buttons for "Amplitude" and "Decibel" (selected); "Trace spacing" with a checkbox for "Specify trace spacing" (unchecked) and a text field for "True trace spacing (m or ft)" set to "50.00"; and "dB scale control" with a checkbox for "Set 0dB value" (unchecked) and two text fields for "Zero dB value" (set to "1.00") and "e+" (set to "0"). At the bottom are "OK", "Help", and "Cancel" buttons.

Parameter Description:

The **Input amplitude treatment** selects the amplitude to use as input to the F-K transform, either relative or true amplitude.

True amplitude — If selected, use the true seismic amplitude as in the input seismic traces for the analysis. True amplitude traces are scaled by one common factor per record.

Relative amplitude — If selected, use relative seismic amplitude scaled traces in the analysis. Relative amplitude traces are scaled independently of one another.

The **Output amplitude scale** selects the output amplitude scale, either absolute amplitude or dB down from the maximum.

Amplitude — If selected, the output amplitude scale is set absolute amplitude.

Decibel — If selected, the output amplitude scale is set in dB down from the maximum.

The **Trace spacing** defines manually the trace spacing to be considered and overwrites information from the seismic trace headers.

Specify trace spacing — If checked, specify manually the space between traces in record. Otherwise uses the trace spacing from headers. By default, the group interval is read from the seismic data and the trace-to-trace spacing is calculated from the group interval. If the Geometry Definition step has not been applied to the data, the seismic data will not contain information regarding the group interval and this option should be used.

True trace spacing (m or ft) — Enter the trace interval in m or ft, depending on the project units. {>=0}

The **dB scale control** sets zero dB amplitude for comparison of two dB scale images.

Set 0dB value — If checked, the zero dB amplitude value may be entered. Using this option allows to compare two dB scale images.

Zero dB value — Enter the Zero dB value and its exponent.

F-X Deconvolution

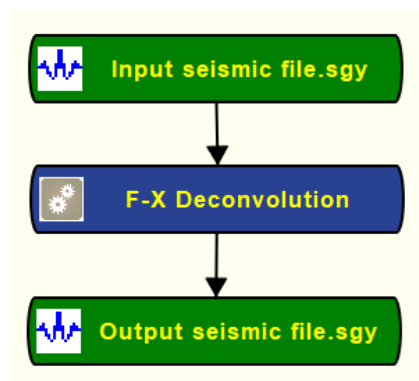
Usage: The F-X Deconvolution step is a 2D multi-channel noise filter designed to attenuate random noise. This time-variant, adaptive filter removes the non-predictable part of the data using the assumption that the signal portion of the data is predictable and the noise portion of the data is inherently random, and therefore non-predictable. The step allows to specify the length of the filter window, in samples, the width of the filter window, in traces, and the filter adaptation percent.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Hornbostel, S., 1991, Spatial prediction filtering in the t-x and f-x domain, Geophysics, v. 56, no 12, p. 2019-2026.

Example Flowchart:



Step Parameter Dialog:

F-X Deconvolution

Design window length

☒ Whole trace

☐ Specify length

Length (ms)

Taper length (ms)

Design window width

☒ Entire record

☐ Specify width

Width (traces)

Prediction filter

Width (traces)

Processing Frequency Range

Minimum frequency (Hz.)

Maximum frequency (Hz.)

OK Help Cancel

Parameter Description:

The **Design window length** specifies the length of the window of the filter.

Whole trace — If selected, the filter is equal to the length of the input seismic trace.

Specify length — If selected, the length of the filter is defined manually.

Length (ms) — Enter the length of the filter in milliseconds. {>=0}

Taper length (ms) — Enter the taper length of the filter in milliseconds. {>=0}

The **Design window width** specifies the width of the filter.

Entire record — If selected, the width of the filter is equal to the number of traces of the input record.

Specify width — If selected, the width of the filter is manually defined.

Width (traces) — Enter the width of the filter in number of traces.

The **Prediction filter** specifies the size of the prediction filter.

Width (traces) — Enter the width of the prediction filter in number of traces.

The **Processing Frequency Range** specifies the frequency band where the filter is going to be applied.

Minimum frequency (Hz.) — Enter the minimum frequency value, in Hertz, of the frequency band. {>=0}

Maximum frequency (Hz.) — Enter the maximum frequency value, in Hertz, of the frequency band. {>=0}

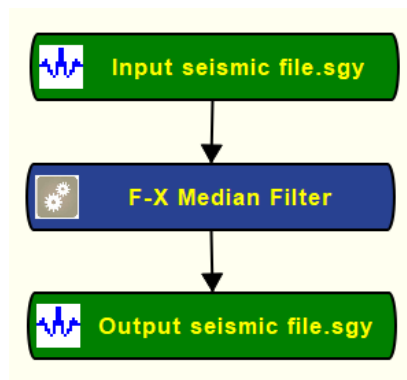
F-X Median Filter

Usage: The F-X Median Filter step is a single channel filter that may be used to remove spikes or other noise from the seismic data without damaging dipping data. The operator is applied in the temporal frequency domain using fully overlapping cosign-tapered window panes of specified height. A horizontal 1D median filter is applied to the frequency amplitudes whilst leaving the phase unchanged. Either the entire dataset or a specified tapered time window may be filtered. The input data in the form of time traces and does not require prior slicing or transformation.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

F-X Median Filter

Parameters

Filter width in traces

Overlapping panes' height (ms)

Data selection

☒ All data

☐ Specified extent

Processing aperture

Start time (ms.)

End time (ms.)

Taper length (ms.)

OK Help Cancel

Parameter Description:

The **Parameters** specify the median filter parameters.

Filter width in traces — Enter the width in number of traces of the spatial median filter to be applied to each temporal frequency component.

Overlapping panes' height (ms) — Enter the height in milliseconds of each of the fully-overlapping cosine-tapered panes from which frequency components are derived. In general, shorter panes will exhibit more filtering, but these should be sufficiently long to allow realistic longer frequency estimation.

The **Data selection** specifies the size of the data input for the median filter.

All data — If selected, the entire data length will be filtered.

Specified extent — If selected, the specified data aperture will be filtered.

The **Processing aperture** specifies the processing aperture size if **Specified extent** is selected.

Start time (ms) — Enter the required time in milliseconds at which filtering is to begin. {>=0}

End time (ms) — Enter the required time in milliseconds at which filtering is to end. {>=0}

Taper length (ms) — Enter the length, in milliseconds, of the start and end tapers used to taper in the filtered data to the input data. {>=0}

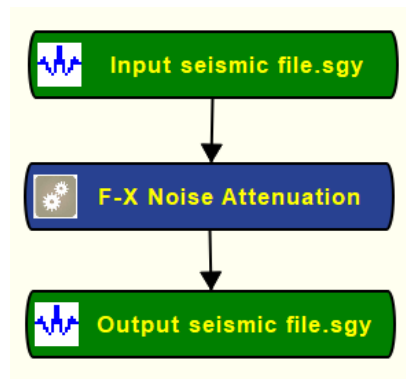
F-X Noise Attenuation

Usage: The F-X Noise Attenuation step is a random noise attenuation technique in the frequency-space domain. This filtering method predicts the signal with spatial changes in dip or amplitude using the F-X domain.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

FX Noise Attenuation

Design window length (ms) 500.0

Design window width (traces) 31

Filter order 9

Filter adaptation (%) 95.0

OK Help Cancel

Parameter Description:

Design window length (ms) — Enter the filter length in milliseconds. {>=0}

Design window width (traces) — Enter the width of the filter in number of traces. {>=0}

Filter order — Enter the filter order.

Filter adaptation (%) — Enter the filter adaptation in percentage.

F-X-Y Median Filter

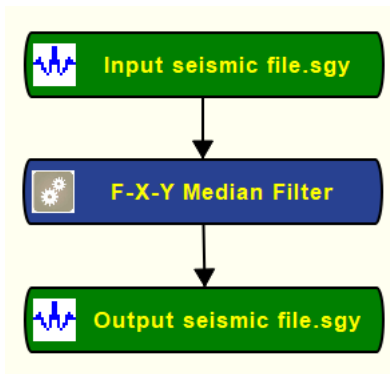
Usage: The F-X-Y Median Filter step is a multi-channel filter that may be used to remove spikes or other noise from the seismic data without damaging dipping data. The operator is applied in the temporal frequency domain using fully overlapping cosign-tapered window panes of specified height. A horizontal 2D median filter is applied to the frequency amplitudes whilst leaving the phase unchanged. Either the entire dataset or a specified tapered time window may be filtered. The input data in the form of time traces and does not require prior slicing or transformation.

Note: This filter will be most often used with 3D post-stack data sorted by CMP line and CMP location, but it may be used with other data provided adjacent records are sufficiently similar for median filtering across records to make sense. Due to parallel data handling, the output from F-X-Y Median Filter must be written directly to disk using Seismic File without further processes in that job flow.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

F-X-Y Median Filter

Parameters

Filter width in traces

Overlapping panes' height (ms)

Data selection

☒ All data

☐ Specified extent

Processing aperture

Start time (ms.)

End time (ms.)

Taper length (ms.)

OK Help Cancel

Parameter Description:

The **Parameters** specify the filter parameters.

Filter width in traces — Enter the width of the spatial median filter to be applied to each temporal frequency component.

Overlapping panes' height (ms) — Enter the height in milliseconds of each of the fully-overlapping cosine-tapered panes from which frequency components are derived. In general, shorter panes will exhibit more filtering, but these should be sufficiently long to allow realistic longer frequency estimation.

The **Data selection** specifies the size of the data input for the median filter.

All data — If selected, the entire data length will be filtered.

Specified extent — If selected, the specified data aperture will be filtered.

The **Processing aperture** specifies the processing aperture size if **Specified extent** is selected.

Start time (ms) — Enter the required time in milliseconds at which filtering is to begin. {>=0}

End time (ms) — Enter the required time in milliseconds at which filtering is to end. {>=0}

Taper length (ms) — Enter the length, in milliseconds, of the start and end tapers used to taper in the filtered data to the input data. {>=0}

Footprint Filter

Usage: The Footprint Filter step is a KK filtering technique for application to 3D post-stack data that is focused on attenuating acquisition footprint noise. Two techniques are available:

1) Application of a global high cut KK filter. Seismic signals generally display most of its energy in the KK domain close to zero, whereas the jitter sometimes seen due to acquisition will have high KK amplitudes. This filter is simple, effective and fast.

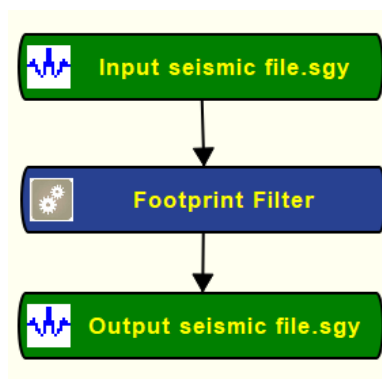
2) A local adaptive noise removal algorithm for when the acquisition footprint exhibits in the KK domain as spikes. The seismic signal energy is protected with an exclusion zone around the origin. This technique is significantly more time-consuming and should be used only when the first technique does not address the type of acquisition noise seen.

Footprint Filter is applied to post-stack 3D data which has been converted to time slices. Use Time Slice (Processing Category Display) in a prior job flow to convert such data to time slices for input to Footprint Filter. After Footprint Filter, use Time Slice to Trace (Processing Category Display) in a further job flow to revert the filtered data to normal order.

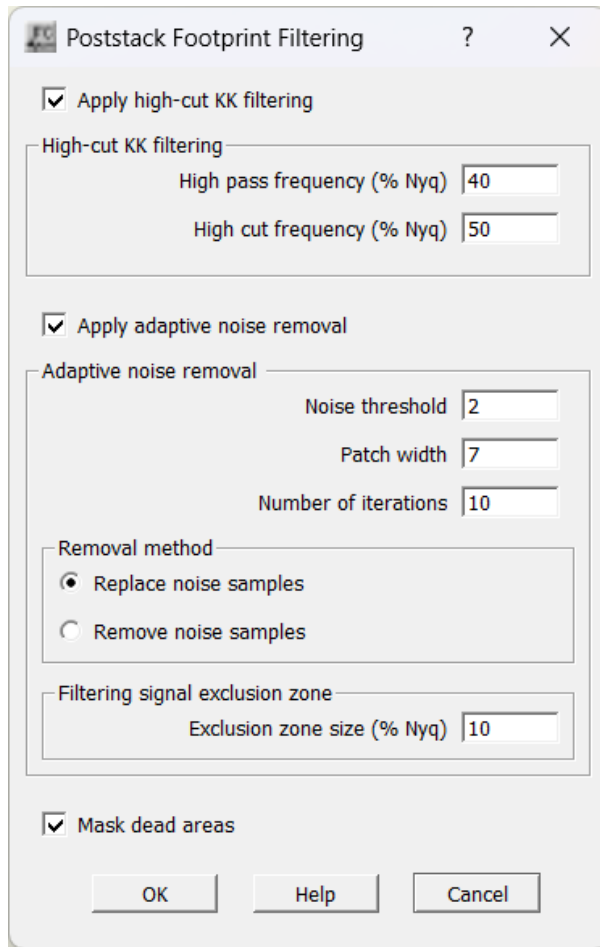
Input Links: 1) Seismic data sorted by Slice Number (record key) and CMP Line (mandatory).

Output Links: 1) Seismic data sorted by Slice Number (record key) and CMP Line (mandatory).

Example Flowchart:



Step Parameter Dialog:



The screenshot shows a dialog box titled "Poststack Footprint Filtering". It contains several sections with checkboxes and input fields. The first section, "High-cut KK filtering", is checked and contains two input fields: "High pass frequency (% Nyq)" with the value 40 and "High cut frequency (% Nyq)" with the value 50. The second section, "Adaptive noise removal", is also checked and contains three input fields: "Noise threshold" with the value 2, "Patch width" with the value 7, and "Number of iterations" with the value 10. Below these is a "Removal method" section with two radio buttons: "Replace noise samples" (selected) and "Remove noise samples". The third section, "Filtering signal exclusion zone", contains one input field: "Exclusion zone size (% Nyq)" with the value 10. The final section, "Mask dead areas", is checked. At the bottom are three buttons: "OK", "Help", and "Cancel".

☒ Apply high-cut KK filtering

High-cut KK filtering

High pass frequency (% Nyq)

High cut frequency (% Nyq)

☒ Apply adaptive noise removal

Adaptive noise removal

Noise threshold

Patch width

Number of iterations

Removal method

☒ Replace noise samples

☐ Remove noise samples

Filtering signal exclusion zone

Exclusion zone size (% Nyq)

☒ Mask dead areas

Parameter Description:

Apply high-cut KK filtering — If checked, a high-cut KK cosine filter as specified will be applied.

The **High-cut KK filtering** specifies the frequencies of the high-cut KK filter.

High pass frequency (% Nyq) — Enter the KK taper-off beginning frequency.

High cut frequency (% Nyq) — Enter the KK taper-off ending frequency.

Apply adaptive noise removal — If checked, an adaptive noise removal filter will be applied.

The **Adaptive noise removal** specifies the adaptive noise removal parameters.

Noise threshold — Enter the number of standard deviations of a sample amplitude above the standard deviation of the sample amplitudes within a local area or 'patch' for that sample to be regarded as noise.

Patch width — Enter the KK plane is divided into overlapping 'patches' to be analyzed for noise spikes. This parameter is the side length of each square patch.

Number of iterations — Enter the number of iterations of the adaptive noise removal algorithm.

The **Removal method** selects the removal method for the KK filter.

Replace noise samples — If selected, the amplitude of a noise sample will be replaced by the average value within the patch.

Remove noise samples — If selected, the amplitude of a noise sample will be set to zero.

The **Filtering signal exclusion zone** specifies a signal exclusion zone based on the percentage of the Nyquist.

Exclusion zone size (% Nyq) — Enter the size of the area around the KK origin to be protected from the adaptive filter to preserve the signal.

Mask dead areas — If checked, then input data dead zones will be masked after application of the KK filtering.

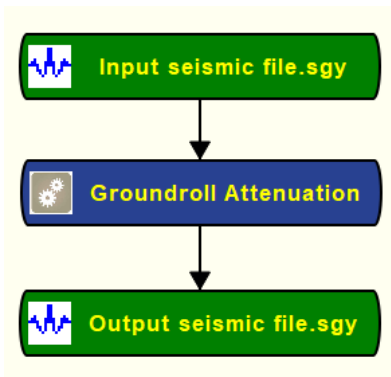
Groundroll Attenuation

Usage: The Groundroll Attenuation step applies a low-cut filter designed to remove low-frequency, high-amplitude surface waves. The orthogonalization option enhances groundroll attenuation by projecting the noisy signal components onto an orthogonal basis relative to the desired signal, separating coherent reflection energy from the groundroll noise. This step preserves the integrity of reflection events while minimizing the risk of signal leakage, making it especially valuable in land seismic surveys where groundroll is prevalent.

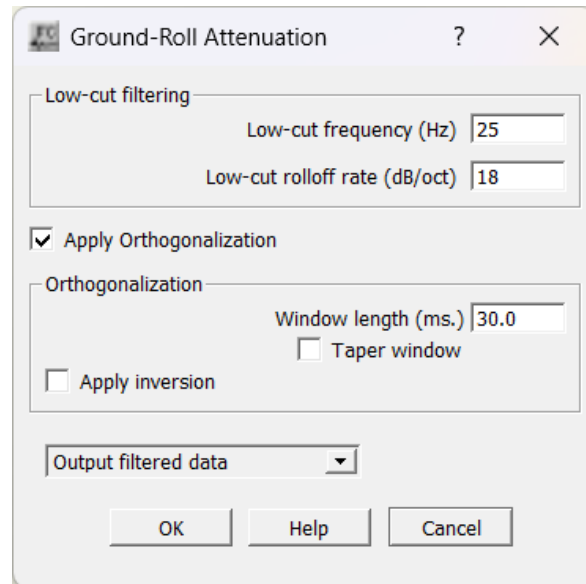
Input Links: 1) Seismic data sorted by Slice Number (record key) and CMP Line (mandatory).

Output Links: 1) Seismic data sorted by Slice Number (record key) and CMP Line (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Low-cut filtering** specifies the low-cut filter parameters to be applied.

Low-cut frequency (Hz) — Enter the low cut-frequency in Hertz.

Low-cut rolloff rate (dB/oct) — Enter the low-cut rolloff rate in dB per octave.

Apply Orthogonalization — If checked, applies orthogonalization before applying the filter.

The **Orthogonalization** specifies the orthogonalization parameters to be considered if Apply Orthogonalization is checked.

Window length (ms.) — Enter the window length in milliseconds of the orthogonalization window.

Taper window — If checked, apply a taper window.

Apply inversion — If checked, apply the inverse of the orthogonalization.

Horizontal Median Filter

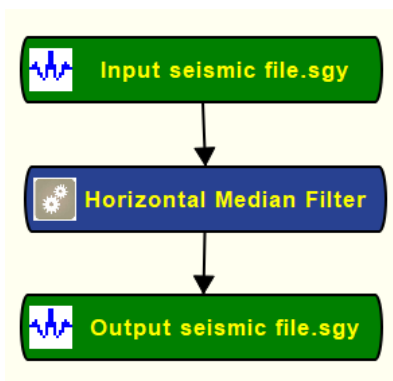
Usage: The Horizontal Median step allows to apply a horizontal median filter across the data traces of a gather or stack. This process is very useful in processing VSP data for separation of up-going and down-going events.

Input Links: 1) Seismic data in any sort order (mandatory).

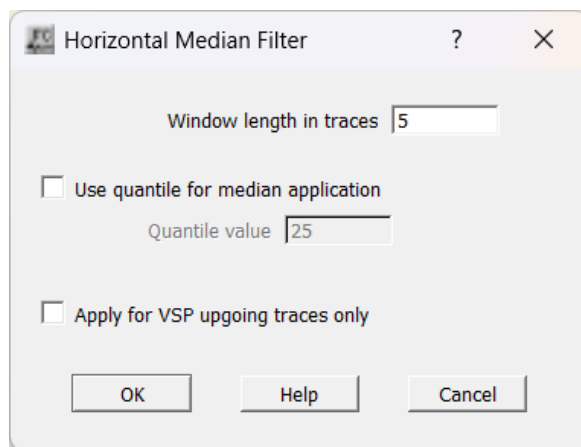
Output Links: 1) Seismic data in any sort order (mandatory).

References: Hardage, B. A., 1983, Vertical Seismic Profiling, Geophysical Press.

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Window length in traces — Enter the number of traces in the spatial window. {>=0}

Use quantile for median application — If checked, the median value is computed over the selected quantile.

Quantile value — Enter the quantile value to calculate the median.

Apply for VSP upgoing traces only — If checked, the horizontal median filter is only applied to seismic traces marked as VSP upgoing traces.

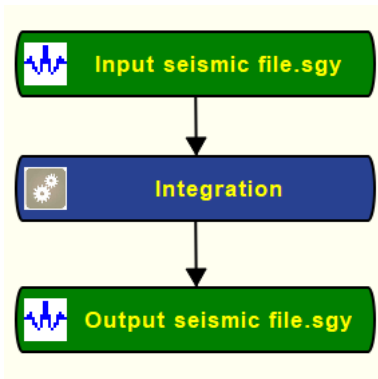
Integration

Usage: The Integration step integrates data samples in each input seismic data trace.

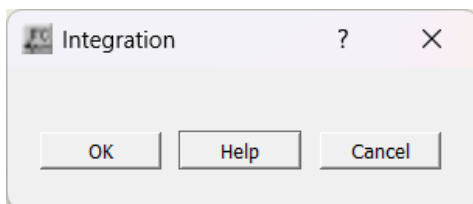
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in same sort order as the input (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description: There are no parameters for this step.

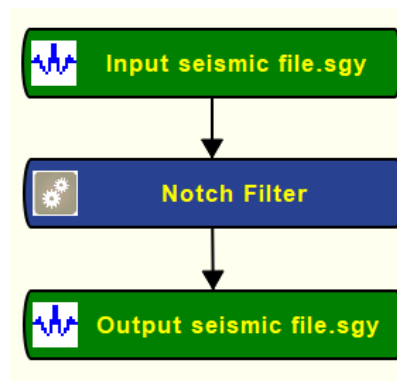
Notch Filter

Usage: The Notch Filter step applies a frequency domain notch filter to the input data. The filter is specified by describing the frequency notch and the width of the notch. Options exist to (1) apply the filter as a function of header word flags, (2) parameterize the notch as a function of header word flags.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Notch Filter' with a standard Windows-style title bar (minimize, maximize, close buttons). The dialog is divided into two main sections. The top section, titled 'Application window', contains two checkboxes. The first checkbox, 'Apply filter based on a trace header flag', is unchecked. Below it are a 'Trace header field' dropdown menu (set to 'None') and a 'Trace header value' text input field (containing '1'). The second checkbox, 'Notch frequency is in a trace header field', is also unchecked. Below it is a 'Trace header field' dropdown menu (set to 'None'). The bottom section of the dialog contains two text input fields: 'Notch frequency (Hz)' with the value '50' and 'Notch width (Hz)' with the value '4'. At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

The **Application window** specifies the window of application for the notch filter.

Apply filter based on a trace header flag — If checked, the application of the filter is to be controlled by the value of a trace header flag.

Trace header field — Select the seismic trace header from the drop-down menu.

Trace header value — Enter the value of a trace header flag, set the value of the trace header. When the value of the trace header equals the specified value, the filter will be applied. Otherwise, the filter will not be applied.

Notch frequency is in a trace header field — If checked, the value of the notch frequency is to be controlled by the value of a trace header field.

Trace header field — Enter the value of a trace header field, select the trace header from the drop-down menu.

Notch frequency (Hz) — Enter the value of the notch frequency in Hertz.

Notch width (Hz) — Enter the width of the notch frequency in Hertz.

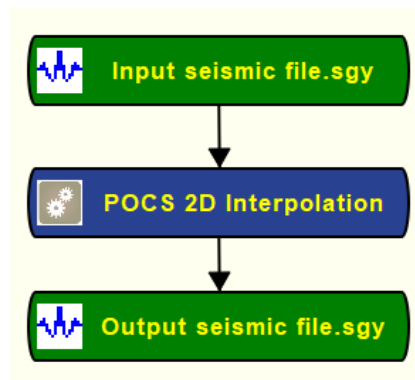
POCS 2D Interpolation

Usage: The POCS 2D Interpolation step uses the Projection Onto Convex Sets (POCS) algorithm to interpolate missing or irregularly sampled seismic traces in two-dimensional datasets. This method is particularly effective in reconstructing spatially coherent data by iteratively projecting the incomplete seismic data onto two constraint sets: one representing the known data (e.g., acquired traces) and the other representing a desired property such as sparsity in a transform domain. Through these projections, POCS gradually fills (i.e., cooling rate) in missing traces.

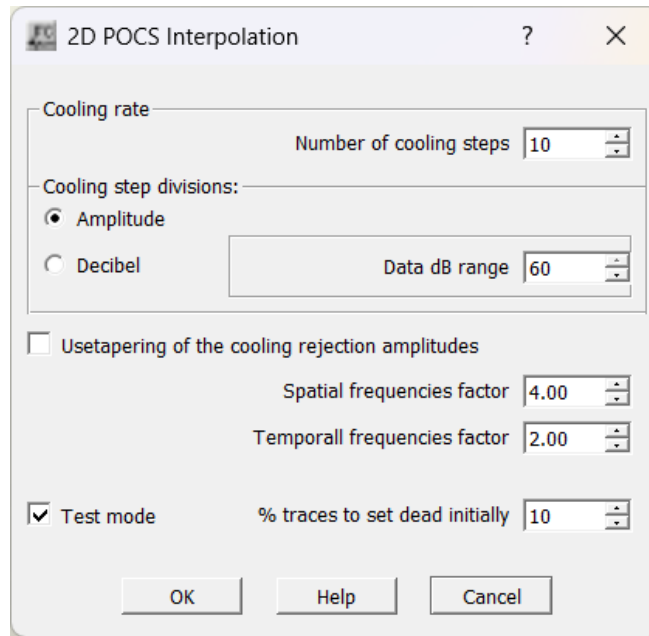
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Cooling rate** specifies the colling parameters for the 2D POCS interpolation.

Number of cooling steps — Select the number of cooling steps for the 2D POCS interpolation.

The **Cooling step divisions** specifies the parameters for the cooling steps.

Amplitude — If selected, the cooling rate is based on steps calculated from the seismic amplitudes.

Decibel — If selected, the cooling rate is based on steps calculated from the seismic amplitudes considering a decibel scale

Data dB range — Select the amplitude data range in decibel.

Use tapering of the cooling rejection amplitudes — If checked, use a taper of the rejected amplitudes per cooling step.

Spatial frequencies factor — Select the spatial frequencies factor.

Temporal frequencies factor — Select the temporal frequencies factor.

Test mode — If checked, consider test mode and seismic traces are considered dead from the input seismic. This option allows parameterizing the parameters of the processing step.

% traces to set dead initially — Select the percentage of dead traces initially considered for testing.

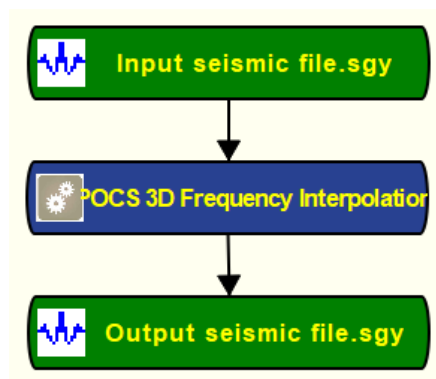
POCS 3D Frequency Interpolation

Usage: The POCS 4D Frequency Interpolation step use the Projection Onto Convex Sets (POCS) algorithm to interpolate missing or irregularly sampled seismic traces in three-dimensional datasets. This method is particularly effective in reconstructing spatially coherent data by iteratively projecting the incomplete seismic data onto two constraint sets: one representing the known data (e.g., acquired traces) and the other representing a desired property such as sparsity in a transform domain. Through these projections, POCS gradually fills (i.e., cooling rate) in missing traces.

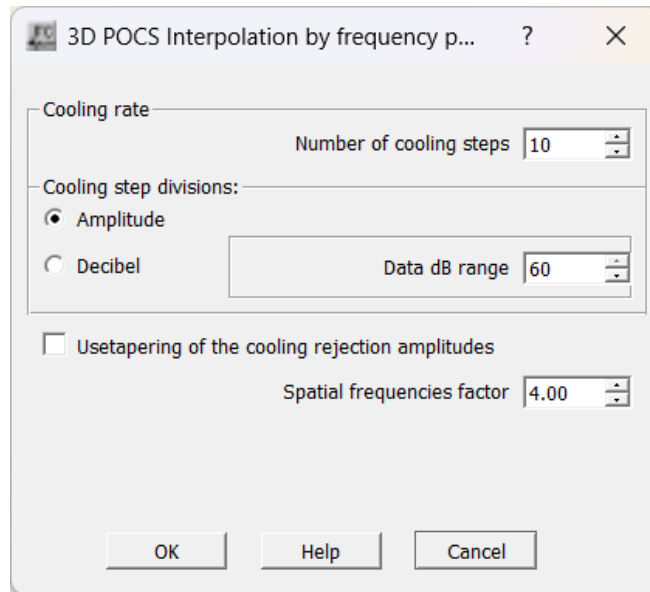
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Cooling rate** specifies the colling parameters for the 3D POCS interpolation.

Number of cooling steps — Select the number of cooling steps for the 3DPOCS interpolation.

The **Cooling step divisions** specifies the parameters for the cooling steps.

Amplitude — If selected, the cooling rate is based on steps calculated from the seismic amplitudes.

Decibel — If selected, the cooling rate is based on steps calculated from the seismic amplitudes considering a decibel scale

Data dB range — Select the amplitude data range in decibel.

Use tapering of the cooling rejection amplitudes — If checked, use a taper of the rejected amplitudes per cooling step.

Spatial frequencies factor — Select the spatial frequencies factor.

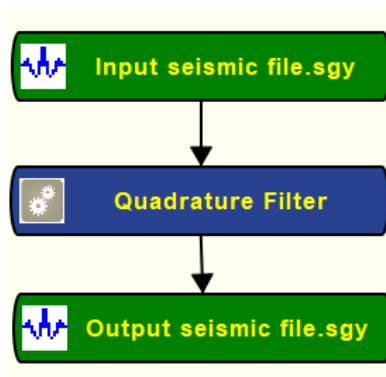
Quadrature Filter

Usage: The Quadrature Filter step computes the Hilbert transform of the input seismic data. Quadrature filters are usually applied to enhance the presence of discontinuities and reveal the structure of the seismic image.

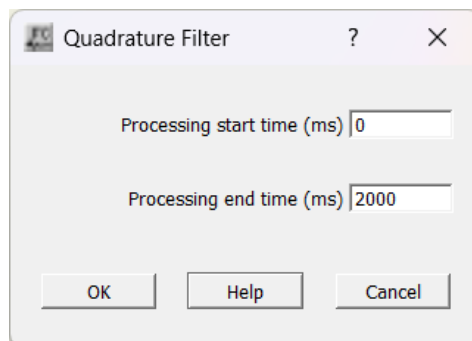
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Processing start time (ms) — Enter the processing start time in milliseconds. {>=0}

Processing end time (ms) — Enter the processing end time in milliseconds. {>=0}

Radial Transform Filter

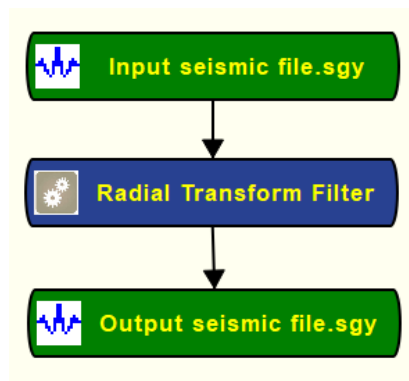
Usage: The Radial Transform Filter step is a 2D pre-stack single channel filter for attenuation of noise originating from a point source with a specific apparent velocity by means of the radial transform. For example, shot generated noise may be attenuated by application of Radial Transform Filter to common shot gathers. Each input record must be ordered by offset. The input 2D record is first converted to the radial domain such that each radial trace represents a different apparent velocity within the range of interest, radiating from a start time (usually zero) at zero offset. Using the output data type 'Radial traces', these traces may be output and displayed: Coherent noise of particular apparent velocity will appear as low frequency in this domain, and can be attenuated by using a low frequency filter or a median reject filter. Uncontaminated data remains untouched by the radial transform. The region of the input data records which will be filtered may be displayed using the output data type 'Filter region model'.

Input Links: 1) 2D Seismic data offset-sorted records (mandatory).

Output Links: 1) 2D Seismic data offset-sorted records (mandatory).

Reference: Henley, D., 2008, A Convenient Truth: Radial Trace Filtering – Simple and Effective, CSEG Recorder, vol. 34, no 1.

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

Transform start time (ms) — Enter the time of the origin for the radial transform in milliseconds. This will often be zero, but sometimes a positive value can give better noise attenuation.

The **Reject noise apparent velocity range** specifies the noise window parameters defined as apparent velocity.

Minimum apparent velocity — Enter the minimum apparent velocity, in milliseconds, of the reject noise window.

Maximum apparent velocity — Enter the maximum apparent velocity, in milliseconds, of the reject noise window.

The **Output data type** specifies the type of output seismic file.

Filtered data — If selected, the output data will be Radial Transform filtered data.

Radial traces — If selected, the output will be the radial transformed traces, filtered or unfiltered depending on the parameter settings (See Usage above).

Filter region model — If selected, the output will allow display of the exact region of the input data which will be filtered by Radial Transform Filter in its Filtered data mode (See Usage above).

Filter the radial traces — If checked, the radial traces will be filtered.

The **Radial trace filtering** specifies the type of rejection filter.

Apply a low cut filter — If selected, applies a low-cut filter.

Low cut frequency — Specify the low-cut frequency in Hertz of the Butterworth filter.

Reject dB/octave — Specify the rate of fall-off of the filter.

Apply a median reject filter — If selected, applies a median reject filter. Low frequencies are attenuated by subtracting the median filtered data from the data.

Lowest freq to protect — Specify the lowest frequency that will not be attenuated by the median reject filter. The median filter length used will be the wavelength of this frequency in samples.

Mute the radial traces — If checked, the radial traces will be attenuated.

The **Radial trace mute** specifies the radial trace mute parameters if **Mute the radial traces** is checked.

dB reduction — All data within the radial traces will be attenuated by the specified amount.

% tapering — Specify the percentage of the radial trace zone(s) which will be tapered.

The **Interpolation type** derives the radial traces from the input data that requires interpolation of the data. Nearest offset is the fastest, while linear and quadratic interpolation may give a smoother result and better radial domain low frequency attenuation.

Nearest offset — If selected, radial traces will be constructed by picking nearest offset samples.

Linear — If selected, linear interpolation will be used to construct radial traces.

Quadratic — If selected, quadratic interpolation will be used to construct radial traces.

The above parameters may be adjusted by trial and error to obtain the best attenuation, or by inspection of the radial traces.

Radon Demultiple

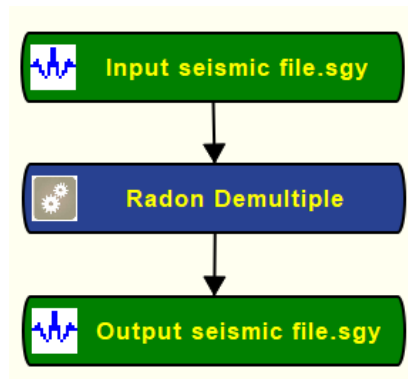
Usage: The Radon Demultiple step performs parabolic radon demultiple through a modeling of multiples in the parabolic radon domain followed by subtraction of those multiples in the time domain. The step allows to specify the transform type, the range of ray parameters in the output transform, and the spatial and temporal taper lengths used to generate the transform.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Hampson, D., 1991, Inverse velocity stacking for multiple elimination, Journal of the Canadian Society of Exploration Geophysics, 22, p. 44-55.

Example Flowchart:



Step Parameter Dialog:

Radon Demultiple

Time window

☐ Limit application time

☒ Use constant start time
Start time (ms)

☐ Start time referenced to horizon
Multiplier for time horizon
Length of taper zone (ms)

Offset window

☐ Define maximum reference offset
Maximum reference offset

AGC window

☐ Apply and remove AGC
AGC operator length (ms)

Type of output

☒ Estimated primaries ☐ Multiple model

Model moveout

Minimum differential moveout
Maximum differential moveout
Minimum multiple moveout

Ray parameters

☐ Set number of ray parameters
Number of ray parameters

Bandpass filter

Low cut (Hz)
Low pass (Hz)
High pass (Hz)
High cut (Hz)

Additional parameters

Percent pre-whitening
Minimum live traces

OK Help Cancel

Parameter Description:

The **Time window** specifies the time window where the Radon demultiple will be applied.

Limit application time — If checked, limits the application of the Radon demultiple in the vertical dimension based on a user-defined time window.

Use constant start time — If selected, use a constant start time to the time window.

Start time (ms) — Select the start time in milliseconds to the time window.

Start time referenced to horizon — If selected, use a start time to the time window that is referenced to the horizon where the radon demultiple will be applied.

Multiplier for time horizon — Enter the multiplier for be applied to the horizon to define the time window.

Length of taper zone (ms) — Select the length in milliseconds of the taper zone for the time window.

The **Model moveout** sets the range of parabolas that will generate the primary and multiple models.

Minimum differential moveout — Enter the minimum differential moveout, expressed in milliseconds on the far-offset trace. The primary model is generated with parabolas from the <minimum differential moveout> to the <minimum multiple moveout>.

Maximum differential moveout — Enter the maximum differential moveout, expressed in milliseconds on the far-offset trace. The multiple model is generated with parabolas from the <minimum multiple moveout> to the <maximum differential moveout>.

Minimum multiple moveout — Enter the minimum multiple moveout, expressed in milliseconds on the far-offset trace. The multiple model is generated with parabolas from the <minimum multiple moveout> to the <maximum differential moveout>.

The **Ray parameters** specify ray parameters

Set number of ray parameters — If checked, the number of ray parameters is determined manually. By default, the number of ray parameters is determined internally.

Number of ray parameters — set the number of ray parameter.

The **Offset window** specifies the parameters for window definition.

Define maximum reference offset — If checked, limit the input seismic data by a maximum reference offset

Maximum reference offset — Enter the reference maximum offset. Maximum offset of the input record that is going to be used.

The **AGC Window** defines parameter for AGC filter to be applied before demultiple.

Apply and remove AGC — If checked, and AGC filter is applied before the F-K Velocity filter and removed from the output seismic file. The AGC filter is used exclusively internally to improve the performance of the F-K filter.

AGC operator length — Enter the AGC operator length in ms.

The **Bandpass filter** specifies the bandpass filter parameters, as defined in a trapezoid, to be applied during the processing.

Low-cut (Hz) — enter low-cut frequency in Hz.

Low pass (Hz) — enter low pass frequency in Hz.

High pass (Hz) — enter high pass frequency in Hz.

High cut (Hz) — enter high cut frequency in Hz.

The **Additional parameters** specifies the additional parameters to stabilize the Radon Demultiple.

Percent pre-whitening — Enter the amount of pre-whitening used to stabilize the least-squares inversion in the presence of noise.

Minimum live traces — Enter the minimum number of live traces that must be present in a gather in order to transform that gather.

The **Type of output** specifies the type of output from Radon Demultiple.

Estimated primaries — If selected, output estimated primary reflections.

Multiple model — If selected, output modelled multiple reflection. This multiple model can then be subtracted to the input seismic data.

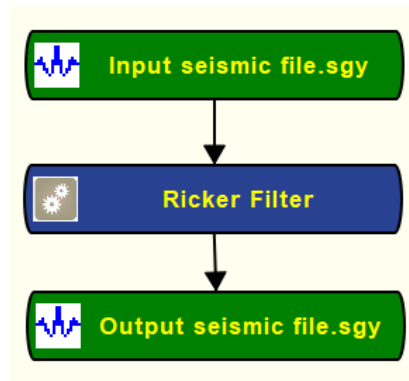
Ricker Filter

Usage: The Ricker Filter step applies a ricker filter to the input seismic file. The Ricker filter is completely determined by the center frequency of the Ricker wavelet.

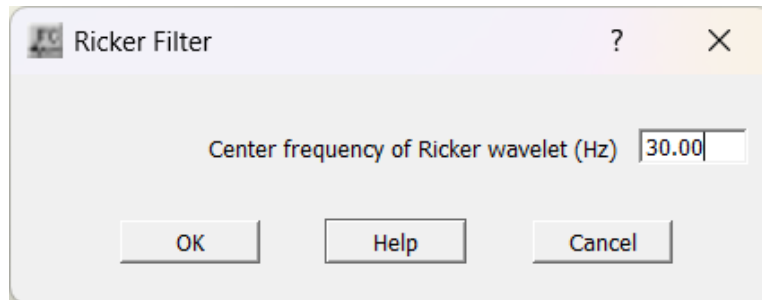
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Center frequency (Hz) — Specify the center frequency of the Ricker wavelet. {>=0}

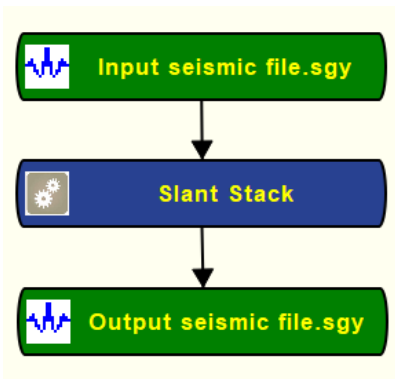
Slant Stack

Usage: The Slant Stack step reorganize the input seismic data from the time-offset domain into the tau-p domain and sums seismic traces along linear trajectories (slants) corresponding to constant ray parameters, effectively decomposing the wavefield into plane waves.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Type of transform** specifies the type of transformation of the Slant Stack.

Forward — If selected, applies the forward operator.

Inverse — If selected, applies the inverse operator.

The **Resolution** specifies the type of resolution of the Slant Stack.

Low — If selected, applies at slant stack with high resolution.

Medium — If selected, applies a slant stack with medium resolution.

Header for P-values — Select the trace header to be used for output of the constant P value traces from the forward transform and used for input to the inverse transform.

Use direct (X,T) interpolation — If checked, uses a time-space interpolation.

The **Forward transform** specifies the parameters for the forward transform.

Specify minimum velocity — If selected, enter the minimum velocity for the forward transform.

Specify max slope (traces/second) — If selected, enter the range of P values by the range of slopes (Linear) or by differential moveout (Parabolic).

% Whitening — Enter the percentage of whitening to be applied.

P-values sampling factor — Select the ...

Times increasing with offset — Select the...

Split-spread or +ve and -ve dips — Select the ...

Add % -ve dips — Select the ...

The **Inverse transform** specifies the parameters for the inverse transform.

Original trace offsets — If selected, the range of the inverse transformed offsets will match those of the original record.

Regularized offsets — If selected, the range of the inverse transformed offsets will be as the original record, but at evenly spaced offsets.

Reconstructed offset Increment (m.) — Enter the output inverse transformed data offset increment to be required.

This affects the maximum temporal frequency which can be transformed without aliasing.

Maximum unaliased frequency (Hz) — Enter the maximum temporal frequency to be included in the transformation.

Maximum frequency (Hz) — Enter the maximum temporal frequency to be included in the transformation.

Recalc freqs — Recalculate the frequencies.

Minimum live traces — Enter the minimum number of traces in a record for applying the filter. Records with fewer traces will not be transformed or output.

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Tau-p Inverse Transform

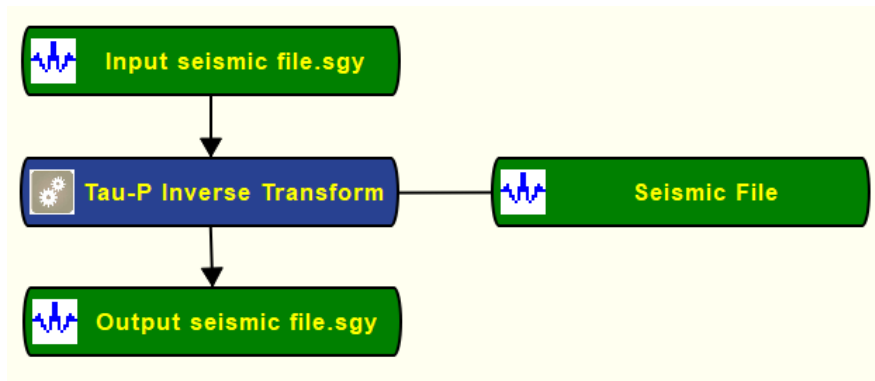
Usage: The Tau-P Inverse Transform step transforms 2D Tau-P domain pre-stack data back to the time-offset domain after conversion to this domain after the use of Tau-P Transform.

Input Links: 1) 2D Seismic pre-stack Tau-P domain data records ordered by Ray Parameter (mandatory); 2) Auxiliary seismic data file: the original offset-time shot records for restoration of headers to the inverted data (mandatory).

Output Links: 1) 2D Seismic pre-stack data records ordered by offset (mandatory).

Reference: Kostov, C., 1990, Toeplitz Structure in Slant-Stack Inversion: 60th Annual Internat..Mtg., Soc. Expl. Geophys., Expanded Abstracts, 1618-1621.

Example Flowchart:



Step Parameter Dialog:

Tau-P Inverse Transform

Type of Tau-P transform

☒ Parabolic

☐ Linear

Output data offsets

☒ Original t-x data offsets

☐ Regular offsets

Bandpass filter

Low cut (Hz)

Low pass (Hz)

High pass (Hz)

High cut (Hz)

Percent pre-whitening

OK Help Cancel

Parameter Description:

The **Type of Tau-P transform** specifies the type of Tau-P transform.

Parabolic — If selected, a parabolic inverse transform will be performed. This must be the same as was used for the forward transform.

Linear — If selected, a linear inverse transform will be performed. This must be the same as was used for the forward transform.

The **Output data offsets** specifies whether to use the original t-x data to obtain the offsets to be inverted, or to specify regular offsets.

Original t-x data offsets — If selected, an auxiliary input file will be required. This should be the original t-x data before forward Tau-P transform. The offsets returned will match those on this file.

Regular offsets — If selected, the inverse transformed records will contain regular offsets.

The **Bandpass filter** defines the filter to be applied to the data, before inverse Tau-P transformation. It is sensitive if the same frequency range is inverted as specified for the forward transform, but not essential. If aliasing noise is a problem on inversion, then the inversion high pass or high cut frequencies may be decreased.

Low-cut (Hz) — Enter the bandpass low-cut frequency in Hz.

Low pass (Hz) — Enter the bandpass low-pass frequency in Hz.

High pass (Hz) — Enter the bandpass high-pass frequency in Hz.

High cut (Hz) — Enter the bandpass high cut frequency in Hz.

Percent pre-whitening — Enter the percentage of pre-whitening. A Toeplitz matrix inversion is used for the Tau-P inversion of each frequency. A small amount of white noise added may be needed to stabilize the inversion. A fraction of one percent is often sufficient, and decreases the smearing sometimes seen when larger values are used.

Tau-p Transform

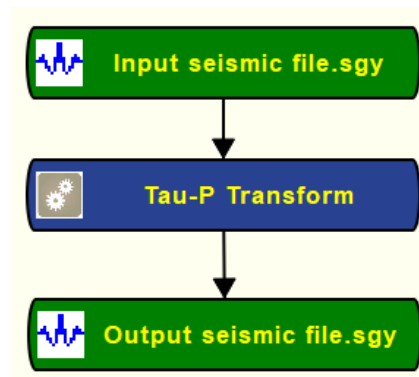
Usage: The Tau-P Transform step transforms 2D pre-stack data to the Tau-P domain for further processing. The Tau-P domain data may be inverted to the time-offset domain by the use of Tau-P Inverse Transform. The input traces of each record are time-shifted according to their offsets, and then a low-cut spatial frequency filter is applied. This will attenuate much of the noise energy at that particular apparent velocity. The time-shifted data is then restored.

Input Links: 1) 2D Seismic pre-stack data records ordered by offset (mandatory).

Output Links: 1) 2D Seismic pre-stack Tau-P domain data records ordered by Ray Parameter (mandatory).

Reference: Kostov, C., 1990, Toeplitz Structure in Slant-Stack Inversion: 60th Annual Internat..Mtg., Soc. Expl. Geophys., Expanded Abstracts, 1618-1621.

Example Flowchart:



Step Parameter Dialog:

Tau-P Transform

Type of Tau-P transform

☒ Parabolic

☐ Linear

P values specification

☒ Use Velocity

☐ Specify a maximum differential moveout

☒ Split-spread (-ve offsets)?

Minimum live traces

Velocity P values range specification

Minimum moveout velocity

Maximum moveout velocity

Reference time (sec)

Time P values range specification

Min slope (ms./100')

Max differential moveout (ms.)

Reference max offset

Frequency range

Maximum frequency (Hz)

Ray parameters

Number of ray parameters

OK Help Cancel

Parameter Description:

The **Type of Tau-P transform** specifies the function of offset used for the Tau-P transform.

Parabolic — If checked, a signed offset squared function will be used. This transform type yields the best inversion back to the original domain

Linear — If checked, the function used will be offset itself.

The **P values specification** specifies which method will be used to specify the range of P values to be calculated.

Use Velocity — If checked, the range of P values to be calculated will be determined by the minimum and maximum velocities specified. In the case of the Parabolic transform, these velocities will be moveout velocities. In the case of the Linear transform, these velocities will be apparent velocities.

Specify a differential moveout range — If checked, the minimum P value will be calculated from the maximum time shift at the specified max offset. The maximum P value will be calculated from the minimum time shift at the specified max offset.

Split-spread (-ve offsets)? — If checked, the P-values calculated will be a negative P-value range and a positive P-value range.

Minimum live traces — Enter the minimum number of live traces read for a record to be transformed to the Tau-P domain.

The **Velocity P values range specification** parameterizes the range of P values to be calculated by means of velocity.

Minimum moveout velocity (Parabolic transform) — Enter the minimum moveout velocity. The maximum P value will be calculated from this and the specified reference time.

Maximum moveout velocity (Parabolic transform) — Enter the maximum moveout velocity. The minimum P value will be calculated from this and the specified reference time.

Reference time (sec) — (Parabolic transform only). Enter the time in seconds at which the moveout velocity is measured.

The **Time P values range specification** parameterizes the range of P values to be calculated by means of differential moveout.

Min slope (ms/1000') (Linear transform) — Enter the minimum slope in milliseconds per thousand meters/feet. The minimum P value to calculate will be calculated from this value.

Max differential moveout (ms) (Parabolic transform) — Enter the maximum differential moveout at the specified reference time. The maximum P value to calculate will be calculated from this value.

Reference max offset (Parabolic transform only) — Enter the offset for the minimum and maximum differential moveouts specified.

The **Ray parameters** specify the ray parameters.

Number of ray parameters — Enter the number of P values to be calculated. If split-spread, half of these will be used for negative P values and half for positive. The number required depends on the total range of ray parameters. These P-values will be regularly spaced. If the increment multiplied by the offset is greater than half a wavelength of a frequency, then aliasing noise on inverse transform may result. The inversion execution time depends on this parameter, and testing with a few shot records is recommended to determine the smallest value possible without undue aliasing noise.

The **Frequency range** parameterizes the maximum frequency to be considered.

Maximum frequency (Hz) — Enter the maximum frequency to be transformed.

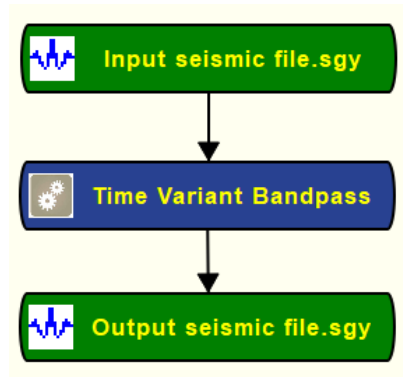
Time Variant Bandpass

Usage: The Time Variant Bandpass step allows to apply up to five (5) different time-variant bandpass filters to the seismic trace data. You specify the low cut, low pass, high pass and high cut, filter points for each filter and the starting time for application of the filter. The step allows to specify the filter taper length and control the smoothness of the transition between adjacent filters.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Filter	Low-cut (Hz)	Low-pass (Hz)	High-pass (Hz)	High-cut (Hz)	Start time (ms)
1	5.0	10.0	60.0	90.0	0.00
2	5.0	10.0	60.0	90.0	1000.00
3	5.0	10.0	60.0	90.0	2000.00

Number of filters to use: Filter taper length (samples):

OK Help Cancel

Parameter Description:

Number of filters to use — Enter the number of filters to apply. {1,10}

Filter taper length — Enter the length of the filter taper in samples. The longer the filters taper length, the smoother the transition between adjacent filters.

Low-cut (Hz) — Enter the low-cut frequency of the bandpass filter in Hertz. {>=0}

Low pass (Hz) — Enter the low pass frequency of the bandpass filter in Hertz. {>=0}

High pass (Hz) — Enter the high pass frequency of the bandpass filter in Hertz. {>=0}

High cut (Hz) — Enter the high cut frequency of the bandpass filter in Hertz. {>=0}

Start time (ms) — Enter the start time in milliseconds to start the application of each filter. {>=0}

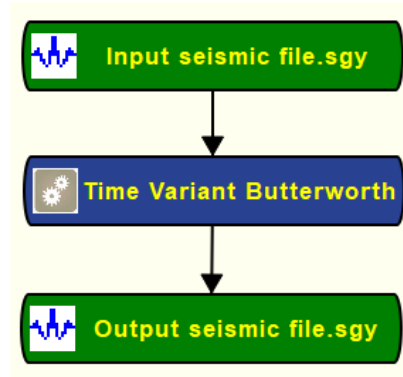
Time Variant Butterworth

Usage: The Time Variant Butterworth step allows to apply up to ten (10) different time-variant Butterworth filters to the seismic trace data. You specify the low pass, high pass and low and high rolloff rates in decibels (dB) for each filter, as well as the starting time for application of the filter. The step also specifies the filter taper length, which controls the smoothness of the transition between adjacent filters.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Time Variant Butterworth

Number of filters to use Filter taper length (samples)

Filter	Low-pass (Hz)	High-pass (Hz)	Low-rolloff (dB/oct)	High-rolloff (dB/oct)	Start time (ms)
1	9.0	72.0	18.0	18.0	0.00
2	9.0	72.0	18.0	18.0	1000.00
3	9.0	72.0	18.0	18.0	2000.00

OK Help Cancel

Parameter Description:

Number of filters to use — Enter the number of filters to apply. {1,10}

Filter taper length — Enter the length of the filter taper in samples. The longer the filters taper length, the smoother the transition between adjacent filters.

Low frequency (Hz) — Enter the low pass frequency of the Butterworth filter in Hertz. {>=0}

High frequency (Hz) — Enter the high pass frequency of the Butterworth filter in Hertz. {>=0}

Low rolloff rate (dB/oct) — Enter the low pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff. {>=0}

High rolloff rate (dB/oct) — Enter the high pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff. {>=0}

Start Time (ms) — Enter the start time in milliseconds to the start application of each filter. {>=0}

Velocity-Guided Butterworth Filter

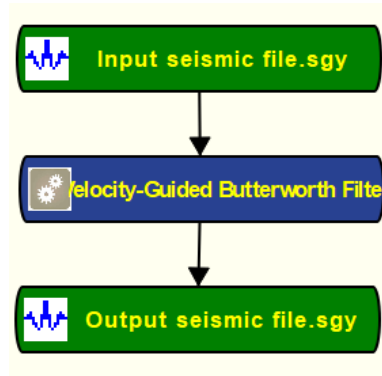
Usage: The Velocity-Guided Butterworth Filter step is a 2D pre-stack single channel filter for Butterworth filter with a particular apparent velocity in the offset-time domain.

The input traces of each record are time-shifted according to their offsets, and then a low-cut spatial frequency filter is applied. This will attenuate much of the noise energy at that particular apparent velocity. The time-shifted data is then restored.

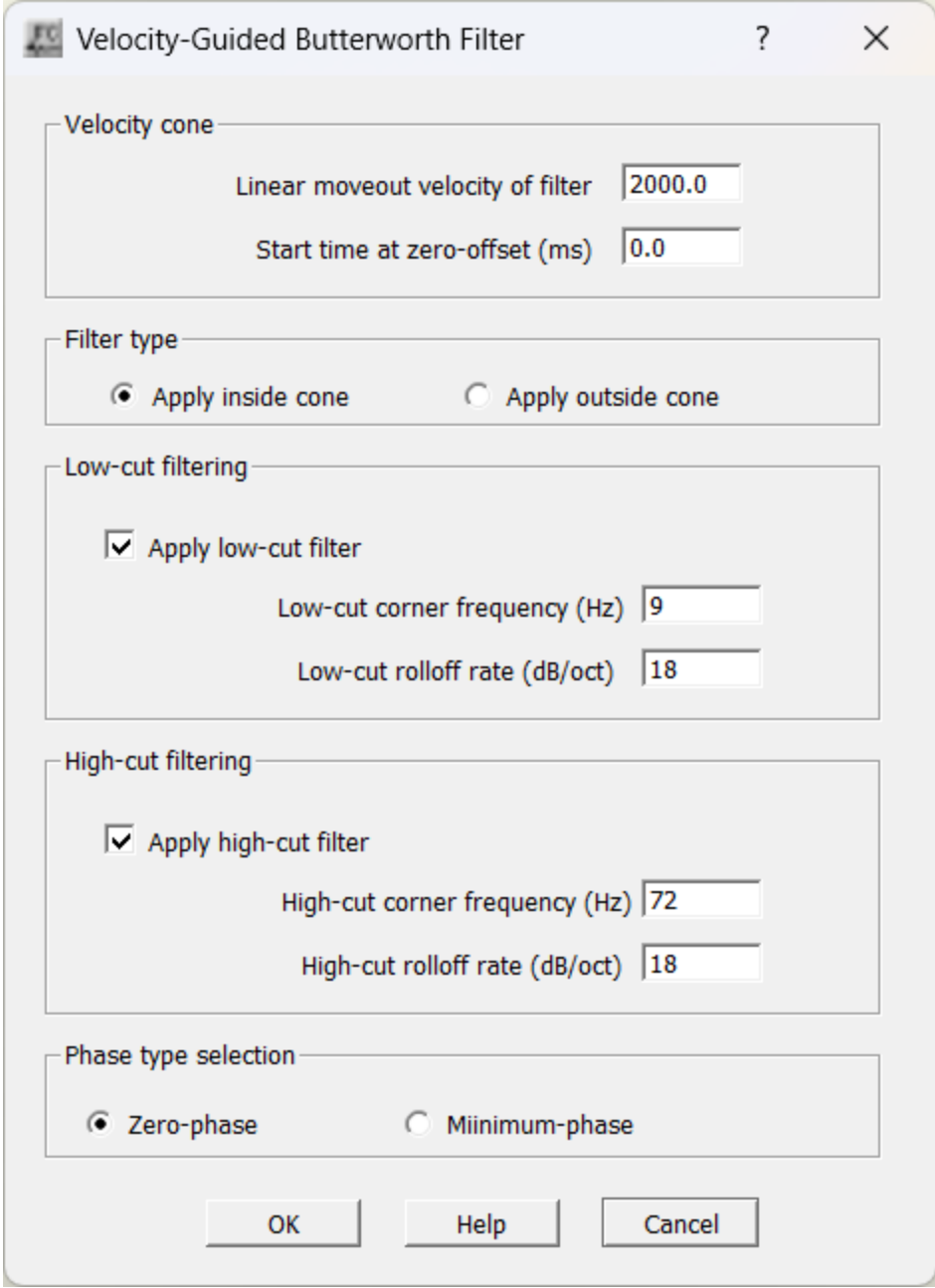
Input Links: 1) 2D Seismic pre-stack data records ordered by offset (mandatory).

Output Links: 1) 2D Seismic pre-stack data records ordered by offset (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Velocity-Guided Butterworth Filter". It contains several sections for configuring filter parameters. The "Velocity cone" section has two input fields: "Linear moveout velocity of filter" set to 2000.0 and "Start time at zero-offset (ms)" set to 0.0. The "Filter type" section has two radio buttons: "Apply inside cone" (selected) and "Apply outside cone". The "Low-cut filtering" section has a checked checkbox "Apply low-cut filter", with "Low-cut corner frequency (Hz)" set to 9 and "Low-cut rolloff rate (dB/oct)" set to 18. The "High-cut filtering" section has a checked checkbox "Apply high-cut filter", with "High-cut corner frequency (Hz)" set to 72 and "High-cut rolloff rate (dB/oct)" set to 18. The "Phase type selection" section has two radio buttons: "Zero-phase" (selected) and "Minimum-phase". At the bottom are three buttons: "OK", "Help", and "Cancel".

Section	Parameter	Value
Velocity cone	Linear moveout velocity of filter	2000.0
	Start time at zero-offset (ms)	0.0
Filter type	Apply inside cone	☒
	Apply outside cone	☐
Low-cut filtering	Apply low-cut filter	☒
	Low-cut corner frequency (Hz)	9
	Low-cut rolloff rate (dB/oct)	18
High-cut filtering	Apply high-cut filter	☒
	High-cut corner frequency (Hz)	72
	High-cut rolloff rate (dB/oct)	18
Phase type selection	Zero-phase	☒
	Minimum-phase	☐

Parameter Description:

The **Velocity cone** specifies velocity parameters to define the velocity-guided Butterworth filter.

Linear moveout velocity filter — Enter linear moveout velocity for the Butterworth filter in m/s or ft/s.

Start time at zero-offset (ms) — Enter the start time at zero-offset in milliseconds

The **Filter type** specifies the filter type.

Apply inside cone — If selected, apply the Butterworth filter inside the defined velocity cone.

Apply outside cone — If selected, apply the Butterworth filter outside the defined velocity cone.

The **Low-cut filtering** specifies low-cut Butterworth filter parameters.

Apply low-cut filter — If checked, apply a Butterworth filter with a low-cut.

Low-cut corner frequency (Hz) — Enter the low pass frequency of the Butterworth filter in Hertz.

Low-cut rolloff rate (dB/oct) — Enter the low pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

The **High-cut filtering** specifies high-cut Butterworth filter parameters

Apply high-cut filter — If checked, apply a Butterworth filter with a low-cut.

High-cut corner frequency (Hz) — Enter the high pass frequency of the Butterworth filter in Hertz.

High-cut rolloff rate (dB/oct) — Enter the high pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

Velocity-Guided Noise Rejection Filter

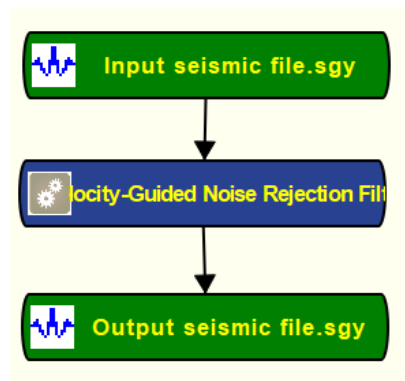
Usage: The Velocity-Guided Noise Rejection Filter step is a 2D pre-stack single channel filter for attenuation of noise with a particular apparent velocity in the offset-time domain.

The input traces of each record are time-shifted according to their offsets, and then a low-cut spatial frequency filter is applied. This will attenuate much of the noise energy at that particular apparent velocity. The time-shifted data is then restored.

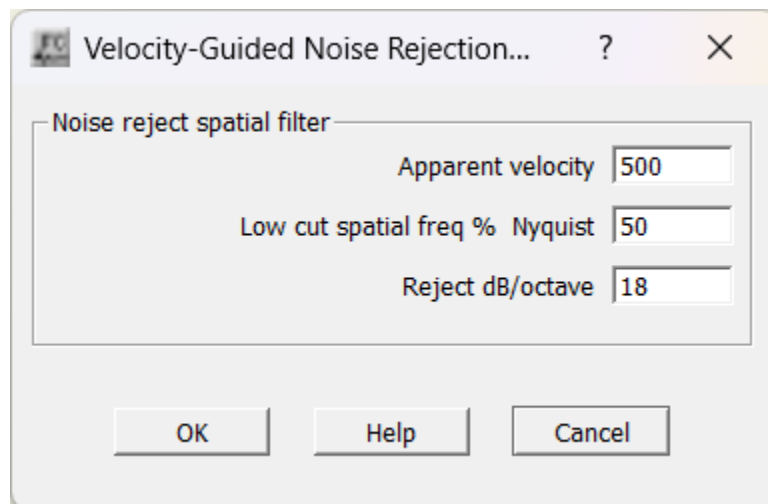
Input Links: 1) 2D Seismic pre-stack data records ordered by offset (mandatory).

Output Links: 1) 2D Seismic pre-stack data records ordered by offset (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Noise reject spatial filter** specifies the noise rejection filter parameters.

Apparent velocity — Enter the apparent velocity at which the noise is to be attenuated.

Low-cut spatial freq % Nyquist — Enter the low-cut point as a percentage of the Nyquist frequency of the spatial frequency filter to be used.

Reject dB/octave — Enter the cut-off attenuation rate of the low-cut Butterworth filter to be used.

Geometry Steps

This section documents the processing steps available in the Geometry category.
Processing steps currently available are:

Geometry	
	Processing Categories
2-D CMP Binning	
3-D CMP Binning	
Adjust Streamer Positions	
Bin Fold Limit	
CMP Fold - Data	
Coordinate Conversion	
Crooked Line Binning	
Extract Geometry	
Feathering Calculation	
Geometry Definition	
OBS Positioning	
Offset Binning	
Position 2D Streamer	
Real Time Crooked Line Binning	
Regularization 2D	
Regularization 3D	
Regulate Marine Geometry	
Set Streamer Positions	
Simple Marine Geometry	
UK00A P1/90 Geometry	
Update Marine Streamer	
Update Receiver Positions	
Update Source Positions	

Note Trace Header Geometry Application

The first step in the majority of processing sequences is to update the seismic field headers with the acquisition geometry information. This information is required to perform basic data analysis and to execute almost all multi-channel seismic reflection data processing steps.

There are three basic structures for the processing flow that is used to update the seismic trace header with the acquisition geometry information. The structure you use will depend on the nature of the seismic survey. The three seismic surveys and their associated processing flows can be classified as follows;

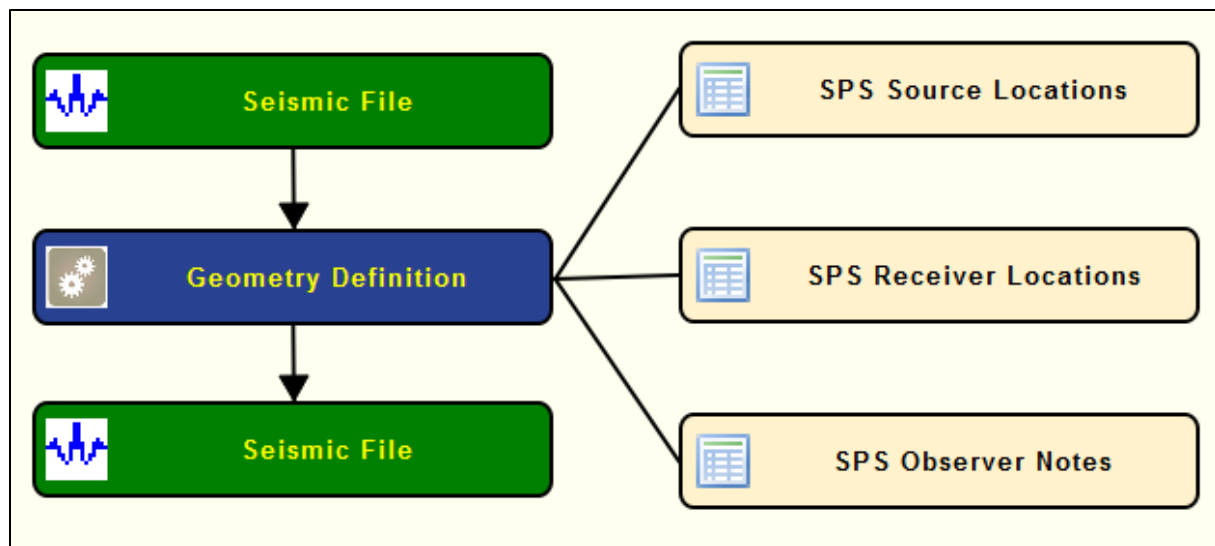
1. 2D seismic: In SPW, 2D seismic surveys are those in which the sources and receivers are laid out on the same 2D line and the CMP number can be computed as
$$\text{CMP} = \frac{(\text{Source Location} + \text{Receiver Location})}{2}$$
. This implies that source location 101 and receiver location 101 are co-located (i.e. have the same X, Y coordinates).

2. Crooked line 2D seismic: In SPW, Crooked line 2D seismic surveys are those that will be processed as a single CMP line, though the sources and receivers are not necessarily laid out along the same line. This implies that source location 101 and receiver location 101 need not be co-located (i.e. are not required to have the same X, Y coordinates).

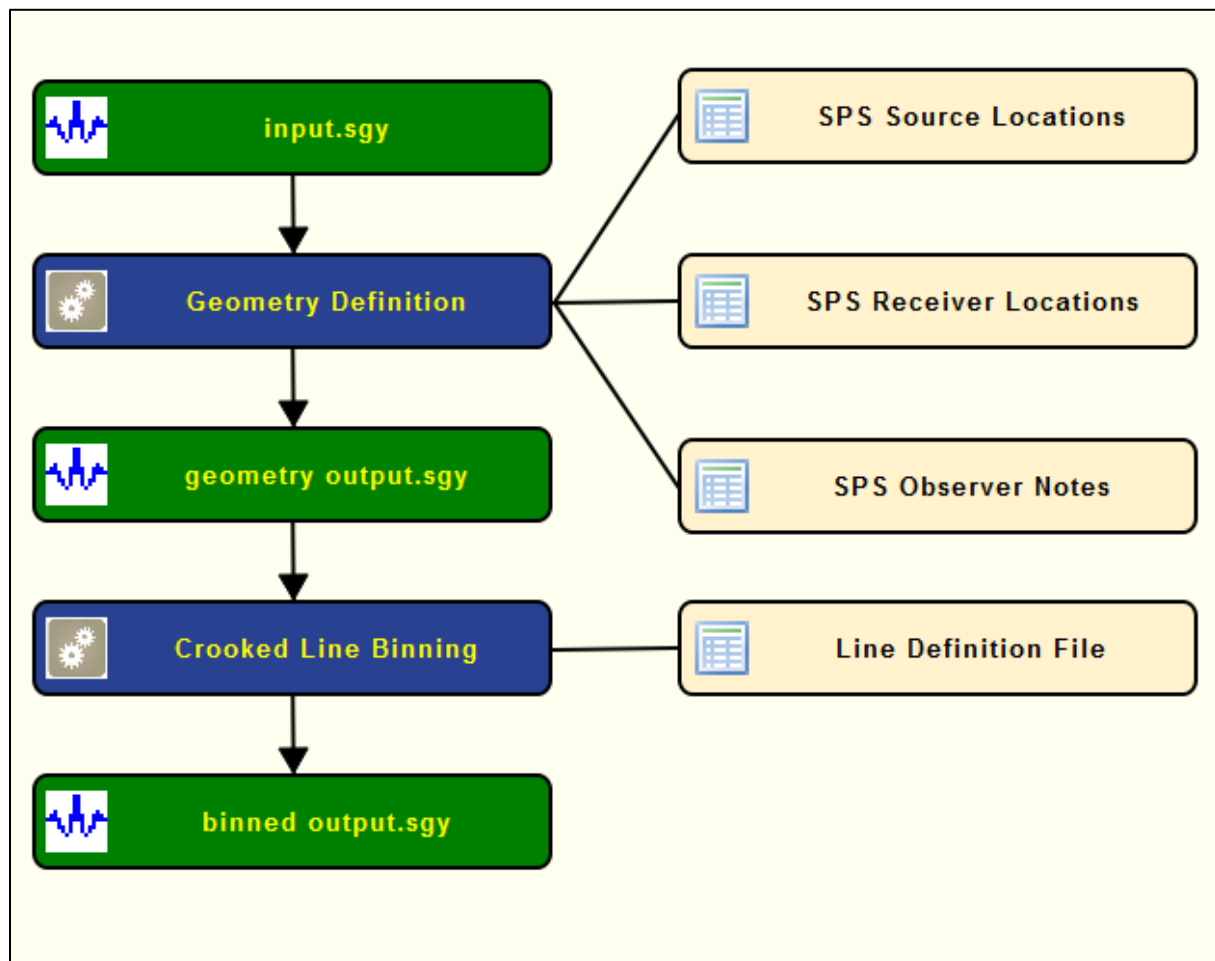
3. 3D seismic: In SPW, 3D seismic surveys are those in which the sources and receivers are laid out really and the data will be organized in terms of inlines and crosslines.

An example of each of these three types of processing flows can be found in the Templates library under the Geometry category.

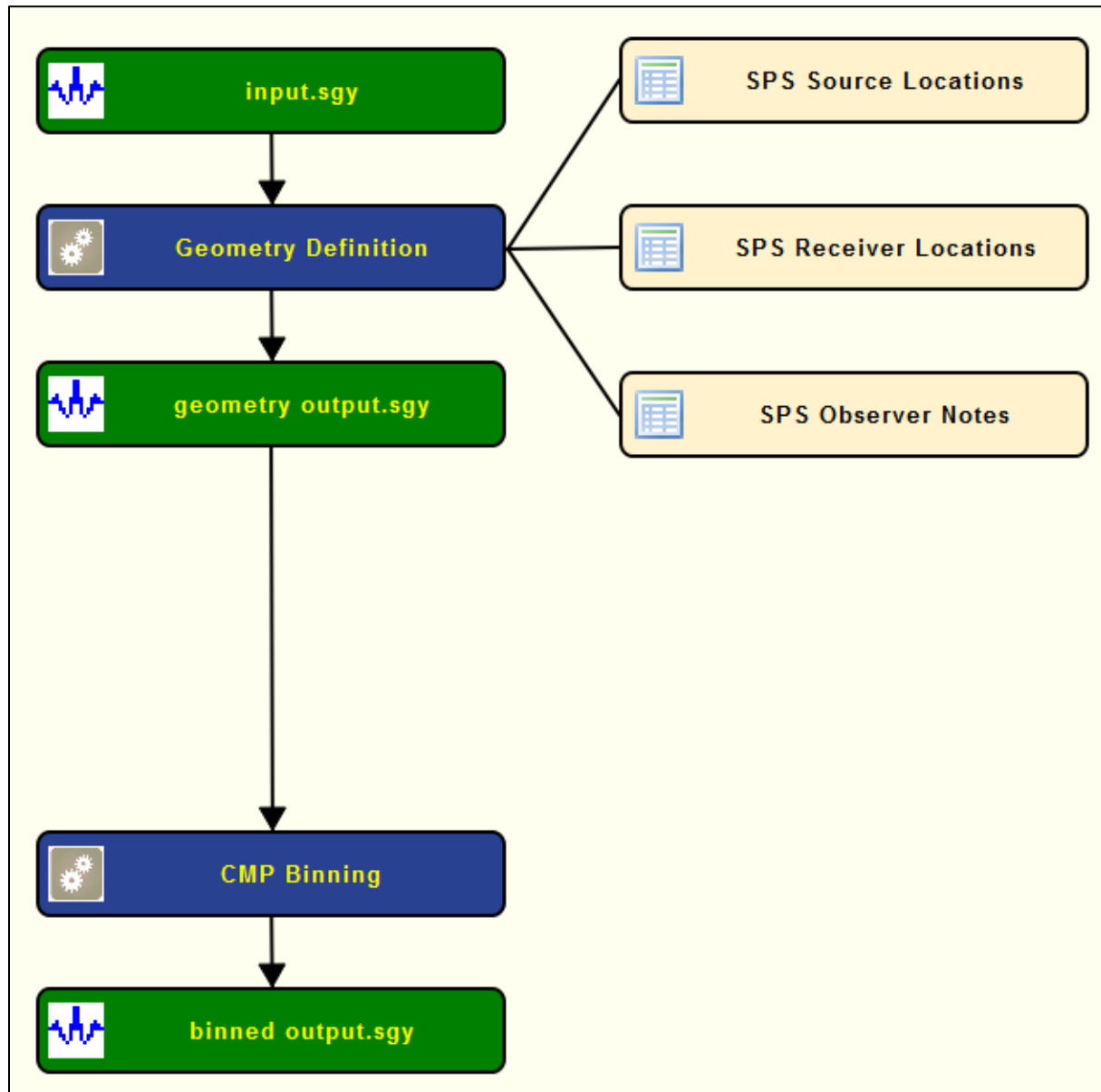
Example Flowchart for a 2D seismic survey:



Example Flowchart for a crooked line 2D seismic survey:



Example Flowchart for a 3D seismic survey:



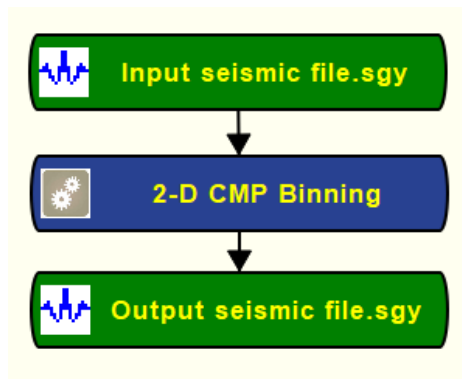
2-D CMP Binning

Usage: The 2-D CMP Binning step assigns CMP line and location numbers according to user specified coordinate parameters. The user can manually define the line or use the project parameters.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

2D CMP Binning

2-D Line Definition

Line number: 1

First midpoint number: 1

Common midpoint increment: 1

Common midpoint size: 25.00

Check survey parameters: ...

Design mode:

☒ End points ☐ Azimuth

2-D Line definition by End points

Start of line easting: 1000000.00

Start of line northing: 1000000.00

End of line easting: 1000000.00

End of line northing: 1000000.00

Bin locations defined at:

☐ Bin centers ☒ Bin corners

Input Trace Headers to use:

☒ Source and Receiver XYs ☐ CMP XYs and Offset

Project updates

☒ Update from project

☐ Update project

☒ Output ASCII Binning file

☐ Output ASCII Coverage file

☐ Display a bin fold map in real time

OK Help Cancel

Parameter Description:

The **2-D Line Definition** specifies the line parameters.

Line number — Enter the line number.

First midpoint number — Enter the location of the first midpoint number.

Common midpoint increment — Enter the midpoint number increment.

Common midpoint size — Enter the common midpoint size.

Check survey parameters — Check and accept line parameters.

The **Bin locations defined at** specifies the locations of the bin.

Bin centers — If checked, use the bin centers.

Bin corners — If checked, use the bin corners.

The **Project updates** allow values to be read from the project, or alternatively to update the project.

Update from project — Select to update from the project.

Update project — Select to update the project.

The **Design mode**: specifies how line is defined.

End points — If selected, line is defined by end points.

Azimuth — If selected, line is define by azimuth.

The **2-D Line definition by ...** specifies the type 2-D line definition by end point or azimuth.

Start of the line easting — Enter the start line easting coordinate.

Start of the line northing — Enter the start line northing coordinate.

End of the line easting — Enter the end line easting coordinate.

End of the line northing — Enter the end line northing coordinate.

The **Input Trace Headers to use**: specifies the trace header parameterization.

Source and Receiver XYs — If selected, use trace headers corresponding to source and receiver coordinates.

CMP XYs and offsets — If selected, use trace headers corresponding to CMP and offsets.

Output ASCII Binning file — If checked, writes the binning file in ASCII.

Output ASCII Coverage file — If checked, writes the binning coverage file in ASCII.

Display a bin fold map in real time — If checked, creates a display of the bin map in real-time.

3-D CMP Binning

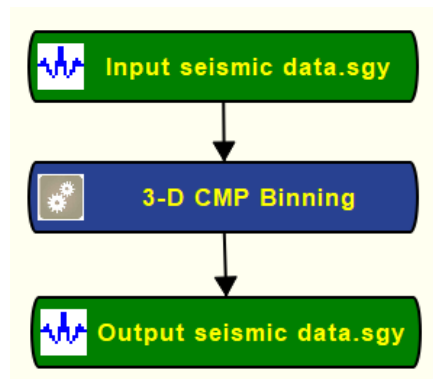
Usage: The 3-D CMP Binning step assigns CMP line and location numbers according to user specified coordinate parameters. The user can define manually the bin grid or use the project parameters.

The option of Flex binning allows each bin to contain more traces, by increasing the effective size of each bin and thereby including traces which also fall into neighboring bins. The amount of flex can also be proportional to the trace offset. The flex traces may be added immediately to the output data flow, or else their locations may be output to a flex file. This option allows stacking in of the flex traces without extra sorting overhead.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

3D CMP Binning

Define bin grid

Input Trace Headers to use:

- ☒ Source and Receiver XYs
- ☐ CMP XYs and Offset

Bin locations defined at:

- ☐ Bin centers
- ☒ Bin corners

Project updates

- ☐ Update from project
- ☐ Update project

Binning type specification

- ☒ No flex binning
- ☐ Output flex traces directly
- ☐ Output flex locations to a flex file
- ☐ Set alternative trace bin headers

CMP Line

CMP Location

Flex offset selection

Offsets interval

Maximum offset

☐ Don't write coverage to database

Source ID header location

OK **Help** **Cancel**

Parameter Description:

The **Define bin grid** specifies the bin grid parameters.

The **Input Trace Headers to use** specifies the type of information to use from the headers.

Source and Receivers XYs — If checked, use the coordinates of the source and receivers.

CMP XYs and Offset — If checked, use the coordinates of the CMP and the offsets.

The **Bin locations defined at** specifies the locations of the bin.

Bin centers — If checked, use the bin centers to define bin locations.

Bin corners — If checked, use the bin corners to define bin locations.

The **Project updates** allow values to be read from the project, or alternatively to update the project.

Update from project — Select to update from the project.

Update project — Select to update the project.

The **Binning type specification** specifies the type of binning.

No flex binning — If selected, flex binning is not considered during binning.

Output flex traces directly — If selected, output flex traces to the output seismic file.

Output flex locations to a flex file — If selected, output flex traces to an auxiliary file and not considered in the output seismic file.

Set alternative trace bin headers specifies the seismic trace header locations for CMP line and CMP location.

CMP Line — Define the CMP line to include in the headers.

CMP Location — Define the CMP location to include in the headers.

The **Flex offset selection** specifies the flex binning parameterization.

Offset interval — Enter the offset interval to be used.

Maximum offset — Enter the maximum offset to be used.

Don't write coverage to database — If checked, writes the fold coverage into the database.

The **Source ID header location** — Enter the seismic trace header location with the source ID.

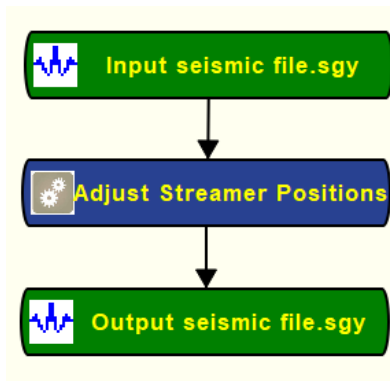
Adjust Streamer Positions

Usage: The Adjust Streamer Positions step uses direct arrival times to automatically adjust streamer receiver coordinates

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Adjust Streamer Positions

Set streamer configuration Set marine configuration

☒ Read direct arrival picks from trace header: User defined 8

☒ Allow source position adjustment

Velocity for streamer positioning

☐ Use near surface velocity from database

☐ Use specified sea water velocity 1500.00

☒ Use velocity averaged over... 12 records

Set diagnostics

OK Help Cancel

Parameter Description:

The **Set streamer configuration** — If selected, sets number of channels per streamer and the trace header word used to specify the source ID. If using the database, most of these parameters will be available in the dialog.

The **Set marine configuration** — If selected, sets the number of sources and number of streamers used during the acquisition. If using the database, most of these parameters will be available in the dialog.

Read direct arrival picks from trace header — If checked, the Direct Arrival time on each trace will be read from the specified trace header, as written by the step Real Time Direct Arrival Picker.

Allow source position adjustment — If checked, allow the source position to be moved during the streamer location optimization. The source position will be initially adjusted to minimize the difference between the source-receiver distances and those calculated as a product of the first arrival times and the velocity. A source position shift may be due to the velocity used being slightly incorrect.

The **Velocity for streamer positioning** specifies the velocity to be used to define the streamer position ...

Use near surface velocity from database — If checked, use near surface water velocity stored in database.

Use specified sea water velocity — Is checked, allows the definition of the sea water velocity (m/s).

Use velocity averaged over... — Is checked, average the velocity obtained from using each source record in isolation for the adjustment of the receiver positions. A uniform averaged velocity is more plausible, but using the separate source-record calculated velocities for this procedure possibly gives better results.

Set diagnostics — if selected, set parameters for an output ASCII text diagnostic file to be written (currently to the SPW project Report folder), or Specify trace headers for diagnostic values to be written to, or Modify the parameter weightings used in the calculation of streamer positions.

Bin Fold Limit

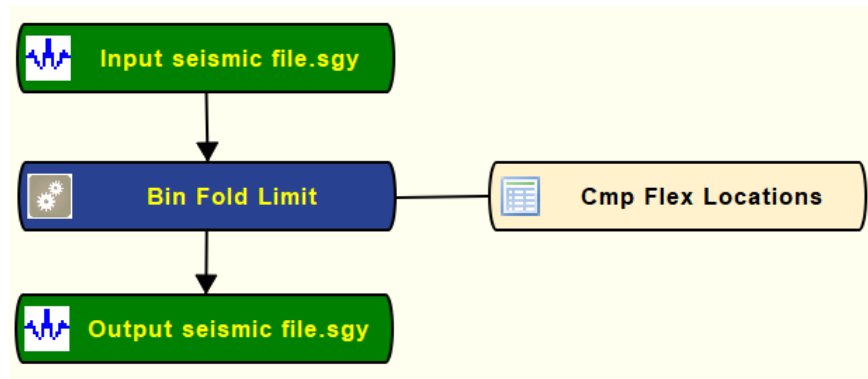
Usage: The Bin Fold Limit step adds extra flex traces to input binned data from an input Flex Table as output from CMP Binning in flex mode. Flex traces are selected from the flex table locations as specified by the Bin Fold Limit parameters.

An alternative to using CMP Binning in flex mode and Bin Fold Limit to improve coverage is to interpolate the binned data with, for example, 3D Missing Data Interpolation.

Input Links: 1) 3D Seismic data sorted by CMP Line and CMP Location, with CMP Location as the record key (mandatory); 2) Flex Table as output by CMP Binning with flex trace location data.

Output Links: 1) 3D Seismic data sorted by CMP Line and CMP Location (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box for the Bin Fold Limit step contains the following options and fields:

- ☐ Read alternative trace bin headers
- CMP Line: User defined 1 (dropdown)
- CMP Location: User defined 2 (dropdown)
- ☐ Diagnostic print
- Buttons: OK, Help, Cancel

Parameter Description:

Read alternative trace bin headers – If checked, manually specify the trace header location for CMP line and CMP location.

CMP Line – Select the trace header word with the location of the CMP Line.

CMP Location – Select the trace header word with the location of the CMP Location.

Diagnostic print – If checked, prints the diagnostic in the command window.

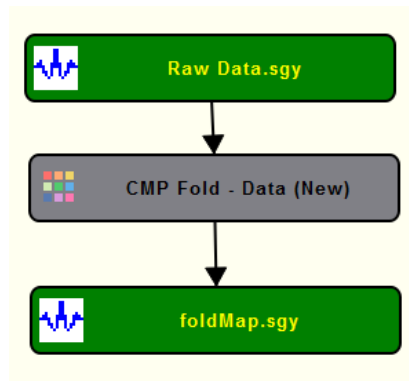
CMP Fold - Data

Usage: The CMP Fold – Data step extracts information related to the CMP fold from the seismic data trace headers.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Fold map in seismic data format.

Example Flowchart:



Step Parameter Dialog:

CMP Fold -3D Data

Output Bin fold file name

File Browse...

☐ Specify an offset range

Offset range specification

Minimum offset 0.0

Maximum offset 0.0

☐ Specify an azimuth range

Map area

☒ Survey

☐ Data

Azimuth range specification

Minimum azimuth (deg.) 0.0

Maximum azimuth (deg.) 0.0

OK Help Cancel

Parameter Description:

Output Bin fold file name — Select file to save the bin fold map in *.bsf form.

Specify an offset range — If checked, CMP fold map is limited by minimum and maximum offset distance as it is written in the trace headers.

The **Offset range specification** sets the minimum and maximum offset to be considered.

Minimum offset — Enter the minimum offset considered to build the CMP fold map.

Maximum offset — Enter the maximum offset considered to build the CMP fold map.

Specify an azimuth range — If checked, CMP fold map is limited by minimum and maximum azimuth defined in degrees from the North.

The **Azimuth range specification** sets the minimum and maximum azimuth to be considered.

Minimum azimuth (deg.) — Enter the minimum azimuth considered to build the CMP fold map.

Maximum azimuth (deg.) — Enter the maximum azimuth considered to build the CMP fold map.

The **Map area** defines map area either by survey or data.

Survey — If selected, the CMP fold map is built from survey geometry.

Data — If selected, the CMP fold map is built from data geometry.

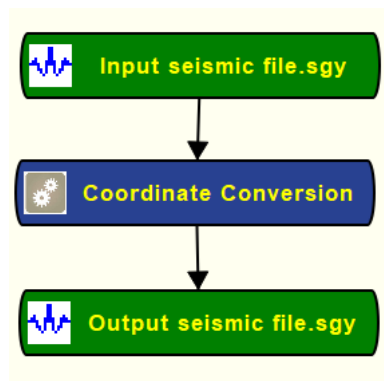
Coordinate Conversion

Usage: The Coordinate Conversion step allows converting the coordinates stored in the seismic traces headers between geographic (latitude/longitude), Transverse Mercator, UTM or UPS. This step allows converting the source, receiver and CMP coordinates simultaneously or individually.

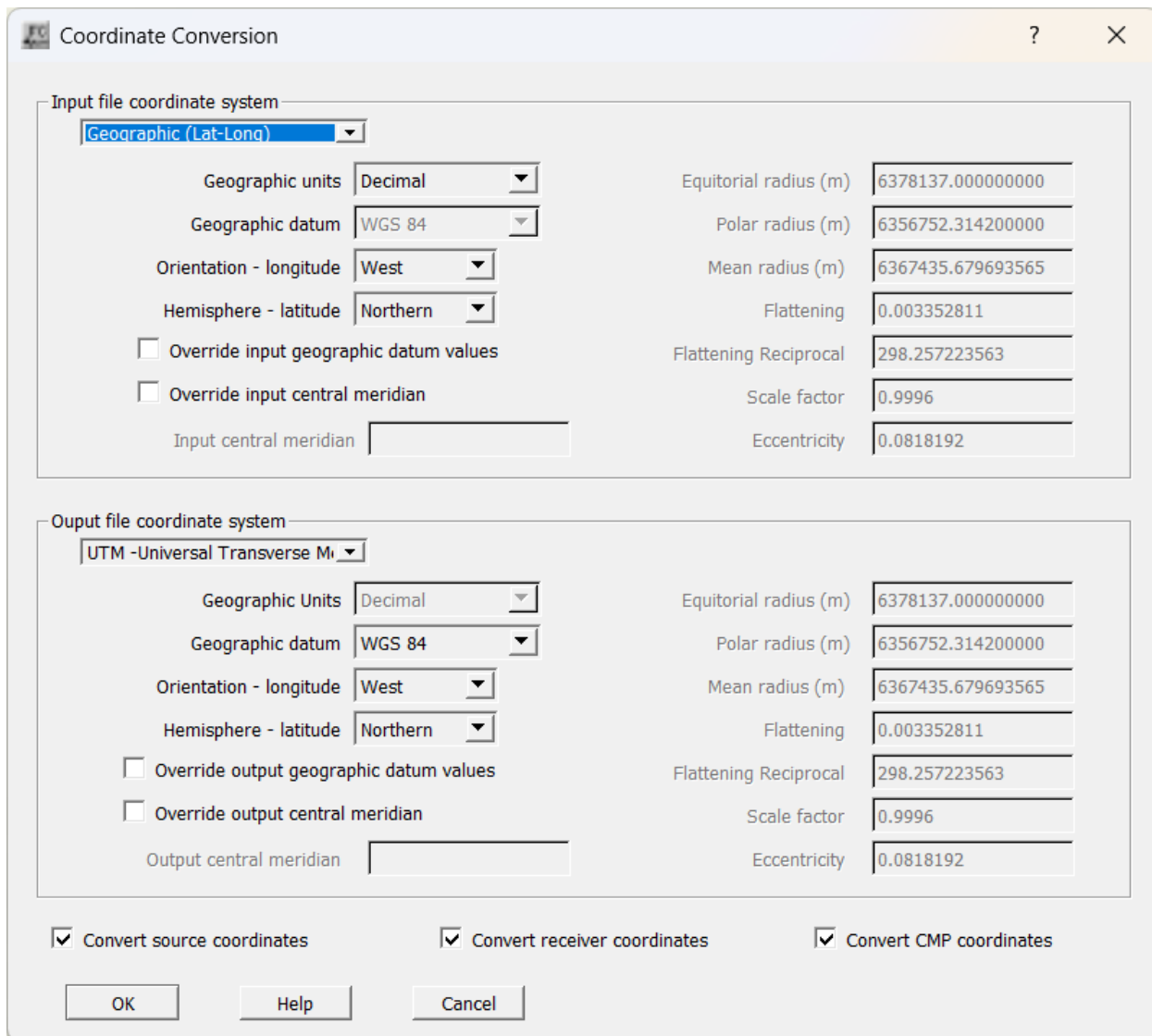
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a 'Coordinate Conversion' dialog box with two main sections: 'Input file coordinate system' and 'Output file coordinate system'. Each section contains dropdown menus for 'Geographic units', 'Geographic datum', 'Orientation - longitude', and 'Hemisphere - latitude'. There are also checkboxes for 'Override input/output geographic datum values' and 'Override input/output central meridian', and a text field for 'Input/output central meridian'. To the right of these settings are eight input fields for geodetic constants: Equatorial radius (m), Polar radius (m), Mean radius (m), Flattening, Flattening Reciprocal, Scale factor, and Eccentricity. At the bottom, there are three checked checkboxes: 'Convert source coordinates', 'Convert receiver coordinates', and 'Convert CMP coordinates'. The dialog has 'OK', 'Help', and 'Cancel' buttons at the bottom.

Input file coordinate system		Output file coordinate system	
Input file coordinate system	Geographic (Lat-Long)	Output file coordinate system	UTM -Universal Transverse Mercator
Geographic units	Decimal	Geographic Units	Decimal
Geographic datum	WGS 84	Geographic datum	WGS 84
Orientation - longitude	West	Orientation - longitude	West
Hemisphere - latitude	Northern	Hemisphere - latitude	Northern
☐ Override input geographic datum values		☐ Override output geographic datum values	
☐ Override input central meridian		☐ Override output central meridian	
Input central meridian		Output central meridian	
Equatorial radius (m)	6378137.000000000	Equatorial radius (m)	6378137.000000000
Polar radius (m)	6356752.314200000	Polar radius (m)	6356752.314200000
Mean radius (m)	6367435.679693565	Mean radius (m)	6367435.679693565
Flattening	0.003352811	Flattening	0.003352811
Flattening Reciprocal	298.257223563	Flattening Reciprocal	298.257223563
Scale factor	0.9996	Scale factor	0.9996
Eccentricity	0.0818192	Eccentricity	0.0818192

☒ Convert source coordinates
 ☒ Convert receiver coordinates
 ☒ Convert CMP coordinates

OK
 Help
 Cancel

Parameter Description:

The **Input file coordinate system** specifies the coordinate system of the input seismic file.

Geographic (Lat-Long) — Select the coordinate system. The user may choose between Geographic (latitude/longitude), Transverse Mercator, UTM – Universal Transverse Mercator or UPS – Universal Polar Stereographic.

Geographic units (only for Geographic (Lat-Long)) — Select if the geographic coordinates are in Decimal or DD MM SS.

Geographic datum — Select the datum of the selected coordinate system. Only available for Transverse Mercator, UTM and UPS.

Orientation – longitude — Select between East or West.

Hemisphere – latitude — Select the hemisphere of the coordinate system.

Override input geographic datum values — If checked, overrides the standard parameters of the selected coordinate reference system.

Equatorial radius (m) — Enter the value in meters for the user-defined equatorial radius.

Polar radius (m) — Enter the value in meters for the user-defined polar radius.

Mean radius (m) — Enter the value in meters for the user-defined mean radius.

Flattening — Enter the value for flattening.

Flattening reciprocal — Enter the flattening reciprocal values.

Scale — Enter the scale factor.

Eccentricity — Enter the eccentricity value.

Override input central meridian — If checked, overrides the central meridian for the input coordinate reference system.

Input central meridian — Enter the value for the user-defined central meridian.

The **Output file coordinate system** specifies the coordinate system of the input seismic file.

Geographic (Lat-Long) — Select the coordinate system. The user may choose between Geographic (latitude/longitude), Transverse Mercator, UTM – Universal Transverse Mercator or UPS – Universal Polar Stereographic.

Geographic units (only for Geographic (Lat-Long)) — Select if the geographic coordinates are in Decimal or DD MM SS.

Geographic datum — Select the datum of the selected coordinate system. Only available for Transverse Mercator, UTM and UPS.

Orientation – longitude — Select between East or West.

Hemisphere – latitude — Select the hemisphere of the coordinate system.

Override output geographic datum values — If checked, overrides the standard parameters of the selected coordinate reference system.

Equatorial radius (m) — Enter the value in meters for the user-defined equatorial radius.

Polar radius (m) — Enter the value in meters for the user-defined polar radius.

Mean radius (m) — Enter the value in meters for the user-defined mean radius.

Flattening — Enter the value for flattening.

Flattening reciprocal — Enter the value for flattening reciprocal.

Scale — Enter the scale factor.

Eccentricity — Enter the eccentricity value.

Override output central meridian — If checked, overrides the central meridian for the output coordinate reference system.

Output central meridian — Enter the value for the user-defined central meridian.

Convert source coordinates — If checked, apply coordinate conversion to source coordinates.

Convert receiver coordinates — If checked, apply coordinate conversion to receiver coordinates.

Convert CMP coordinates — If checked, apply coordinate conversion to CMP coordinates.

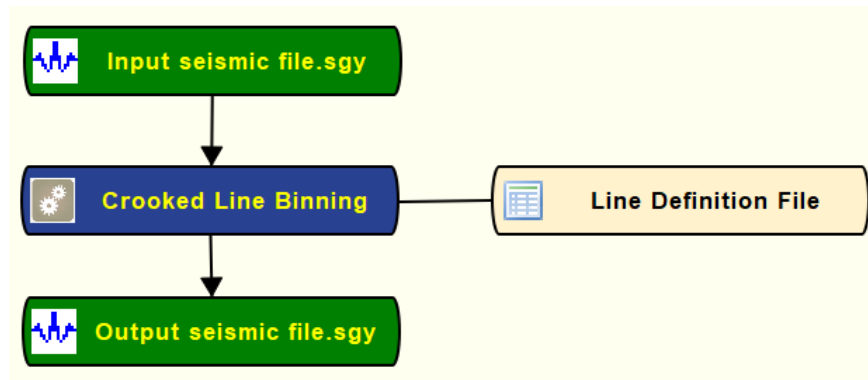
Crooked Line Binning

Usage: The Crooked Line Binning step selects those traces from an input 2D pre-stack seismic data file whose source-receiver mid-points fall sufficiently close to the centers of bins following a crooked line defined by 2D locations in a Line Definition card data file. The input data mid-points are calculated from the source and receiver eastings and northings placed in the trace headers through the use of SPS files by Geometry Definition. The Line Definition card data file contains the eastings and northings of crooked line CMP positions of a best-fit line determined by Crooked Line Fit. This processing step is only available for Crooked Line projects.

Input Links: 1) 3D Seismic data in any sort order (mandatory); 2) Line Definition card data file (mandatory).

Output Links: 1) Crooked line 2D CMP binned seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Crooked Line Binning

Assigned line number

Number of first midpoint

Inline bin size

Line width

Input coordinates method:

☐ Shape file

☒ Line Definition file

Output data cmp coordinates

☒ Bin coordinates ☐ Source-receiver midpoints

Source and receiver binning

☐ Bin source locations ☐ Bin receiver locations

Flex binning

☐ Use flex binning Inline % flex

OK Help Cancel

Parameter Description:

Assigned line number — Enter the inline bin dimension.

Number of first midpoint — Enter the number of the first midpoint.

Line width (ft or m) — Enter the crossline bin dimension.

The **Input coordinates method** specifies the coordinate parameterization.

Shape file — not yet implemented.

Line definition file — If selected, uses a line definition card data to define the line coordinates.

The **Output data CMP coordinates** specifies if output coordinates are bin coordinates or source-receiver midpoints.

Bin coordinates — If selected, those traces which fall into crooked line bins and output will be given CMP coordinates which reflect the center points of the bins.

Source-receiver coordinates — If selected, those traces which fall into crooked line bins and output will be given CMP coordinates equal to their source-receiver mid-points.

The **Source and Receiver Binning** specifies if the binning is performed at source or receiver locations.

Bin source locations — If checked, those traces whose source locations fall into crooked line bins will be output.

Bin receiver locations — If checked, those traces whose receiver locations fall into crooked line bins will be output.

The **Flex Binning** specifies the flex binning parameters.

Use flex binning — If checked, those traces whose source locations fall into or sufficiently close to crooked line bins will be output.

In-line % flex — Enter the percentage distance from a trace mid-point to the boundary of a bin as compared to the bin width for that trace to be considered valid and output as a flex trace.

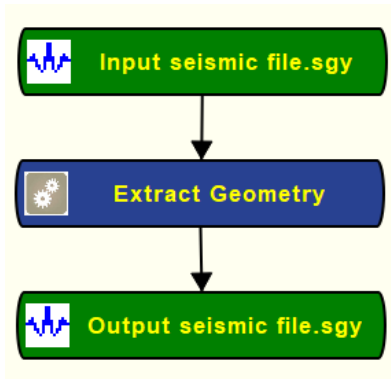
Extract Geometry

Usage: The Extract Geometry step extracts geometry information from the seismic trace header and create source, receiver SPS card data files or UKOOA P190 Locations card data file.

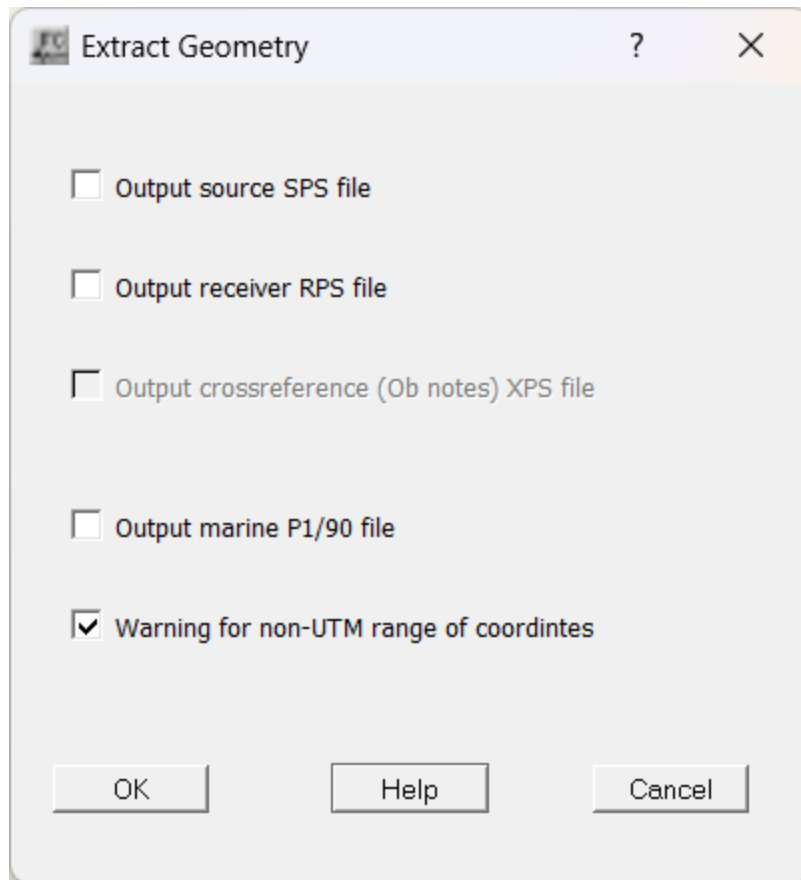
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Source SPS card data file (mandatory); 2) Receiver SPS card data file (mandatory); 3) Observer SPS card data file (UKOOA P190 Locations).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Output source SPS file — If checked, output source coordinates of the input seismic file in a source SPS card data file.

Output receiver SPS file — If checked, output receiver coordinates of the input seismic file in a receiver SPS card data file.

Output marine P1/90 file — If checked, output coordinates of the input seismic file in a marine UKOOA P190 card data file.

Warning for non-UTM range of coordinates — If checked, warns if the UTM range of coordinates is null.

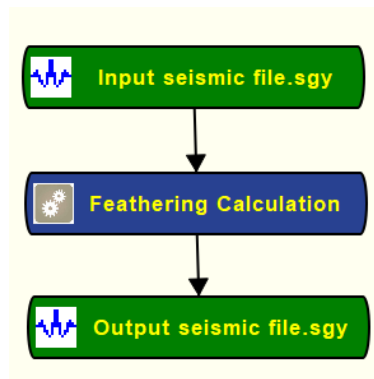
Feathering Calculation

Usage: The Feathering Calculation step calculates the feathering estimate of a streamer based on the coordinates stored in the trace headers. The feathering value can be stored in a user-defined trace header value.

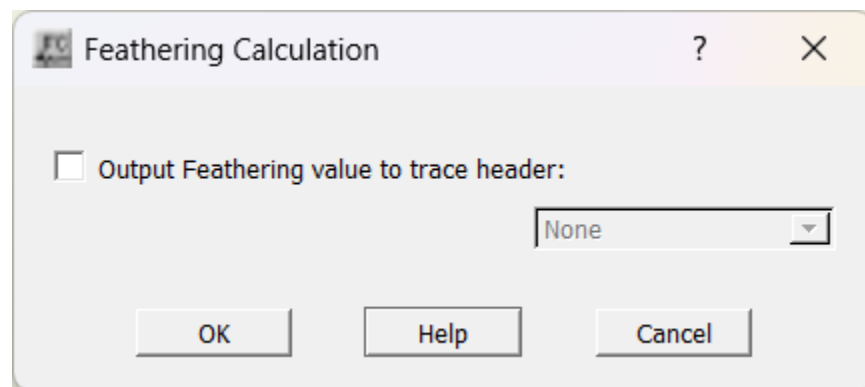
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Output Feathering value to trace header — If checked, writes the feathering value in a user-defined trace header location.

Geometry Definition

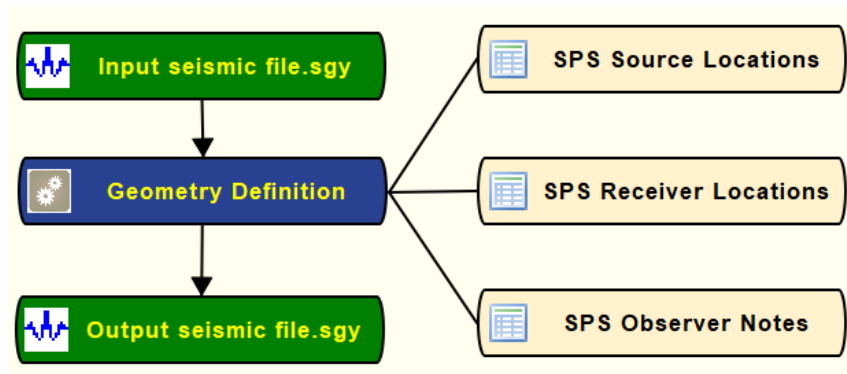
Usage: The Geometry Definition step assigns survey information to the trace headers based on the source, receiver, and observer notes SPS files. The Geometry Definition step assigns CMP number based on the source and receiver numbers using the following formula: $\text{CMP Location} = (\text{Source Location} + \text{Receiver Location})$. Therefore, for 2D lines it is imperative that source and receiver locations as defined in the SPS files share the same coordinate system. This implies that Source location 1 has the same X, Y position as Receiver location 1, and that Source location 2 has the same X, Y position as Receiver location 2, etc... In the case of 3D data, this is not an issue, as CMP Line and Location will be labeled by the CMP Binning step.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Observers Notes – SPS Format cards (mandatory); 3) Receiver Locations – SPS Format cards (mandatory); 4) Source Locations – SPS Format cards (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

References: -

Example Flowchart:



Step Parameter Dialog:

Geometry Definition

☒ Kill undefined traces and records

☐ Output a list of killed traces

☐ Use unsigned offsets

☐ Define survey orientation for signed offsets

Enter survey orientation (degrees)

☒ Assign trace header statics from sps files

☐ Use unsigned azimuths

☐ Use source and receiver index numbers

Azimuth definition

☐ Zero degrees azimuth = East

☒ Zero degrees azimuth = North

Nominal receiver interval

OK Help Cancel

Parameter Description:

Kill undefined traces and records — If checked, any traces or records that are not represented in the SPS files will be marked as dead.

Output a list of killed traces — If checked, outputs a list of killed traces by geometry.

Use unsigned offsets — If checked, the offset values written to the seismic header will be unsigned.

Define survey orientation for signed offsets — If checked, the sign on offset values will be adjusted for the orientation of the dominant receiver line azimuth, such that offset up-the-spread will be positive, and offsets down-the-spread will be negative.

Enter survey orientation (degrees) — Enter the value of the survey orientation in degrees.

Assign trace header statics from SPS files — If checked, trace header statics are assigned from auxiliary SPS files.

Use unsigned azimuths — If checked, the azimuth values written to the seismic header will range from 0 to 360 degrees, with zero degrees of azimuth equal to the user-specified direction. By default, azimuth values are signed and range from 0 to +/-180 degrees, with zero degrees of azimuth equal to the user-specified direction.

Use source and receiver index number — Define source and receiver by its index number.

The **Azimuth definition** specifies the origin of azimuth.

Zero degrees azimuth = East — If selected, then zero degrees of source-receiver azimuth will be set equal to due East.

Zero degrees azimuth = North — If selected, then zero degrees of source-receiver azimuth will be set equal to due North.

Definition of azimuths using the Geometry Definition parameters.

Nominal receiver interval — Enter the nominal interval between receiver stations in distance units.

Geometry Definition Example:

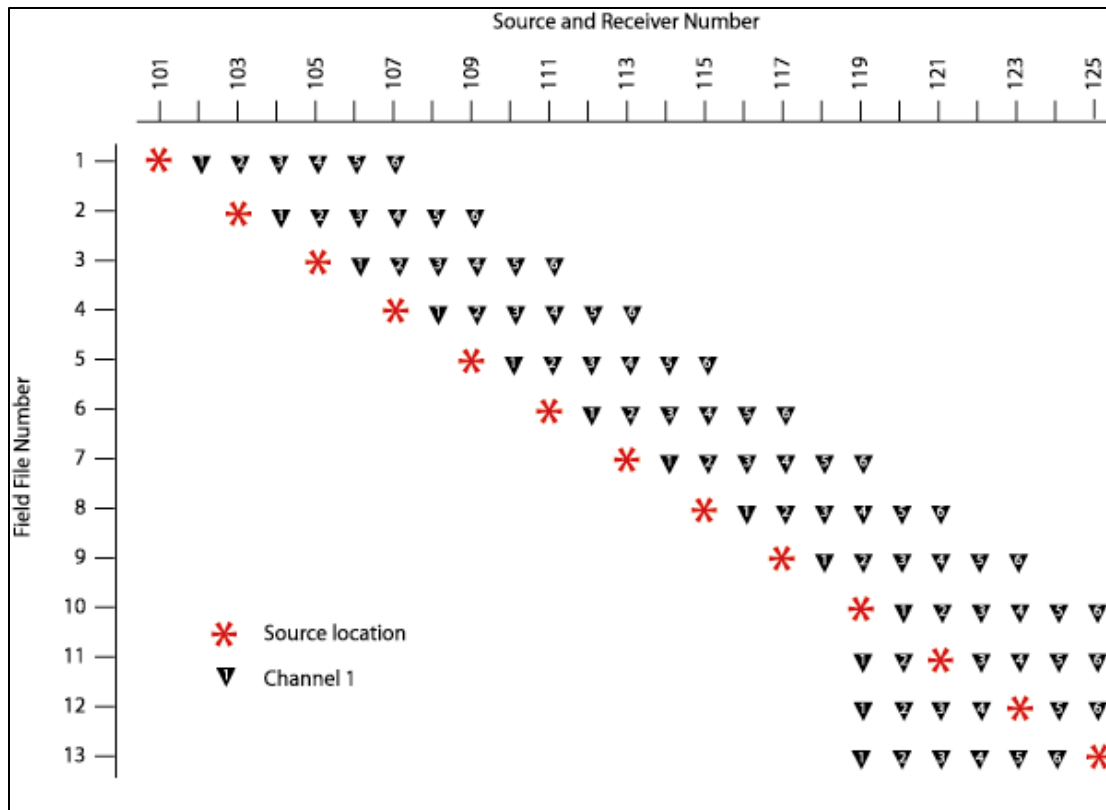


Figure 1. 2D seismic survey consisting of a 6-channel spread and a 25-m station interval. The spread “rolls-off” at the end of the line.

SPS Source Locations

SPS Source Record

File name: C:/Leonardo/DATA/Geosurveys3D/Survey/SourceLocations

File Browse...

Spreadsheet Map

Record ID	Line name	Point number	Point index	Point code	Static correct	Point depth	Seismic datum	Uphole time	Water depth	Point easting	Point northing	Surface elevati	Day of year	Time of day
1	S	1	100	0		0	0	0	0	1000.0	1000.0	100.0	0	0
2	S	1	102	0		0	0	0	0	1000.0	1050.0	100.0	0	0
3	S	1	104	0		0	0	0	0	1000.0	1100.0	100.0	0	0
4	S	1	106	0		0	0	0	0	1000.0	1150.0	100.0	0	0
5	S	1	108	0		0	0	0	0	1000.0	1200.0	100.0	0	0
6	S	1	110	0		0	0	0	0	1000.0	1250.0	100.0	0	0
7	S	1	112	0		0	0	0	0	1000.0	1300.0	100.0	0	0
8	S	1	114	0		0	0	0	0	1000.0	1350.0	100.0	0	0
9	S	1	116	0		0	0	0	0	1000.0	1400.0	100.0	0	0
10	S	1	118	0		0	0	0	0	1000.0	1450.0	100.0	0	0
11	S	1	120	0		0	0	0	0	1000.0	1500.0	100.0	0	0
12	S	1	122	0		0	0	0	0	1000.0	1550.0	100.0	0	0
13	S	1	124	0		0	0	0	0	1000.0	1600.0	100.0	0	0

OK Help

Analyze format Save changes

Figure 2. Source SPS file corresponding to the survey illustrated in Figure 1.

SPS Receiver Locations

SPS Receiver Record

File name: C:/Leonardo/DATA/Geosurveys3D/Survey/ReceiverLocation File Browse...

Spreadsheet Map

Record ID	Line name	Point number	Point index	Point code	Atmospheric correction	Point depth	Geoid datum	Uphole time	Water depth	Point easting	Point northing	Surface elevation	Day of year	Time of day
1	R	1	1	0	0	0.0	0	0	0	1000.0	1000.0	100.0	0	0
2	R	1	2	0	0	0.0	0	0	0	1000.0	1025.0	100.0	0	0
3	R	1	3	0	0	0.0	0	0	0	1000.0	1050.0	100.0	0	0
4	R	1	4	0	0	0.0	0	0	0	1000.0	1075.0	100.0	0	0
5	R	1	5	0	0	0.0	0	0	0	1000.0	1100.0	100.0	0	0
6	R	1	6	0	0	0.0	0	0	0	1000.0	1125.0	100.0	0	0
7	R	1	7	0	0	0.0	0	0	0	1000.0	1150.0	100.0	0	0
8	R	1	8	0	0	0.0	0	0	0	1000.0	1175.0	100.0	0	0
9	R	1	9	0	0	0.0	0	0	0	1000.0	1200.0	100.0	0	0
10	R	1	10	0	0	0.0	0	0	0	1000.0	1225.0	100.0	0	0
11	R	1	11	0	0	0.0	0	0	0	1000.0	1250.0	100.0	0	0
12	R	1	12	0	0	0.0	0	0	0	1000.0	1275.0	100.0	0	0
13	R	1	13	0	0	0.0	0	0	0	1000.0	1300.0	100.0	0	0
14	R	1	14	0	0	0.0	0	0	0	1000.0	1325.0	100.0	0	0
15	R	1	15	0	0	0.0	0	0	0	1000.0	1350.0	100.0	0	0
16	R	1	16	0	0	0.0	0	0	0	1000.0	1375.0	100.0	0	0
17	R	1	17	0	0	0.0	0	0	0	1000.0	1400.0	100.0	0	0
18	R	1	18	0	0	0.0	0	0	0	1000.0	1425.0	100.0	0	0
19	R	1	19	0	0	0.0	0	0	0	1000.0	1450.0	100.0	0	0
20	R	1	20	0	0	0.0	0	0	0	1000.0	1475.0	100.0	0	0
21	R	1	21	0	0	0.0	0	0	0	1000.0	1500.0	100.0	0	0
22	R	1	22	0	0	0.0	0	0	0	1000.0	1525.0	100.0	0	0
23	R	1	23	0	0	0.0	0	0	0	1000.0	1550.0	100.0	0	0
24	R	1	24	0	0	0.0	0	0	0	1000.0	1575.0	100.0	0	0
25	R	1	25	0	0	0.0	0	0	0	1000.0	1600.0	100.0	0	0

OK Help Analyze format Save changes

Figure 3. Receiver SPS file corresponding to the survey illustrated in Figure 1.

SPS Relation Record															
SPS Relation Record															
File name C:/Leonardo/DATA/Geosurveys3D/Survey/ObserverNotes File Browse...															
Spreadsheet															
	Record ID	Tape number	Record number	Record Index	Instrument code	Source line number	Source point number	Source point index	From channel	To channel	Channel increment	Receiver line number	From receiver	To receiver	Receiver index
1		X	1	1		1	101	1	1	6	1	1	102	107	1
2		X	2	1		1	103	1	1	6	1	1	104	109	1
3		X	3	1		1	105	1	1	6	1	1	106	111	1
4		X	4	1		1	107	1	1	6	1	1	108	113	1
5		X	5	1		1	109	1	1	6	1	1	110	115	1
6		X	6	1		1	111	1	1	6	1	1	112	117	1
7		X	7	1		1	113	1	1	6	1	1	114	119	1
8		X	8	1		1	115	1	1	6	1	1	116	121	1
9		X	9	1		1	117	1	1	6	1	1	118	123	1
10		X	10	1		1	119	1	1	6	1	1	120	125	1
11		X	11	1		1	121	1	1	6	1	1	119	120	1
12		X	11	0		1	121	1	1	6	1	1	122	125	1
13		X	12	1		1	123	1	1	6	1	1	119	122	1
14		X	12	1		1	123	1	1	6	1	1	124	125	1
15		X	13	1		1	125	1	1	6	1	1	119	124	1

Figure 4. Observer SPS file corresponding to the survey illustrated in Figure 1.

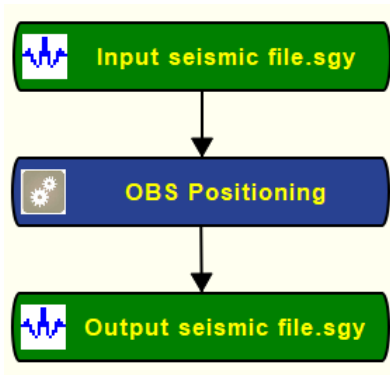
OBS Positioning

Usage: The OBS Positioning step accurately estimates the Ocean Bottom Seismometer (OBS) position (x, y, z) from knowledge of the sources locations and the picked first arrivals.

Input Links: 1) Seismic file from receiver gathers recorded with the OBS instrument, with source Easting/Northing/Elevation header information (mandatory); 2) First Break times - Pick First arrival picks (optional).

Output Links: 1) Seismic file from receiver gathers with the computed receiver Easting/Northing/Elevation (mandatory).

Example Flowchart:



Step Parameter Dialog:

OBS receiver Positioning

First arrival picks

☒ Use first arrivals from header word
First arrivals value (ms) User defined 8

☐ Use first arrivals from card data

Receiver / Sources parameters

☒ Sources are mainly at the same depth

Velocity check

☐ Check range of the computed water velocity

Minimum velocity 1450.0

Maximum velocity 1550.0

OK Help Cancel

Parameter Description:

The **First arrival picks** specifies the first arrival times picks parameters.

Use first arrivals from header word — if checked select the header word containing the first arrivals information.

First arrivals values (ms) — Select the trace header word with the first arrivals values.

Use first arrivals from card data — if checked a first arrivals card data will connect to the step.

The **Receiver/Source parameters** specify source elevation parameters.

Sources are mainly at the same depth — if checked all sources are at the same depth range.

The **Velocity check** specifies the range of water velocity.

Check range of the computed water velocity — return a warning message if the inverted velocity exceeds a range specified by the Minimum/Maximum velocities.

Minimum velocity — Enter minimum velocity for water column.

Maximum velocity — Enter maximum velocity for water column.

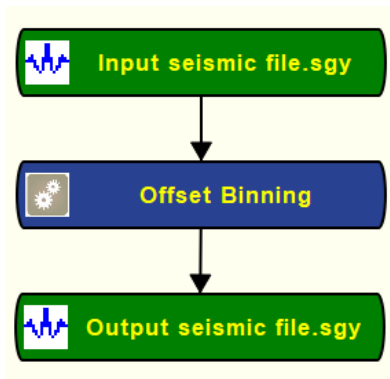
Offset Binning

Usage: The Offset binning step bins the input seismic file by the offset defined in the header of the seismic traces.

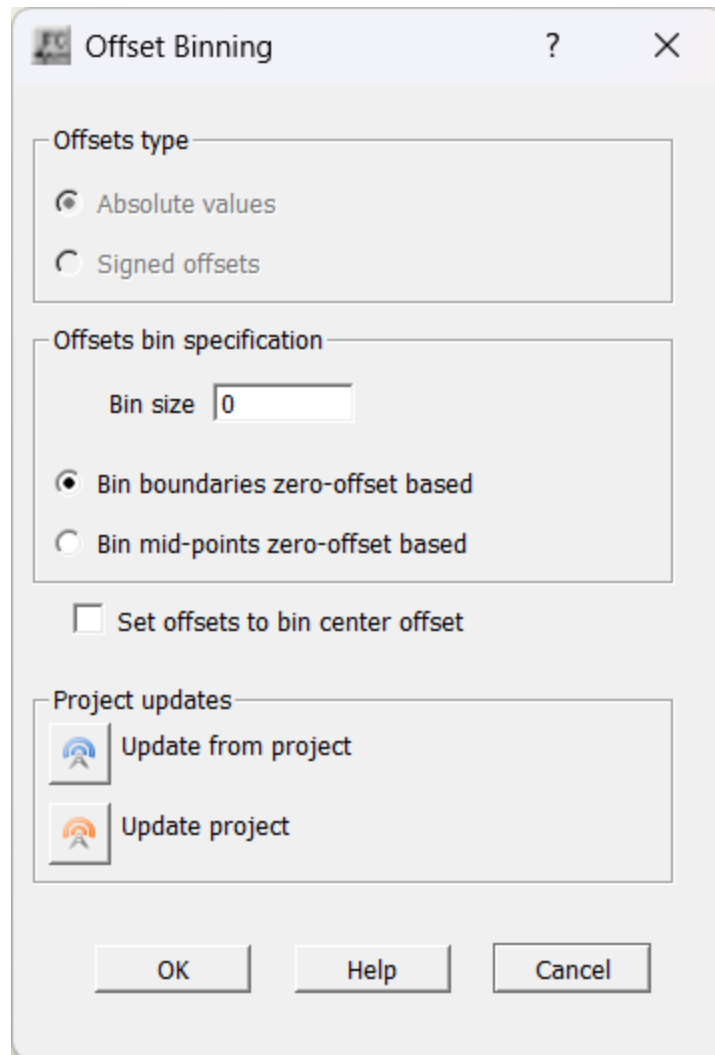
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Offsets type** specifies the type of offsets to be considered from binning.

Absolute values — If selected, use the absolute (i.e., unsigned) offset value.

Signed offsets — If selected, use the signed offset values.

The **Offsets bin specification** specifies the offset bin parameters.

Bin size — Enter the bin size in project units.

Bin boundaries zero-offset based — If selected, the bin is performed considering the boundaries as defined by the zero-offset.

Bin mid-point zero-offset based — If selected, the bin is performed considering the mid-point as defined by the zero-offset.

Set offsets to bin center offset — If checked, overwrites the offsets to the bin center offset.

The **Project updates** specifies the project definition update.

Update from project — Select to update from the project definition parameters.

Update project — Select to update the project parameters from the dialog.

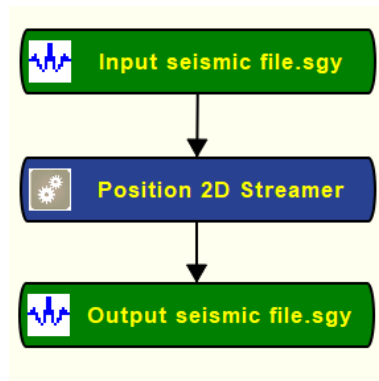
Position 2D Streamer

Usage: The Position 2D Streamer step estimates the receiver positioning by single source position and streamer azimuths.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Position 2D Streamer" and contains the following settings:

- Set streamer configuration** (button)
- Distance behind boat**: Source Near receiver
- ☐ Use feathering header Streamer feathering
- ☐ Use vessel position Vessel position headers: Vessel northing Vessel easting
- ☐ Use direct arrival times Velocity ☐ Use streamer depths
- ☐ Smooth channels:
 - ☒ Use surrounding shots Smoothing length
 - ☐ Use previous shots
- Set diagnostics** (button)
- OK** **Help** **Cancel** (buttons)

Parameter Description:

Set streamer configuration — Select to define the streamer layout, number of sections and number of channels per section. The configuration is done in a new dialog.

The **Distance behind boat** specifies the source and near receiver distance from the acquisition boat.

Source — Enter the distance between the source and the acquisition boat.

Near receiver — Enter the distance between the near receiver and the boat.

Use feathering heard — If checked, use a trace header word to get the feathering value.

Streamer feathering — Select the trace header word where the feathering value is stored.

Use vessel position — If checked, use trace header words to get the vessel's Easting and Northing coordinates.

Vessel northing — Select the trace header word where the vessel northing coordinates are stored.

Vessel easting — Select the trace header word where the vessel easting coordinates are stored.

Use direct arrival times — If checked, use direct arrival times for streamer configuration.

Velocity — Enter the velocity to estimate direct arrivals.

Use streamer depths — If checked, use the streamer depths to estimate direct arrivals.

Smooth Channels — If checked, use a smoothing window over channels positioning.

Use surrounding shots — If selected, use nearby shots for estimates.

Smoothing length — Enter the number of surrounding shots to be considered in the window.

Use previous shots — If selected, use previous shots for estimates.

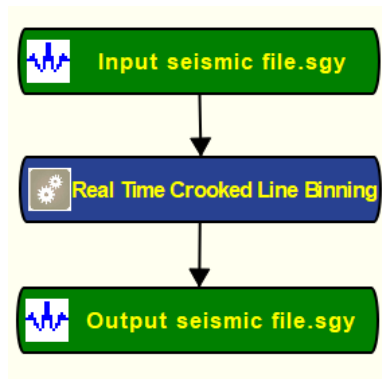
Real-Time Crooked Line Binning

Usage: The Real-Time Crooked Line Binning step does a real time CMP binning of those traces from an input 2D pre-stack seismic data file whose source-receiver mid-points fall sufficiently close to the centers of bins following a crooked line. This processing step is only available for Crooked Line projects.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled 'Real Time Crooked Line Binning' contains the following parameters:

- Bin size (feet or metres): 1.00
- Maximum offset to use for calculating bin locations: 20.0
- Maximum distance from the bin for trace to be included: 5.0
- Offset gather rejection:
 - ☐ Limit trace offsets
 - Minimum Offset: 0.0
 - Maximum Offset: 500.0

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Bin size (feet or meters) — Enter the inline bin dimension.

Maximum offset to use for calculating bin locations — Enter the maximum offset of the traces to be used in the calculation of the bin line.

Minimum distance from the bin for the trace to be included — Enter the minimum offset of the traces to be used in the calculation of the bin line.

The **Offset gather rejection** specifies the offset limits to reject traces for binning.

Limit traces offsets — If checked, limits the traces considered for binning based on the offset.

Minimum offset — Enter the minimum offset to be considered for binning.

Maximum offset — Enter the maximum offset to be considered for binning.

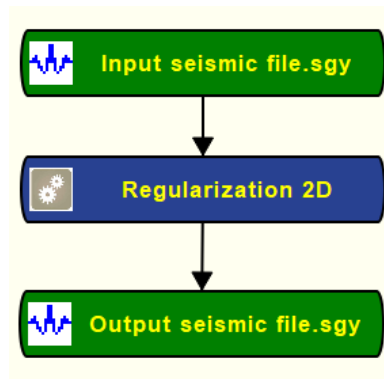
Regularization 2D

Usage: The Regularization 2D step interpolates the seismic data in two-dimensions using the POCS or ALFT methods.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

2D regularization

Header to regularize: Offset

Required header increment 0

Increment subsampling factor 4.00

☐ Use Frequency ordering

☒ Use Amplitude Selection

☒ POCS method

☐ ALFT method

Number of bands 10

Number of Amplitude bands 10

☒ Amplitude bands

☐ Decibel bands

Data dB range 60

☐ Remove evanescent energy

O/p trace separation (m.) 1

Velocity (m/s) 0

OK Help Cancel

Parameter Description:

Header to regularize: — Select the trace header word to regularize.

Required header to increment — Enter header increment of specified header in the regularized output data.

Increment subsampling fact — Enter the increment subsampling factor. The required header increment will be divided by this value and the input data binned to this increment as an initial step before regularization.

Use Frequency ordering — If selected, select number of frequency bands.

Number of bands — Enter the number of frequency bands.

Use Amplitude Selection — If selected, select number of amplitude bands.

Number of amplitude bands — Enter the number of frequency bands.

POCS method — If selected, the data will be divided into bands of equal linear amplitude decreasing from maximum to zero.

ALFT method — If selected, the data will be divided into bands of equal decibels (logarithmic) width, from the maximum amplitude down to the minimum according to the specified range.

Amplitude bands — If selected, the data will be divided into bands of equal linear amplitude decrease from maximum to zero.

Decibel bands — If selected, The data will be divided into bands of equal decibels (logarithmic) width, from the maximum amplitude down to the minimum according to the specified range.

Data dB range — Enter the range of dB.

Remove evanescent energy — If selected, remove evanescent energy.

O/p trace separation (m) — Enter output trace separation in meters.

Velocity (m/s) — Enter the velocity.

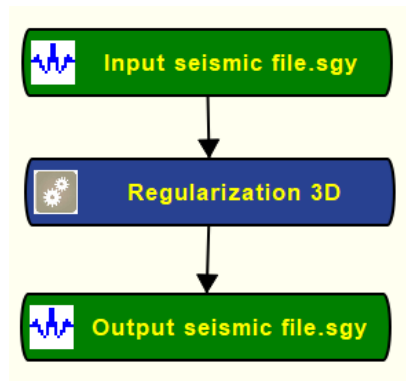
Regularization 3D

Usage: The Regularization 3D step interpolates the seismic data in three-dimensions using the POCS or FXY methods.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

3D regularization

☒ Regularize receivers
☐ Regularize sources
☐ Regularize CMPs

☒ FXY interpolation
☐ POCS method

☒ Allow extrapolation

Data dB range: 60
 Number of dB bands: 10
 Velocity (m/s): 0.0

☐ Remove evanescent energy

☐ Limit processing frequency
 Maximum frequency: 0.0

OK Help Cancel

Parameter Description:

Regularize receivers — If selected, regularization is performed at receivers. The input data must be sorted in common shot records.

Regularize sources — If selected, regularization is performed at sources. The input data must be sorted in common receiver records.

Regularize CMPs — If selected, regularization is performed at CMP locations. The input data must be sorted in common offset using regular offset bin.

FXY interpolation — If selected, the data will be interpolated to the regularized domain by common frequency interpolation.

Allow extrapolations — If checked, allow extrapolations during the regularization.

POCS method — If selected, the Abma POCS method will be used.

Data dB range — Enter data amplitude (dB) range.

Number of dB bands — Enter the number of amplitude (dB) bands.

Remove evanescent energy — If selected, remove evanescent energy.

Velocity (m/s) — Enter the velocity.

Limit processing frequency — If selected, limit the processing frequency.

Maximum frequency — Enter the maximum frequency to consider.

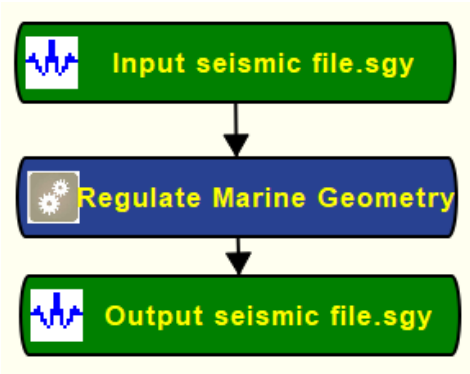
Regulate Marine Geometry

Usage: The Regulate Marine Geometry step set offsets from source and streamer configuration geometry and regularize the input seismic data based on neighbor source locations.

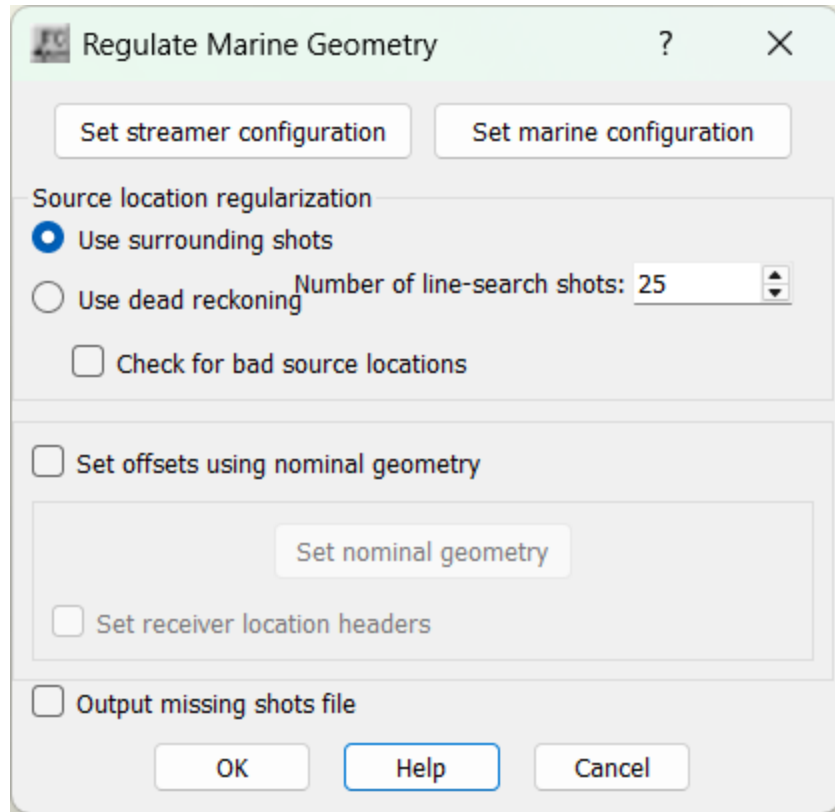
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Set streamer configuration — If selected, set the layout of each streamer, number of sections and channels per section. If using the database these parameters should be present.

Set marine configuration — If selected, set the number of sources, streamers, channels per streamer and the trace header used to specify the source ID. If using the database these parameters should be present.

The **Source location regularization** specifies the source regularization parameterization.

Use surrounding shots — If selected, regularizes using neighbors from central current shot.

Number of line-search shots: — Enter the number of shots be used in the neighborhood.

Use dead reckoning — If selected, line-search shots to those of the same source immediately previous to current shot.

Check for bad source locations — If checked, bad locations will be replaced by the mean of the local locations before source regularization.

Set offsets using nominal geometry — If checked, set nominal source-receiver offsets in the seismic trace header.

Set nominal geometry — Select the source positions and of either the head buoys or the first receivers on the channels relative to a fixed point (the acquisition vessel).

Set receiver location headers — If checked, set nominal receiver headers.

Output missing shot files — If checked, outputs a date stamped csv file specifying field records and sources missing.

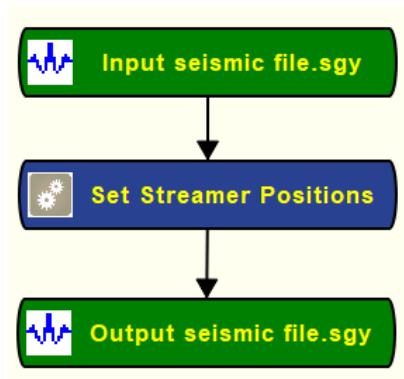
Set Streamer Positions

Usage: The Set Streamer Positions step use direct arrival times to set streamer receiver coordinates.

Input Links: 1) Seismic data in any sort order (mandatory)-

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Set Streamer Positions

Set streamer configuration Set marine configuration

☐ Smooth picks: Average over 'n' shots 25

Streamer depths

Don't use depths Streamer depths

☒ Output depths to trace header

Velocity for streamer positioning

☐ Use near surface velocity from database

☒ Use specified sea water velocity... 1500.00

Streamers' shape

Geometry: Straight, feathered

Parameters

☐ Smooth channels:

☒ Use surrounding shots Smoothing length 15

☐ Use previous shots

Set diagnostics

OK Help Cancel

Parameter Description:

Set streamer configuration — If selected, set the layout of each streamer, number of sections and channels per section. If using the database these parameters should be present.

Set marine configuration — If selected, set the number of sources, streamers, channels per streamer and the trace header used to specify the source ID. If using the database these parameters should be present.

Smooth picks — If checked, arrival picks are averaged before calculation.

Average over 'n' shots — Enter the number of shots to be .

The **Streamer depths** specify parameters for streamer depths.

Don't use depths — Select the type of streamer depths to be used. Available list of options {Don't use depths; Use database depths; Use specific depths; Estimate depths (use current maximum); Estimate Depths (variable); Use depths from streamers birds}

Output depths to trace header — If checked, output streamer depths to trace header.

The **Velocity for streamer positioning** specifies parameters for streamer depths.

Use near surface velocity from database — not implemented yet.

Use specified sea water velocity... — If checked, use a constant sea water velocity and enter velocity (m/s).

The **Streamers' shape** specifies the shape of streamers.

Geometry: — Select the shape/type of streamers' shape.

Parameters — Select parameters with streamers' shape.

Smooth channels: — If checked, smooth channels positions.

Use surrounding shots — If selected, use nearby shots to smooth channels.

Use previous shots — If selected, use previous shots, independently of the location, to smooth channels.

Smoothing length — Enter the number of shots to be used in the smoothing of channels.

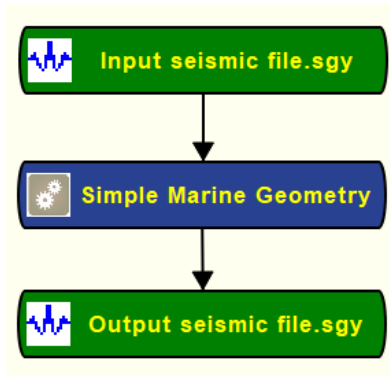
Simple Marine Geometry

Usage: The Simple Marine Geometry step assigns geometry information to the seismic trace headers based for simple 2D marine seismic acquisition.

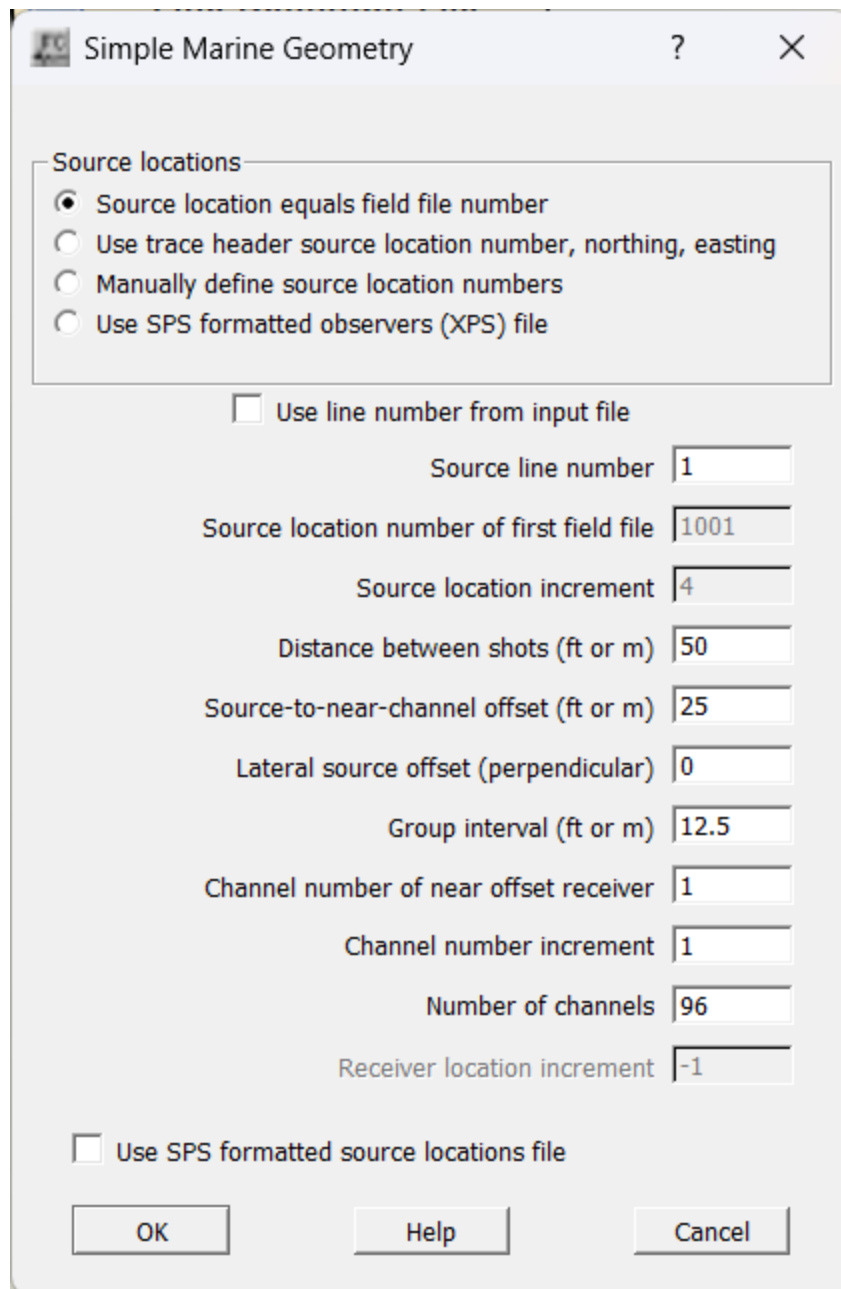
Input Links: 1) Seismic data in any sort order (mandatory); 2) Streamer Definition card data (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Simple Marine Geometry". It contains a "Source locations" section with four radio button options. Below this is a checkbox for "Use line number from input file". If checked, it enables a series of input fields: "Source line number" (1), "Source location number of first field file" (1001), "Source location increment" (4), "Distance between shots (ft or m)" (50), "Source-to-near-channel offset (ft or m)" (25), "Lateral source offset (perpendicular)" (0), "Group interval (ft or m)" (12.5), "Channel number of near offset receiver" (1), "Channel number increment" (1), "Number of channels" (96), and "Receiver location increment" (-1). At the bottom is another checkbox for "Use SPS formatted source locations file" and three buttons: "OK", "Help", and "Cancel".

Simple Marine Geometry

Source locations

- ☒ Source location equals field file number
- ☐ Use trace header source location number, northing, easting
- ☐ Manually define source location numbers
- ☐ Use SPS formatted observers (XPS) file

☐ Use line number from input file

Source line number 1

Source location number of first field file 1001

Source location increment 4

Distance between shots (ft or m) 50

Source-to-near-channel offset (ft or m) 25

Lateral source offset (perpendicular) 0

Group interval (ft or m) 12.5

Channel number of near offset receiver 1

Channel number increment 1

Number of channels 96

Receiver location increment -1

☐ Use SPS formatted source locations file

OK Help Cancel

Parameter Description:

The **Source locations** specify location of sources.

Source location equals field file number — If selected, source locations are set equal to field file number from seismic trace headers.

Use trace header source location number, northing, easting — If selected, source locations are set equal to source location (number, northing and easting) from the trace headers.

Manually define source location numbers — If selected, source locations are defined manually from the parameters below.

Use SPS formatted observers (XPS) file — If selected, source locations are set as defined in the auxiliary observers (XPS) card data file.

Use line number from input file — Use the same line number as the input file.

Source line number — Enter the source location line number.

Source location number of first field file — Enter the location of the source for first field file number.

Source location increment — Enter the source location increment. This value must be an integer value.

Distance between shot (ft or m) — Enter the distance between shots in ft or m, depending on the units defined for the project.

Source-to-near-channel offset (ft or m) — Enter the near offset, distance between source and the near channel. Distance defined in ft or m, depending on the units defined for the project.

Lateral source offset (perpendicular) — Enter the offset distance in the direction perpendicular to the streamer.

Group interval (ft or m) — Enter the distance between each group. Distance defined in ft or m, depending on the units defined for the project.

Channel number of near offset group — Enter the number of the near offset group.

Channel number increment — Enter the increment between channels.

Number of channels — Enter total number of channels in the streamer.

Receiver location increment — Enter the increment between receiver locations.

Use SPS formatted source locations file — If checked, source locations are extracted from an auxiliary source SPS card data file.

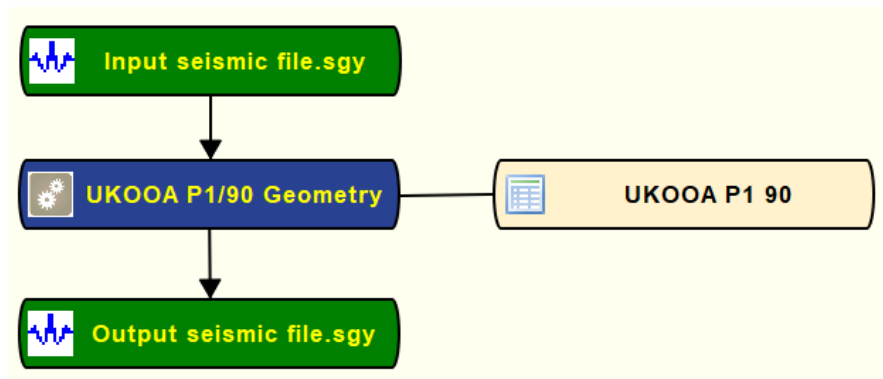
UKOOA P1/90 Geometry

Usage: The UKOOA P1/90 Geometry step assigns survey information to the trace headers based on a geometry file as defined in an auxiliary UKOOA P1/90 card data file.

Input Links: 1) Seismic data in any sort order (mandatory); 2) UKOOA P1 90 card data file (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box, titled "UKOOA P1/90 Geometry Definition", contains the following parameters:

- Source line number: 1
- Nominal group interval: 12.50
- Nominal source interval: 25.00
- Starting CMP location: 1000
- Data dimension: ☒ 2D survey, ☐ 3D survey

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Source line number — Enter the source/sail line number corresponding to the selected P1/90 coordinate file.

Nominal channel interval — Enter the spacing between channels on the cable.

Nominal source interval — Enter the spacing between sources.

Starting CMP location — Enter the initial CMP location.

The **Data dimension** specifies data dimensions.

2D survey — If selected, input seismic file is a 2D survey.

3D survey — If selected, input seismic file is a 3D survey.

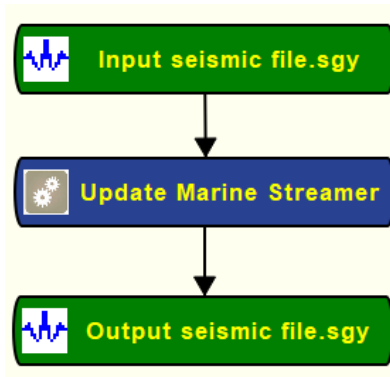
Update Marine Streamer

Usage: The Update Marine Streamer step allows the update of the streamer configuration of an existing geometry already defined on the input seismic data.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Update Marine Streamer'. It contains several input fields with numerical values: 'Distance between shots (ft or m)' is 25, 'Source-to-near-channel offset (ft or m)' is 12.5, 'Group interval (ft or m)' is 6.25, 'Channel number of near offset group' is 1, 'Channel number increment' is 1, and 'Number of channels' is 96. At the bottom, there are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Distance between shots (ft or m) — Enter the distance between shots. Distance defined in ft or m, depending on the units defined for the project.

Source-to-near channel offset (ft or m) — Enter the distance between source and the near channel. Distance defined in ft or m, depending on the units defined for the project.

Group interval (ft or m) — Enter the distance between groups. Distance defined in ft or m, depending on the units defined for the project.

Channel number of near offset group — Enter the number of the channel for the near offset group.

Channel number increment — Enter the increment between the channel number.

Number of channels — Enter the total number of channels.

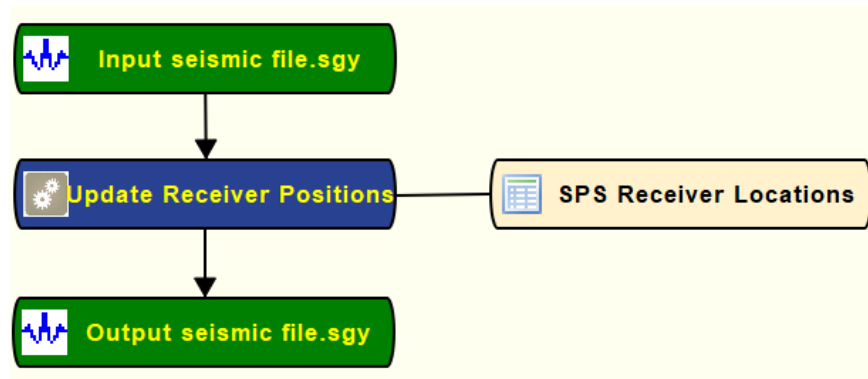
Update Receiver Positions

Usage: The Update Receiver Positions step allows updating the position of the receivers, as defined in the auxiliary SPS Receiver Locations card data file, of the input seismic data file.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Auxiliary SPS Receiver Locations card data file (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Update Receiver Positions

☐ Use unsigned offsets

☐ Define survey orientation for signed offsets

Enter survey orientation

☐ Use unsigned azimuths

Azimuth definition

☐ Zero degrees azimuth = East

☒ Zero degrees azimuth = North

Nominal receiver interval

OK Help Cancel

Parameter Description:

Use unsigned offsets — If checked, the offset values written to the seismic header will be unsigned.

Define survey orientation for signed offsets — If checked, the sign on offset values will be adjusted for the orientation of the dominant receiver line azimuth, such that offset up-the-spread will be positive, and offsets down-the-spread will be negative.

Enter survey orientation (degrees) — Enter the value of the survey orientation in degrees.

Use unsigned azimuths — If checked, the azimuth values written to the seismic header will range from 0 to 360 degrees, with zero degrees of azimuth equal to the user-specified direction. By default, azimuth values are signed and range from 0 to +/-180 degrees, with zero degrees of azimuth equal to the user-specified direction.

The **Azimuth definition** specifies the origin of azimuth.

Zero degrees azimuth = East — If selected, then zero degrees of source-receiver azimuth will be set equal to due East.

Zero degrees azimuth = North — If selected, then zero degrees of source-receiver azimuth will be set equal to due North.

Nominal receiver interval — Enter the nominal interval between receiver stations in distance units.

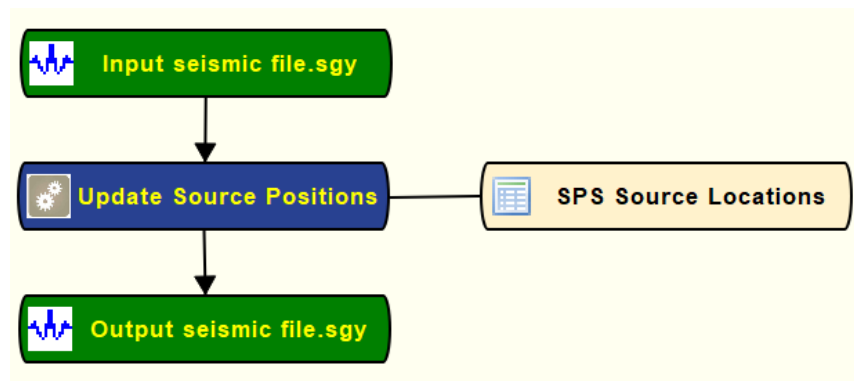
Update Source Positions

Usage: The Update Source Positions step allows updating the position of the sources, as defined in the auxiliary SPS Source Locations card data file, of the input seismic data file.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Auxiliary SPS Source Locations card data file (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Update Source Positions

☒ Recalculate offsets

☐ Use unsigned offsets

☐ Define survey orientation for signed offsets

Enter survey orientation

☐ Use unsigned azimuths

Azimuth definition

☐ Zero degrees azimuth = East

☒ Zero degrees azimuth = North

OK Help Cancel

Parameter Description:

Use unsigned offsets — If checked, the offset values written to the seismic header will be unsigned.

Define survey orientation for signed offsets — If checked, the sign on offset values will be adjusted for the orientation of the dominant receiver line azimuth, such that offset up-the-spread will be positive, and offsets down-the-spread will be negative.

Enter survey orientation (degrees) — Enter the value of the survey orientation in degrees.

Use unsigned azimuths — If checked, the azimuth values written to the seismic header will range from 0 to 360 degrees, with zero degrees of azimuth equal to the user-specified direction. By default, azimuth values are signed and range from 0 to +/-180 degrees, with zero degrees of azimuth equal to the user-specified direction.

The **Azimuth definition** specifies the origin of azimuth.

Zero degrees azimuth = East — If selected, then zero degrees of source-receiver azimuth will be set equal to due East.

Zero degrees azimuth = North — If selected, then zero degrees of source-receiver azimuth will be set equal to due North.

Migration Steps

This section documents the processing steps available in the Migration category.

The types of Migration steps currently available are:

Migration
 Processing Categories
2D Paraxial Ray Tracing
2D Pre-Stack PSPI Migration
3D Finite Differences Wavefront Tracing
Constant Velocity PSKTM
Convert Time to Depth
FK Dip Moveout
PSPI Migration
Phase Shift Migration
Post-Stack Kirchhoff Time Migration
Pre-Stack Kirchhoff Depth Migration
Pre-Stack Kirchhoff Time Migration
Stolt (FK) Migration

2D Paraxial Ray Tracing

Usage: The 2D Paraxial Ray Tracing step is an asymptotic wave method, which uses quantities (local wavefront curvature and spreading information) determined along a central ray via dynamic ray tracing, to evaluate approximately the seismic wave field in its vicinity rather than just on the ray itself (Cerveny et al. 1984). This implementation is designed to run in single thread or in parallel, giving it the possibility to take full advantage of multiple processors at the same time.

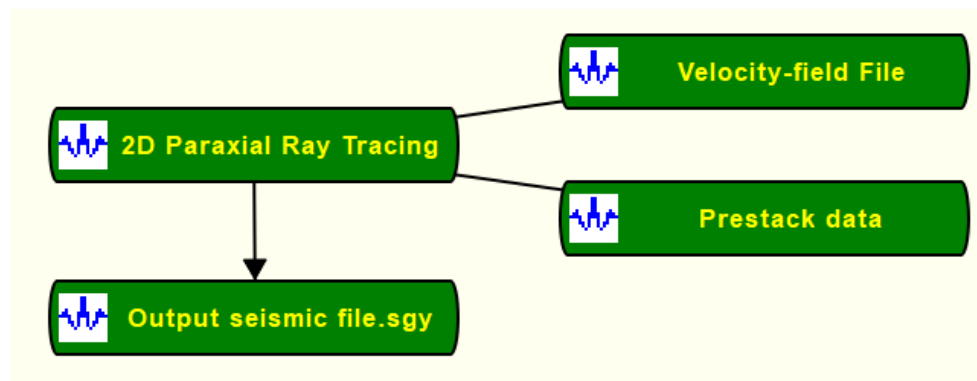
Input Links: -

Auxiliary dataset: 1) Interval Velocity-Field file, created using the step Create Velocity Field under the velocity category (mandatory); 2) Pre-stack dataset, used to get source and receivers geometry (mandatory).

Output Links: 1) Seismic file where the computed source or receiver travel-time tables will be saved (mandatory).

References: Cerveny V, Klimes L, Psencik I (1984) Paraxial ray approximations in the computation of seismic wavefields in inhomogeneous media. Geophys J R Astron Soc 89–104.

Example Flowchart:



Step Parameter Dialog:

2D Paraxial ray tracing

Source/Receiver parameters

- ☒ Run a source ray tracing
- ☐ Run a receiver ray tracing
- ☐ Use recording surface other than zero
- Source elevation: Receiver easting

Travel time tables

- ☐ Set up travel time tables geometry
- First depth sample: 0
- Depth interval: 0.000
- First lateral sample: 0
- Lateral interval: 0.000

Ray tracing parameters

- Time sample interval (Sec): 0.00200
- Number of time samples: 4000
- ☐ Overwrite CMP interval (m): 6.25
- ☐ Set in-line aperature (m): 000.000
- Number of rays: 60
- First take-off angle of rays (deg): -60.0
- Increment of take-off angle (deg): 2.0
- Minimum emergence angle (deg): 0
- Maximum emergence angle (deg): 90
- Extrapolation radius factor: 0.010
- ☒ Solve Eikonal equation in shadow zones

OK Help Cancel

Parameter Description:

The **Source/Receiver parameters** specify source or receiver parameters.

Run a source ray tracing — If selected, shoot rays at source locations.

Run a receiver ray tracing — If selected shoot rays at receiver locations.

Use Recording surface other than zero — If checked, specify the header word containing the source elevation information.

Source elevation — Select the trace header word containing the elevation information.

The **Travel-time tables** specify the geometry related to the travel time table used for the 2D paraxial ray tracing.

Set up travel-time tables geometry — If checked, defines the travel-time tables geometry. If not checked, the geometry of the input velocity file information is used as reference.

First depth sample — Enter the first depth sample in the travel-time table.

Depth interval — Enter the depth interval in the travel-time table.

First lateral sample — Enter the first lateral sample in the travel-time table.

Lateral interval — Enter the lateral interval in the travel-time table.

The **Ray tracing parameters** specify the ray tracing parameters.

Time sample interval — Enter the time sample interval in ray tracing.

Number of time samples — Enter the number of time samples in ray tracing.

Number of rays — Enter the number of rays.

Set in-line aperture — Define the setting for the in-line aperture. If not checked, the maximum aperture is used, which require more compute time.

In-line aperture — Enter the ray tracing aperture for the in-line direction.

First take-off angle of rays (deg.) — Enter the first take-off angle of the rays in degrees.

Increment of take-off angle (deg.) — Enter the increment of the take-off angle.

Minimum emergence angle (deg.) — Enter the minimum emergence angle.

Maximum emergence angle (deg.) — Enter the maximum emergence angle.

Extrapolation radius factor — Enter the factor to determine the radius for extrapolation.

Solve eikonal equation in shadow zones — If checked, implements the eikonal equation in the shadow zones.

2D Pre-Stack PSPI Migration

Usage: The 2D Pre-Stack PSPI Migration step is only available for 2D seismic data and is a 2D 'Phase Shift Plus Interpolation' seismic data migration. The input data must be in the form of frequency slices of CMP vs. Offset. Convert the CMP and offset-sorted data to frequency slices by the use of Frequency Slices step in a prior job flow.

The output data will be in standard trace order and not requiring further transformation.

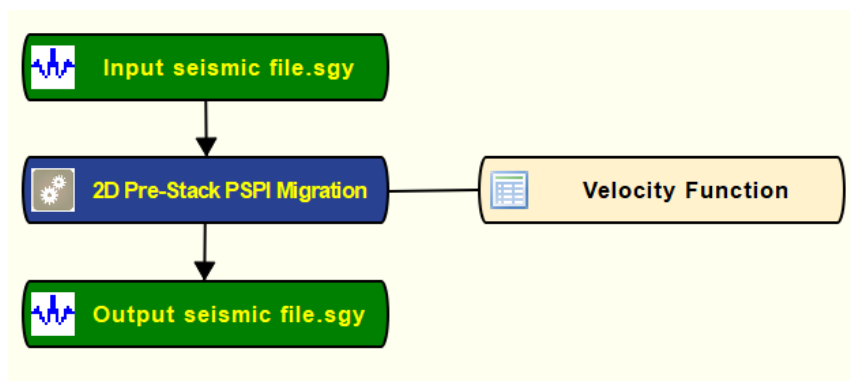
Input Links: 1) Frequency slices ordered by Slice Number and CMP (mandatory).

Output Links: 1) Time traces sorted by CMP and Offset (mandatory).

Reference: Gasdag, J, and Sguazzero P., 1984, Migration of seismic data by phase shift plus interpolation, Geophysics, 49(2), 124-131;

Popovici, A.M., 1996, Pre-stack migration by split-step DSR, Geophysics, vol. 61, no. 5, p. 1412-1416..

Example Flowchart:



Step Parameter Dialog:

PSPI 2D Pre-Stack Migration

Migration mode

☒ Time migration
Output maximum time (ms)

☐ Depth migration
Output maximum depth(ft/m)

Output depth sampling (ft/m)

Migration velocity field

☒ Use velocity field from data file

☐ Use constant migration velocity

Scale input velocities by

Velocity sampling

☒ Use CMP velocity

☐ Use velocity from CMP and offset

Migration step size

Number of output samples

Frequency filtering

Low cut Frequency (Hz.)

Low Pass Frequency (Hz.)

High Pass Frequency (Hz.)

High Cut Frequency (Hz.)

Alias energy removal

Evanescent damping factor

Spatial padding width (CMPs)

Override CMP spacing

☐ Specify CMP spacing

OK Help Cancel

Parameter Description:

The **Migration mode** specifies the migration domain and output format.

Time Migration — If checked, time migration will be performed.

Output maximum time (ms) — Enter the maximum time of the output migrated data in milliseconds. The time sampling will be the same as that of the input data.

Depth Migration — If checked, depth migration will be performed.

Output maximum depth (ft/m) — Enter the maximum depth of the output migrated data.

Output depth sampling (ft/m) — Enter the depth sampling interval of the output migrated data.

The **Migration velocity field** specify parameters related to the velocity field used for migration.

Use velocity field from data file — If checked, then an auxiliary input which contains the velocity field picks file must be specified.

Use constant migration velocity — If checked, then the migration velocity to be used should be specified in the adjacent box.

Scale input velocities by — The migration velocities may be scaled by a constant factor if required.

The **Velocity sampling** specifies velocity sampling parameters (currently disabled).

Use CMP velocity — If selected, then velocity will be CMP dependent only. This is the normal assumption when performing time migration.

Use velocity from CMP and offset — If selected, then velocity field will be expected to be dependent both on CMP and on offset. This is likely to be the case when performing depth migration. This option is not currently available.]

The **Migration step size** specifies the migration step size.

Number of output samples — Enter the number of output migration slices to be output with each iteration of the migration. Every migration iteration takes a roughly constant execution time, so the total execution time can be significantly reduced if

several output slices are calculated at once. There may be a degradation in the migration of dipping data if this parameter is set too high. Consequently, this parameter is data-dependent and may require testing.

The **Frequency filtering** specify filtering parameters. The output migrated data will be Hanning (cosine) tapered.

Low-cut Frequency (Hz.) — Enter the low-cut frequency of the output migrated data.

Low pass Frequency (Hz.) — Enter the low pass frequency of the output migrated data.

High pass Frequency (Hz.) — Enter the high pass frequency of the output migrated data.

High cut Frequency (Hz.) — Enter the high cut frequency of the output migrated data.

The **Alias energy removal** specifies the alias energy removal.

Evanescent damping factor — Enter the amount of suppression of energy which is not a real solution of the acoustic wave equation, as a value between zero and one. A value of 0.5 is recommended.

Spatial padding width (traces) — Enter how many additional traces are to be added (in both CMP line and location directions in the case of 3D migration). These extra traces plus spatial tapering help to minimize interference of migrated energy from one end of the data into migrated data on the other side.

The **Override trace spacing** specifies if the original trace spacing is override by a user defined distance. If the trace spacing cannot be read from or is incorrect in the trace headers, then it may be specified in the following parameter fields.

Specify the CMP spacing — If checked, then the user must enter the distance between CMP locations in the adjacent field.

3D Finite Differences Wavefront Tracing

Usage: The 3D Finite Differences Wavefront Tracing step is a wavefront tracing technique, and a robust alternative to conventional ray tracing. This method relies on the application of Huygens' Principle in the finite difference approximation. That is, every point reached by a wave becomes a secondary source; the sum of these secondary waves determines the form of the wave at any subsequent time. This method accurately computes travel-time information even with step velocity contrast as high as 1:10 regardless of the sharpness of the velocity anomaly. This implementation is designed to run in single thread or in parallel, giving it the possibility to take full advantage of multiple processors at the same time.

Input Links: -

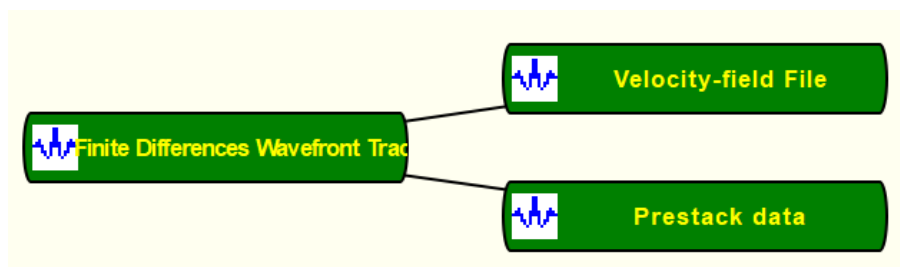
Auxiliary dataset: 1) 3D Interval Velocity-Field file, created using the step Create Velocity Field under the velocity category (mandatory); 2) Pre-stack dataset, used to get source and receivers geometry (mandatory).

Output Links: 1) Seismic file where the computed source or receiver travel-time cubes will be saved (mandatory).

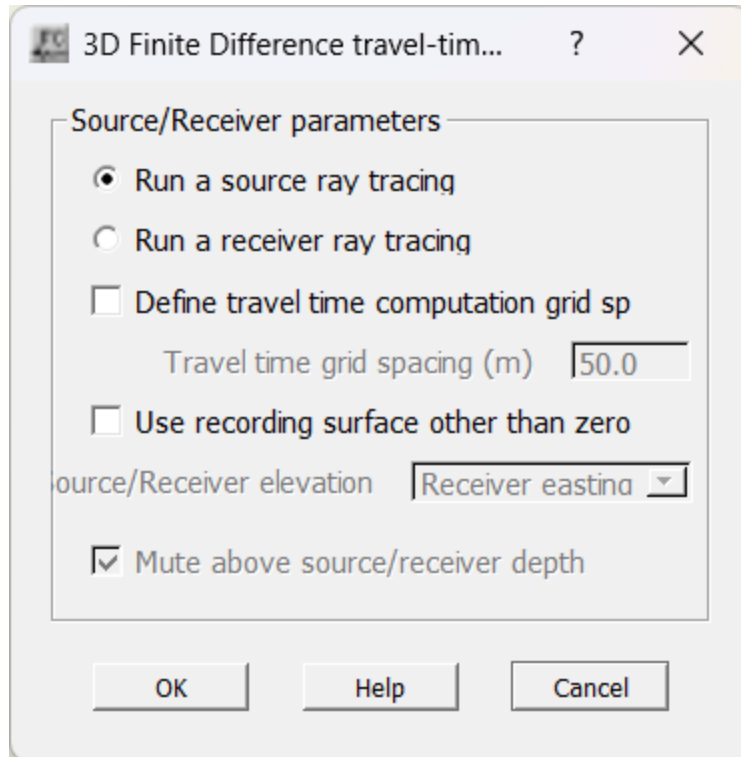
References: Podvin P, LI (1991) Finite difference computation of traveltimes in very contrasted velocity models: a massively parallel approach and its associated. Geophys J Int 105:271–284.

Huygens wavefront tracing: A robust alternative to conventional ray tracing. SEP Report, 95, 101-113 (1997)

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Source/Receiver parameters** specify source and receiver parameters for wavefront tracing.

Run a source ray tracing — If selected, shoot rays at source locations.

Run a receiver ray tracing — If selected, shoot rays at receiver locations.

Define the travel time computation grid (m) — If checked, specify the grid spacing on which the computation is carried; the output grid is the same as the velocity grid.

Travel time grid spacing (m) — Enter the travel time grid spacing.

Use Recording surface other than zero — If checked, specify the header word containing the source elevation information.

Source/Receiver elevation — Select header word with source elevation information.

Mute above the source/receiver depth — This option is only enabled if the recording surface is other than zero.

Constant Velocity PSKTM

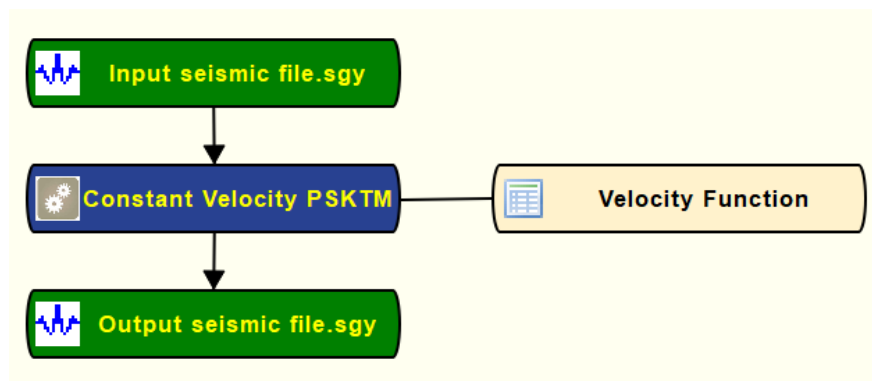
Usage: The Constant Velocity PSKTM step is a migration velocity analysis tool; it runs multiple Pre-Stack Kirchhoff Migrations around the velocity model given as input to pick the velocity that migrate best the data. This implementation is designed to run in single thread or in parallel, giving it the possibility to take full advantage of multiple processors at the same time.

Input Links: 1) Pre-Stack seismic dataset with geometry applied to it and preferably some pre-processing as well (mandatory).

Auxiliary dataset: 1) Velocity model/function (mandatory).

Output Links: 1) Seismic file where the Constant Velocity PSKTM will be saved (mandatory).

Example Flowchart:



Step Parameter Dialog:

Constant Velocity PSKTM

Migration limits

- ☐ Migrate zero samples
- ☐ Constant start time (ms)
- ☐ Constant end time (ms)
- ☒ Limit operator dip
- ☐ Minimum Offset (m)
- ☐ Maximum Offset (m)

Migration velocities

- First Velocity (m/s)
- Velocity Increment (m/s)
- Number of velocities
- Velocity Window (m/s)

Traveltime calculations

- ☒ Assuming a flat topography scenario
- ☐ Accounting for rugged topography

OK Help Cancel

Parameter Description:

The **Migration limits** specify the migration limits for the constant velocity pre-stack Kirchhoff time migration.

Migrate zero samples — If checked, samples with amplitudes value zero will be migrated as well.

Constant Start time (ms) — If checked, defines a constant migration start time for the migration operator.

Constant end time (ms) — If checked, defines a constant migration end time for the migration operator.

Limit operator dip — If checked, limits the dip angle of the migration operator.

Minimum offset (m) — If checked, defines a minimum offset for the migration operator.

Maximum offset (m) — If checked defines a maximum offset for the migration operator.

The **Migration velocities** specify the input parameters related to the velocities.

First Velocity (m/s) — Enter the first velocity to be considered for migration.

Velocity Increment (m/s) — Enter the velocity increment to be considered for migration.

Number of Velocities — Enter the number of velocities to be considered for migration.

Number of Velocities — Enter the number of velocities to be considered for migration.

Velocity window (m/s) — Enter a window around the input velocity model.

The **Traveltime calculations** specify topography parameters for traveltimes calculations.

Assuming a flat topography scenario — If selected, assume a flat recording surface when computing travel-time information.

Accounting for rugged topography — If selected, assume a rugged recording surface when computing travel-time information.

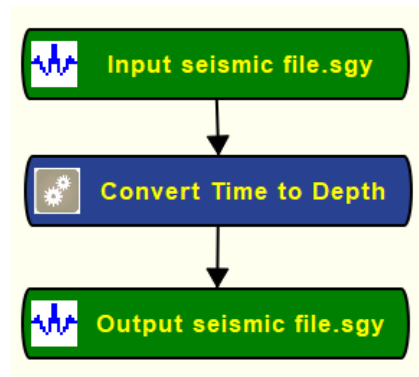
Convert Time to Depth

Usage: The Convert Time to Depth step does a vertical time to depth conversion of a seismic file using an input set of interval velocities. The input velocities are assumed to be in units of feet or meters per second depending the project units. If the input file to be depth converted is a GPR image, and the input velocity file is in units of feet or meters per nanosecond, you must first multiply the velocity values by 1×10^{-9} .

Input Links: 1) Seismic data in any sort order (mandatory); 2) Velocity Function cards (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Convert Time to Depth

Velocity field definition

☐ Use velocity field from data file

☒ Use smooth velocities

☐ Use blocky velocities

☒ Set a final interval velocity:

☒ Use constant velocity

Constant velocity

Transform type

☒ Time to Depth ☐ Depth to Time

O/p Depth interval

Number of Output Samples

Scale input velocities by (%)

Interpolation type

☐ Linear ☒ Quadratic

OK Help Cancel

Parameter Description:

The **Velocity field definition** specifies velocity field parameters.

Use velocity field from data file — If selected, the velocity field used for the time to depth conversion is from an auxiliary velocity field card data.

Use smooth velocities — If selected, input velocities are smoothed horizontally and vertically.

Use blocky velocities — If selected, input velocities are converted into interval velocities.

Set a final interval velocity — Enter the depth interval in your spatial units. To obtain an estimate of the output depth interval, first employ the formula

$X = VT$, where X = estimated depth of section, V = average velocity of section, and T = one-way time of section (i.e. record length divided by two).
Second, employ the formula output depth interval = $\Delta X = X / (\text{number of samples} - 1)$.

Use constant velocity — If checked, use a constant velocity for the domain conversion.

Constant velocity — Enter constant velocity to be used for the migration.

The **Transform type** specifies the direction of the conversion.

Time to depth — If selected does a conversion from the time into the depth domain.

Depth to time — If selected does a conversion from the depth into the time domain.

O/p Depth interval — Enter the output depth interval.

Number of output samples — Enter the number of output samples.

Scale input velocities by (%) — Enter a percentage to scale the input velocity field.

The **Interpolation type** specifies type of velocity interpolation to be used.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

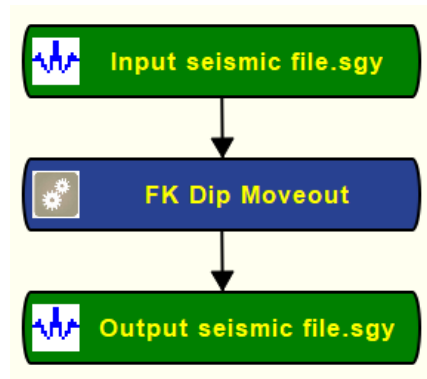
FK Dip Moveout

Usage: The FK Dip Moveout applies a dip moveout correction in the FK domain.

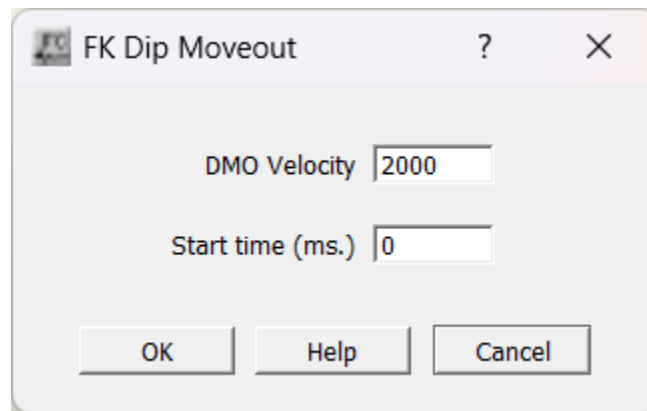
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

DMO Velocity — Enter the dip moveout (DMO) velocity.

Start time (ms) — Enter the starting time where the operator will be applied.

PSPI Migration

Usage: The PSPI Migration step is a post-stack 'Phase Shift Plus Interpolation' seismic data migration. Input data may be 2D or 3D, and both time migration and depth migration are options. The input data must be in the form of frequency slices – data can be converted to frequency slices by using the **Frequency Slices** step in a prior job flow.

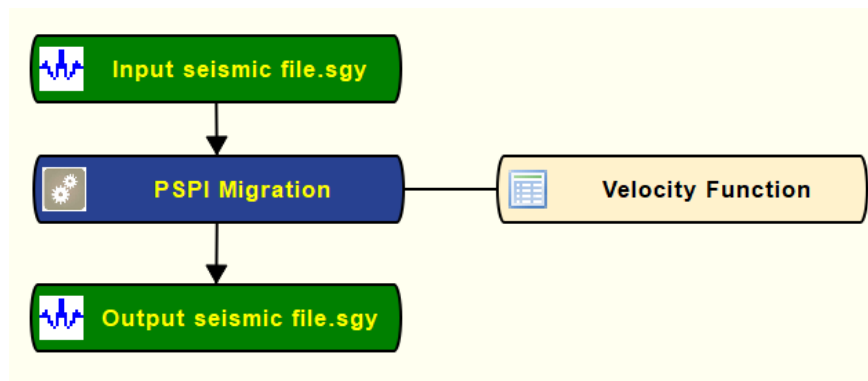
The output data will be in the form of time slices – to convert the time slices back to standard trace order use a subsequent job flow after the migration with the **Time Slices to Traces** step.

Input Links: 1) Frequency slices ordered by Slice Number and CMP Line (3D) or by Slice Number (2D) (mandatory).

Output Links: 1) Time slices (or depth slices) ordered by Slice Number and CMP Line (3D) or by Slice Number (2D) (mandatory).

Reference: Gasdag, J, and Sguazzero P., 1984, Migration of seismic data by phase shift plus interpolation, Geophysics, vol. 49, no. 2, p. 124-131.

Example Flowchart:



Step Parameter Dialog:

PSPI Post Stack Migration

Migration mode

☒ Time migration
Output maximum time (ms) 0

☐ Depth migration
Output maximum depth(ft/m) 0

Output depth sampling (ft/m) 0.00

Migration velocity field

☒ Use velocity field from data file

☐ Use constant migration velocity 2000.0

Scale input velocities by 1.000

☐ Output velocity field only

Migration step size

Number of output samples 10

Frequency filtering

Low cut Frequency (Hz.) 0

Low Pass Frequency (Hz.) 5

High Pass Frequency (Hz.) 50

High Cut Frequency (Hz.) 75

Alias energy removal

Evanescent damping factor 0.500

Spatial padding width (traces) 100

Override trace spacing

☐ Specify trace spacing 0

☐ Specify line spacing (3D) 0

OK Help Cancel

Parameter Description:

The **Migration mode** defines the migration domain (time or depth migration) of the migration.

Time Migration — If checked, time migration will be performed.

Output maximum time (ms) — Enter the maximum time of the output migrated data in milliseconds. The time sampling will be the same as that of the input data.

Depth Migration — If checked, depth migration will be performed.

Output maximum depth (ft/m) — Enter the maximum depth of the output migrated data.

Output depth sampling (ft/m) — Enter the depth sampling interval of the output migrated data.

The **Migration velocity field** specifies the velocity parameters used in the migration.

Use velocity field from data file — If checked, then the file name of an auxiliary input file must be specified which contains the velocity field picks.

Use constant migration velocity — If checked, then the migration velocity to be used should be specified in the adjacent box.

Scale input velocities by — The migration velocities may be scaled by a constant factor if required.

Output velocity field only — If checked, then only the interpolated and fully sampled migration velocity will be output. This flag is for test purposes only.

The **Migration step size** specifies number of output samples.

Number of output samples — Enter the number of output migration slices to be output with each iteration of the migration. Every migration iteration takes a roughly constant execution time, so the total execution time can be significantly reduced if several output slices are calculated at once. There may be a degradation in the migration of dipping data if this parameter is set too high. Consequently, this parameter is data-dependent and may require testing.

The **Frequency filtering** specify and parametrizes the frequency filter to be applied to the migrated data. The output migrated data will be Hanning (cosine) tapered.

Low-cut Frequency (Hz.) — Enter the low-cut frequency of the output migrated data.

Low pass Frequency (Hz.) — Enter the low pass frequency of the output migrated data.

High pass Frequency (Hz.) — Enter the high pass frequency of the output migrated data.

High cut Frequency (Hz.) — Enter the high cut frequency of the output migrated data.

The **Alias energy removal** specify parameters related to alias energy removal.

Evanescent damping factor — Enter the amount of suppression of energy which is not a real solution of the acoustic wave equation, as a value between zero and one. A value of 0.5 is recommended.

Spatial padding width (traces) — Enter how many additional traces are to be added (in both CMP line and location directions in the case of 3D migration). These extra traces plus spatial tapering help to minimize interference of migrated energy from one end of the data into migrated data on the other side.

The **Override trace spacing** defines the trace spacing cannot be read from or is incorrect in the trace headers, then it may be specified in the following parameter fields.

Specify the trace spacing — If checked, enter the distance between trace locations.

Specify the line spacing — If checked, enter the distance between lines (for 3D data only).

Phase Shift Migration

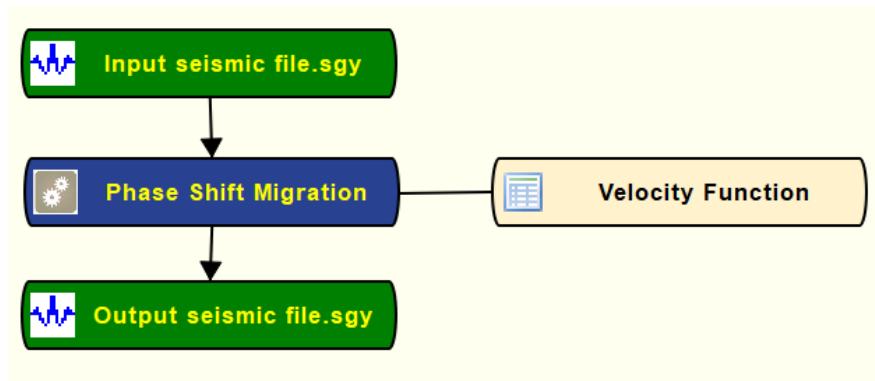
Usage: The Phase Shift Migration step implements a constant velocity or a depth-variable velocity post stack phase shift time migration in the frequency domain. The input velocity field is assumed to be the stacking velocity field derived from velocity analysis of the pre-stack data. This step is currently only available for 2D data.

Input Links: 1) Seismic data in stacked order (mandatory); 2) Velocity Function cards (optional).

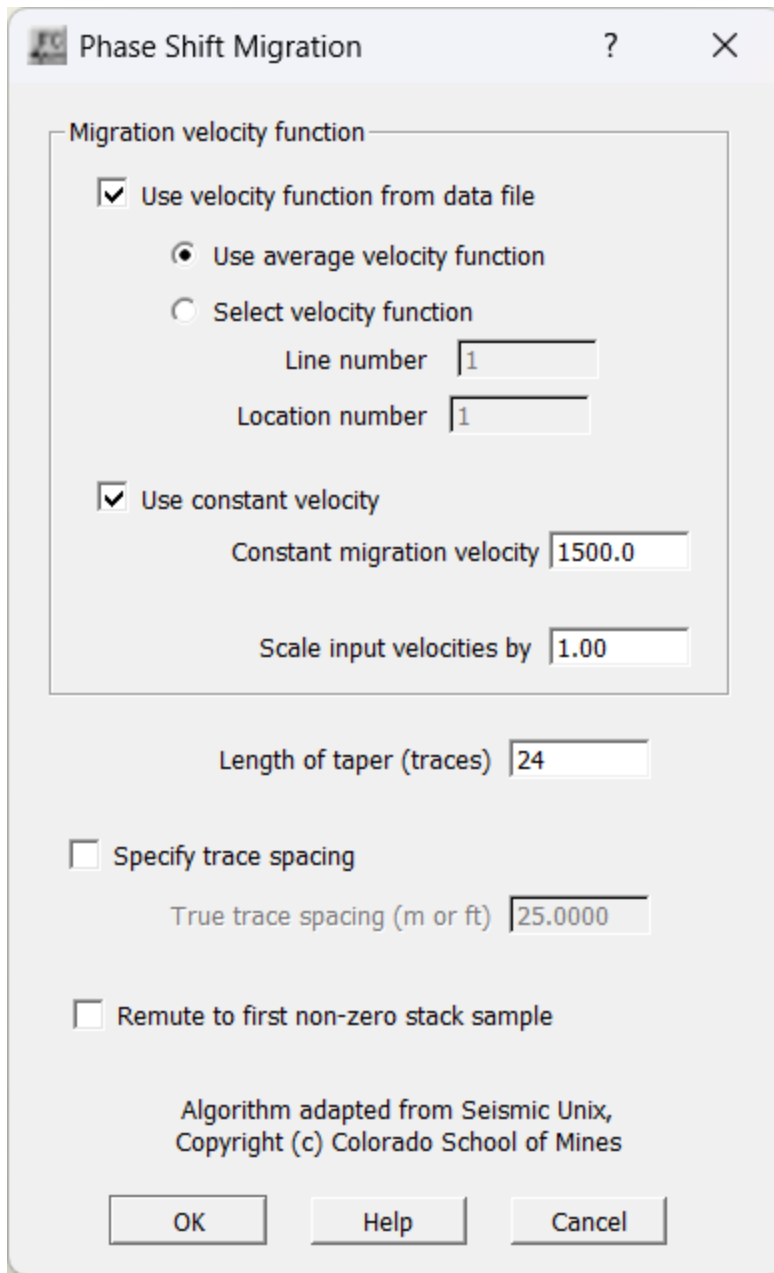
Output Links: 1) Seismic data in stacked order (mandatory) and sampled in time.

Reference: Gazdag, J, 1978, Wave-equation migration by phase shift, Geophysics, 43, p. 1342-1351.

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Phase Shift Migration". It contains several options for configuring migration parameters. The "Migration velocity function" section has three radio buttons: "Use velocity function from data file" (checked), "Use average velocity function", and "Select velocity function". Below the radio buttons are input fields for "Line number" (1) and "Location number" (1). There is also a checked checkbox for "Use constant velocity" with a "Constant migration velocity" input field set to 1500.0, and a "Scale input velocities by" input field set to 1.00. Other options include "Length of taper (traces)" set to 24, "Specify trace spacing" (unchecked) with a "True trace spacing (m or ft)" input field set to 25.0000, and "Remute to first non-zero stack sample" (unchecked). At the bottom, there is a copyright notice and three buttons: "OK", "Help", and "Cancel".

Phase Shift Migration

Migration velocity function

☒ Use velocity function from data file

☐ Use average velocity function

☐ Select velocity function

Line number

Location number

☒ Use constant velocity

Constant migration velocity

Scale input velocities by

Length of taper (traces)

☐ Specify trace spacing

True trace spacing (m or ft)

☐ Remute to first non-zero stack sample

Algorithm adapted from Seismic Unix,
Copyright (c) Colorado School of Mines

OK Help Cancel

Parameter Description:

The **Migration velocity function** specifies the type of velocity to be used for the migration.

Use velocity function from data file — If selected, velocity function is defined from an auxiliary velocity card data file.

Use average velocity function — If selected, use average of the velocity field defined in the velocity card data file.

Select velocity function — If selected, use a velocity function as defined in a specific location from the input velocity card data.

Line number — Enter line number for the location of the velocity function.

Location number — Enter location number for the location of the velocity function.

Use constant velocity — If checked, a constant velocity value will be used as the migration velocity if no velocity cards are linked.

Constant migration velocity — Enter constant velocity value to be used for migration.

Scale input velocities by — The input velocities are multiplied by this number. This scalar is used for adjusting the input velocities if they are interval velocities derived using Dix's equation rather than true interval velocities.

Length of taper (traces) — Enter the length of the taper to be used for the migration in number of traces.

Specify trace spacing — If checked, overwrite trace spacing by defined value.

True trace spacing (m or ft) — Enter trace spacing in ft or m to overwrite geometry.

Remute to first non-zero stack sample — If checked, mute for all traces individually all samples before non-zero.

Post-Stack Kirchhoff Time Migration

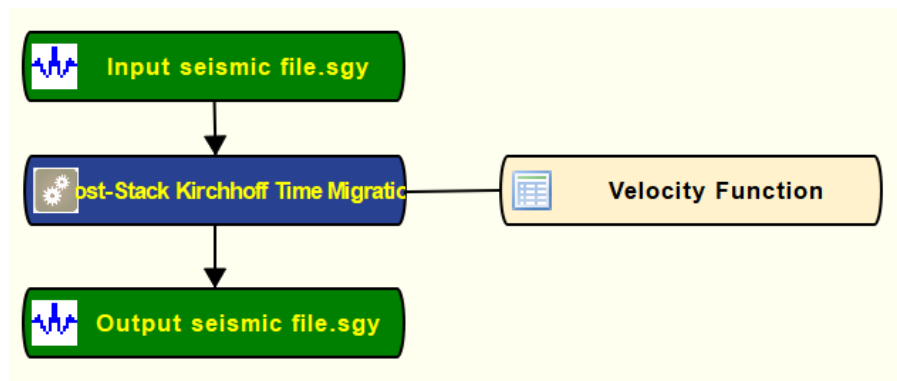
Usage: The Post-Stack Kirchhoff Time Migration step implements a diffraction summation migration of the Kirchhoff type on a post-stack section, which can handle vertically and laterally varying velocity fields. The input velocity field is assumed to be the stacking velocity field derived from velocity analysis of the pre-stack data.

Input Links: 1) Stacked seismic data (mandatory); 2) Velocity Function cards (mandatory).

Output Links: Seismic file where the migrated section will be saved (mandatory).

Reference: Schneider, W. A., 1976, Integral formulation for migration in two and three dimensions, Geophysics, 43, p. 49-76.

Example Flowchart:



Step Parameter Dialog:

Kirchhoff Post Stack-Time Migration

Migration operator dip limits

- ☒ Limit operator dip
 - Dip limit (degrees)

Migration operator anti-alias filtering

- ☒ Apply anti-alias function

Migration output range

- ☒ Migrate zero samples
- ☐ Read from polygon definition

	Limit	Minimum	Maximum
Line	☐	1	1
Location	☐	1	1

Migration operator amplitude corrections

- ☒ Apply directivity correction
- ☒ Apply spreading correction

Migration velocity field

- ☒ Use velocity field from data file
- ☒ Use constant velocity
 - Constant migration velocity
- ☐ Apply residual migration
 - Initial migration velocity
- Scale input velocities by

Migration input range

- ☐ Limit input times
 - ☒ Use constant start time
 - Constant start time (ms)
 - ☐ Start time reference to horizon
 - Horizon time multiplier

Trace geometry

- ☐ Specify trace geometry
 - Trace spacing

OK Help Cancel

Parameter Description:

The **Migration operator dip limits** specifies if any dip limit will be used for the migration.

Limit Operator Dip — If checked, limits the dip angle to be migrated.

Dip limit (degrees) — Enter the dip angle of the migration operator.

The **Migration operator anti-alias filter** specifies the operator of the anti-alias filter to be applied during the migration.

Apply anti-alias function — If checked, apply an anti-aliasing measure to the migration operator.

The **Migration output range** specifies the migrated data output range.

Migrate zero samples — If checked, samples with amplitudes value zero will be migrated as well.

Line (Min/Max) — If checked, limits the range of the migrated CMP lines by defining the minimum and maximum line number.

Location (Min/Max) — If checked, limits the range of the migrated CMP locations by defining the minimum and maximum location number.

The **Migration operator amplitude correction** specifies how migrated amplitudes are handled.

Apply directivity correction — If checked, applies directivity correction to the amplitudes of the migrated data.

Apply spreading correction — If checked, applies spreading correction to the amplitudes of the migrated data.

The **Migration velocity field** specifies velocity model used for migration.

Use velocity field from data file — If checked, connect a velocity function to the migration step as input migration RMS velocities.

Use constant velocity — If checked, uses a constant velocity model for migration.

Constant migration velocity — Enter the constant velocity value to be used for migration.

Apply residual migration — not yet implemented.

Initial migration velocity — not yet implemented.

Scale velocity input — Enter a scaling factor for the input velocities, or else 1.

The **Migration input range** specifies input range of the data for the migration.

Limit input times (ms) — If checked, input data is limited by time windows.

Use constant start time — If selected, defines a constant migration start time.

Constant start time (ms) — Enter migration start time.

Start time reference to horizon — not yet implemented.

Horizon time multiplier — not yet implemented.

The **Trace geometry** allows to overwrite trace spacing stored in the headers.

Specify trace geometry — If checked, specifies trace spacing in meters.

Trace spacing — Enter trace spacing in m or ft.

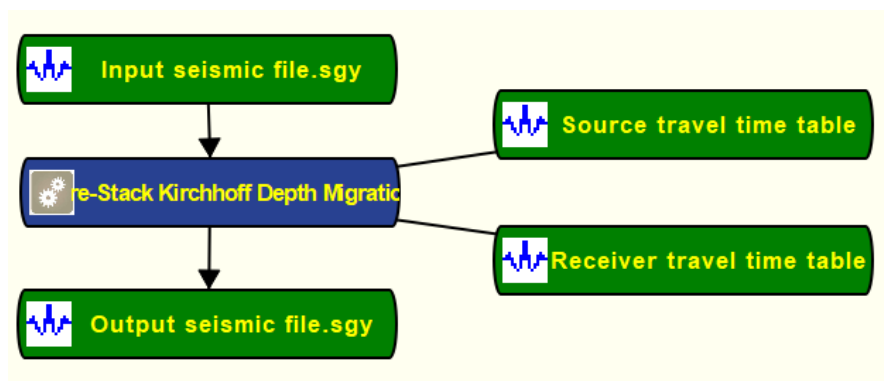
Pre-Stack Kirchhoff Depth Migration

Usage: The Pre-Stack Kirchhoff Depth Migration step implements a diffraction summation migration of the Kirchhoff type on a pre-stack shot gathers. As opposed to the time version, the depth implementation of the Kirchhoff migration does not compute travel time with a straight ray propagation assumption. Instead, it uses travel-time tables that were precomputed using methods like the 2D Paraxial Ray Tracing or the 3D Finite Difference wavefront tracing. This method handles more accurately vertical and lateral changes in the velocity fields and dipping reflectors. This implementation is designed to run in single thread or in parallel, giving it the possibility to take full advantage of multiple processors at the same time.

Input Links: 1) Pre-Stack seismic data in shot gather order (mandatory); 2) Source travel-time tables (mandatory); 3) Receiver travel-time tables (mandatory).

Output Links: 1) Seismic file where the migrated seismic data will be saved (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Input Dataset** specifies if the input data are from a streamer/land acquisition or OBS recording.

Migrate zero samples — Select the type of input data set.

The **Migration limits** specifies the spatial extent of data to be migrated.

Migrate zero samples — If checked, samples with amplitudes value zero will be migrated as well.

Limit operator dip — If checked, limits the dip angle of the migration operator. Enter dip limit in degrees.

Minimum offset (m) — If checked, enter the minimum offset for the migration operator.

Maximum offset (m) — If checked, enter the maximum offset for the migration operator.

The **Anti-alias filtering and Amplitude correction** specify if an anti-alias filter is applied to the migration operator and how amplitude will be handled.

True amplitude — If checked, uses a weight function to approximate true amplitude.

Apply anti-alias filtering — If checked. applies an anti-aliasing measure to the migration operator.

The **Migration grid parameters** specify the spatial extent of the migration grid parameters.

Starting depth point — Enter the first depth point to be migrated in meters.

Depth increment — Enter the depth increment of the migration in meters.

Maximum depth — Enter the last depth point to be migrated in meters.

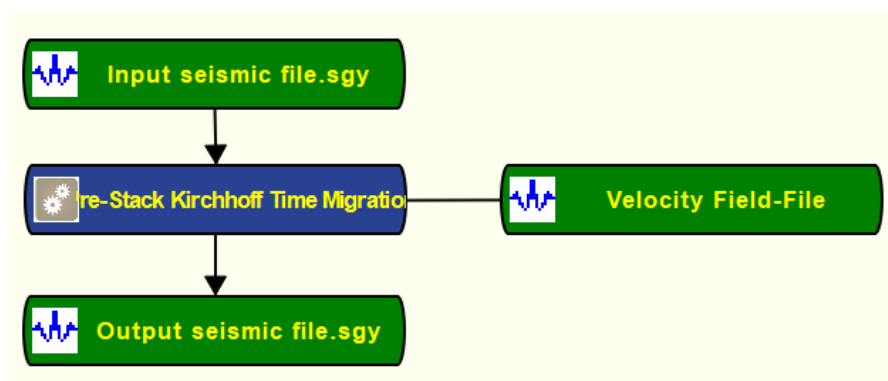
Pre-Stack Kirchhoff Time Migration

Usage: The Pre-Stack Kirchhoff Time Migration step implements a diffraction summation migration of the Kirchhoff type on a pre-stack shot gathers, which can handle vertically and laterally varying velocity fields and deals with the energy smear caused by dipping reflectors. The input velocity field is assumed to be the RMS velocity derived from either the conventional velocity analysis (Semblance/CVS) or from the migration velocity analysis tool. This implementation is designed to run in single thread or in parallel, giving it the possibility to take full advantage of multiple processors at the same time.

Input Links: 1) Pre-Stack seismic data in shot gather order (mandatory); 1) Velocity model or velocity function cards (mandatory).

Output Links: 1) Seismic file where the migrated seismic data will be saved (mandatory).

Example Flowchart:



Step Parameter Dialog:

Kirchhoff Pre-Stack Time Migration

Input dataset

Dataset type: Streamer or Land Data

Migration limits

☐ Migrate zero samples

☐ Constant start time (ms): 0.0

☐ Constant end time (ms): 000000.0

☒ Limit operator dip: 60.0

☐ Minimum Offset: 0.0

☐ Maximum Offset: 2000.0

Amplitude correction

☒ True amplitude

☐ Hight order Amplitude func

Migration velocity field

☒ Use velocity from velocity-field file

☐ Use velocity from card data file

☐ Use constant velocity

Constant migration velocity: 1500.0

Scale input velocities by: 1.00

Migration operator anti-alias filtering

☒ Apply anti-alias function

Traveltime calculations

☒ Assuming a flat topography scenario

☐ Accounting for rugged topography

☐ High order travel time calculation

OK Help Cancel

Parameter Description:

The **Input Dataset** specifies if the input data is from a streamer/land acquisition or OBS.

Dataset type — Select type of data to be migrated (Not yet implemented).

The **Migration limits** specifies the spatial and temporal extent of the migration.

Migrate zero samples — If checked, samples with amplitudes value zero will be migrated as well.

Constant Start time (ms) — If checked, defines a constant migration start time.

Constant end time (ms) — If checked, defines a constant migration end time.

Limit operator dip — If checked, limits the dip angle of the migration operator.

Minimum offset (m) — If checked, defines a minimum offset for the migration operator.

Maximum offset (m) — If checked, defines a maximum offset for the migration operator.

The **Amplitude correction** specifies how amplitudes are handled during migration.

True amplitude — if checked to use a weight function to approximate true amplitude.

High order amplitude function — (Not yet implemented).

The **Migration velocity field** specifies the velocity field to be used for data migration.

Use velocity from velocity-field file — If selected, connects an auxiliary velocity-field file as input velocity model.

Use velocity from card data file — If selected, connects an auxiliary velocity function card as input velocity model.

Use constant velocity — If selected, uses a constant velocity migration.

Constant migration velocity — Enter constant velocity value for migration.

Scale velocity input — enter a scaling factor for the input velocities, or else 1.

The **Migration operator anti-alias filter** specifies the anti-alias filter parameters.

Apply anti-alias function — If checked, applies an anti-aliasing measure to the migration operator.

The **Traveltime calculations** specify how traveltimes for Kirchhoff migration are calculated.

Assuming a flat topography scenario — If selected, assume a flat recording surface when computing travel-time information.

Accounting for rugged topography — If selected, Assume a rugged recording surface when computing travel-time information.

High order travel-time calculation — (Not yet implemented).

Stolt (FK) Migration

2-D only

Usage: The Stolt Migration step implements a constant velocity or depth variable Stolt migration algorithm for post-stack time migration. This migration scheme can accommodate a vertically varying velocity field in the form of one SPW velocity function card. This velocity field is assumed to be the stacking velocity field derived from velocity analysis of the pre-stack data. The user designates a Stolt stretch factor, a maximum frequency to migrate, and temporal and spatial tapers. An option allows the input velocity function to be scaled. Finally, the step allows to override the SPW calculated trace spacing and specify the true trace spacing of the seismic data in the project spatial units of choice. By default, SPW calculates the trace spacing for the stack as the group interval, as defined in the geometry definition, divided by two (2).

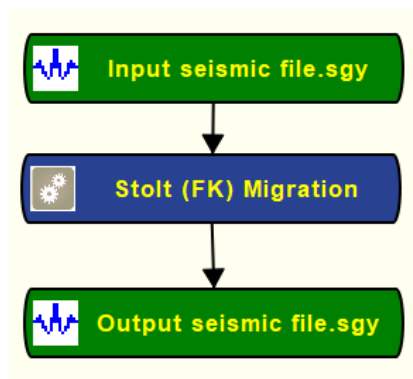
Input Links: 1) Seismic data in stacked order (mandatory); 2) Velocity Function cards (optional).

Output Links: 1) Seismic data in stacked order (mandatory) and sampled in time.

Reference: Stolt, R.H, 1978, Migration by Fourier transform, Geophysics, v. 43, no 1., p. 23-48.

Example Flowchart:

Step Parameter Dialog:



Parameter Description:

Stolt Migration

Migration velocity function

☐ Use velocity function from data file

☒ Use constant velocity

Constant velocity

Stretch factor

Scale input velocities by

Maximum frequency to migrate (Hz)

Trace taper length (traces)

Time taper length (samples)

☐ Specify trace spacing

True trace spacing (m or ft)

Algorithm adapted from Seismic Unix,
Copyright (c) Colorado School of Mines

OK Help Cancel

The **Migration velocity function** specifies the velocity model parameters for migration.

Use velocity unction from data file — If selected, migrates data with a velocity field defined in an auxiliary velocity card data.

Use Constant velocity — If selected, uses a constant velocity value for migration.

Constant velocity — Enter a constant velocity value for the entire stack. This velocity will be used as the constant migration velocity if no velocity cards are linked.

Stretch factor — In the case of a time-variable velocity field, the Stolt stretch factor is designed to stretch the time axis so that the data appear to have propagated through a constant-velocity earth. Values of 0.5 to 1 are typical.

Scale input velocities by — The input velocities are multiplied by this number. This scalar may be used for adjusting the input velocities if they are interval velocities derived using Dix's equation rather than true interval velocities.

Maximum frequency to migrate — Enter the maximum frequency component in the data to be migrated.

Trace taper length (traces) — Number of traces to over which to taper traces at the start and end of the line prior to migration.

Time taper length (samples) — Number of samples to over which to taper at the start and end of each trace prior to migration.

Specify trace spacing — If checked, allows for manual specification of the trace spacing. By default, SPW calculates the trace spacing for the stack as the group interval, as defined in the geometry definition, divided by two (2).

True trace spacing (m or ft) — Enter trace spacing. This value will overwrite the parameters in geometry.

Multi-component Steps

This section documents the processing steps available in the Multi-component category.

The multi-component processing steps currently available are:

Multi-component
 Processing Categories
Apply PS Nonhyperbolic Moveout
CCP Binning - Asymptotic
CCP Binning - Dynamic
Constant Gamma Stacks
Converted Wave Receiver Statics
Crooked Line Asymptotic CCP Binning
Crooked Line Dynamic CCP Binning
Horizontal Component Rotations

The table below shows a summary of the multi-component trace header values used in SPW.

Receiver types	Receiver component trace header values
Hydrophone or pressure sensor	11
Vertical-component receiver	12
Crossline-component receiver	13
Inline component receiver	14
Rotated vertical-component receiver	15
Rotated transverse-component receiver	16
Rotated radial-component receiver	17
Summed vertical component receiver	28

Source types	Source component trace header values
Vertical-component source	22
Crossline-component source	23
Inline component source	24
Rotated vertical-component source	25
Rotated transverse-component source	26
Rotated radial-component source	27

Apply PS Non-hyperbolic Moveout

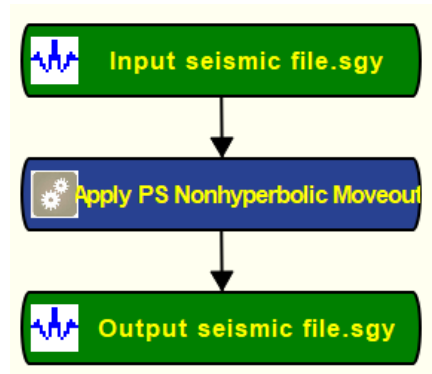
Usage: The Apply PS Non-hyperbolic Moveout step uses the combination of P-wave stacking velocities and Gamma functions to correct non-hyperbolic moveout. Converted wave travel-times are not a hyperbolic function of offset. The total moveout of a converted wave reflection can be described accurately with the double square root (DSR) equation. This equation gives the complete travel time correction as a function of offset, bounce point and gamma, where gamma is defined as the ratio of compressional-wave to shear-wave velocity.

Input Links: 1) Seismic data in any sort order (mandatory); 2) PS Nhmo Gamma Function card data file containing gamma pics (optional); 3) Velocity Function card data file containing P-wave velocity pics (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Yilmaz, 2001, 'Seismic Data Analysis', 2nd Ed. p.1946-1959.

Example Flowchart:



Step Parameter Dialog:

 Apply PS Nonhyperbolic Moveout ? X

Gamma field definition

☐ Use gamma functions from data file

☐ Use gamma field from seismic file

☒ Use constant gamma

Constant gamma

Scale input gamma values by (%)

P-wave velocity field definition

☐ Use velocity functions from data file

☐ Use velocity field from seismic file

☒ Use constant velocity

Constant velocity

Scale input velocities by (%)

Mute control

☒ Apply stretch mute

Percentage

Taper length (samples)

Interpolation type selection

☐ Linear ☒ Quadratic

☐ Do inverse moveout application

OK Help Cancel

Parameter Description:

The **Gamma field definition** specifies the gamma field description for PS nonhyperbolic moveout.

Use gamma functions from data file — If checked, an auxiliary card data file with the gamma field description will be automatically linked into the process.

Use gamma field from seismic file — If checked, an auxiliary seismic file with the gamma field description will be automatically linked into the process.

Use constant gamma — If checked, a constant gamma value will be used for the moveout correction.

Constant gamma — Enter the constant gamma value to be used for the moveout correction.

Scale input gamma values by (%) — Enter a value to be used to scale the input gamma field.

The **P-wave velocity field definition** specifies the P-wave velocity field description for PS nonhyperbolic moveout.

Use velocity functions from data file — If checked, an auxiliary card data file with the P-wave velocity field description will be automatically linked into the process.

Use velocity field from seismic file — If checked, an auxiliary seismic file with the P-wave velocity field description will be automatically linked into the process.

Use constant gamma — If checked, a constant P-wave velocity value will be used for the moveout correction.

Constant gamma — Enter the constant P-wave velocity value to be used for the moveout correction.

Scale input gamma values by (%) — Enter a value to be used to scale the input P-wave velocity field.

The **Mute control** specifies the stretch mute parameters.

Apply stretch mute — If checked, apply a stretch mute after the moveout correction.

Percentage — Enter the percentage of stretch mute to be applied.

Taper length (samples) — Enter the taper length for the stretch mute in number of samples.

The **Interpolation Type Selection** specifies the interpolation type (linear or quadratic). The moveout function causes trace data samples to be moved in time to new locations. Since these new time locations of the data sample values are not usually exactly at the sample interval of the data, the data is interpolated to be evenly sampled at the correct sample interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

CCP Binning - Asymptotic

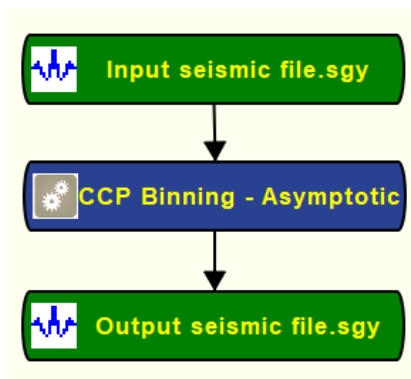
Usage: The Common-Conversion Point (CCP) Binning – Asymptotic processing step will split a converted wave (P-S) trace into pieces and place each piece into the correct 2D or 3D bin location. The Gamma value (normally about 2.0) is used to calculate the curve defining the conversion P to S wave points.

Input Links: 1) Seismic file containing 3C or 4C data (mandatory)

Output Links: 1) Seismic file containing 3C or 4C data with traces binned into common conversion points (mandatory).

Reference: Yilmaz, 2001, 'Seismic Data Analysis', 2nd Ed.

Example Flowchart:



Step Parameter Dialog:

CCP Binning - Asymptotic

Corner 1 - Easting Inline bin size

Corner 1 - Northing Crossline bin size

Corner 2 - Easting First inline number

Corner 2 - Northing Inline increment

Corner 3 - Easting First crossline number

Corner 3 - Northing Crossline increment

 Update from project Gamma

Coordinate definition

☐ Corner points define bin centers

☒ Corner points define bin corners

Survey dimensions

☐ 2D

☒ 3D

OK Help Cancel

Parameter Description:

Corner 1 – Easting (for 3D) — Enter the easting (x) coordinate of the first corner of the survey.

Corner 1 – Northing (for 3D) — Enter the northing (y) coordinate of the first corner of the survey.

Corner 2 – Easting (for 3D) — Enter the easting (x) coordinate of the second corner of the survey.

Corner 2 – Northing (for 3D) — Enter the northing (y) coordinate of the second corner of the survey.

Corner 3 – Easting (for 3D) — Enter the easting (x) coordinate of the third corner of the survey.

Corner 3 – Northing (for 3D) — Enter the northing (y) coordinate of the third corner of the survey.

Inline bin size (for 3D) — Enter the size in distance units of the in-line side (1 to 2) of each bin.

Crossline bin size (for 3D) — Enter the size in distance units of the cross-line side (1 to 3) of each bin.

First inline number (for 3D) — Enter the first inline number. This line number is assigned to all the bins along the side of the survey from corner 1 to corner 2.

Inline increment (for 3D) — Enter the increment in line numbers between adjacent CMP lines.

First crossline number (for 3D) — Enter the first crossline number. This location number is assigned to all the bins along the side of the survey from corner 1 to corner 3.

Crossline increment (for 3D) — Enter the increment in locations between adjacent CMP locations.

Update from project — If clicked, update geometry parameters directly from the project geometry settings.

Gamma — Enter the gamma parameter value. Gamma is the V_p/V_s ratio. This parameter defines the curve of the conversion point.

The **Coordinate definition** specifies whether the corner points define the bin centers or corners following the figure below.

Corner points define bin centers — If selected, specify that corner points define bin centers.

Corner points define bin corners — If selected, specify that corner points define bin corners.

The **Survey dimensions** specifies whether the dimensions of the survey are 2D or 3D.

2D — If selected, specify 2D line survey.

3D — If selected, specify a 3D grid survey.

CCP Binning - Dynamic

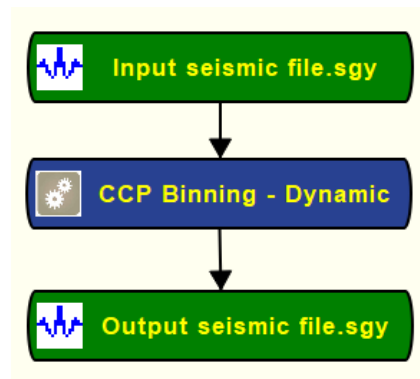
Usage: The Common-Conversion Point (CCP) binning - Dynamic step assigns CCP numbers to mode-converted PS data as a function of the source-receiver offset and a constant or time-variable V_p/V_s ratio (γ).

Input Links: 1) Converted wave data volume in any sort order (mandatory).

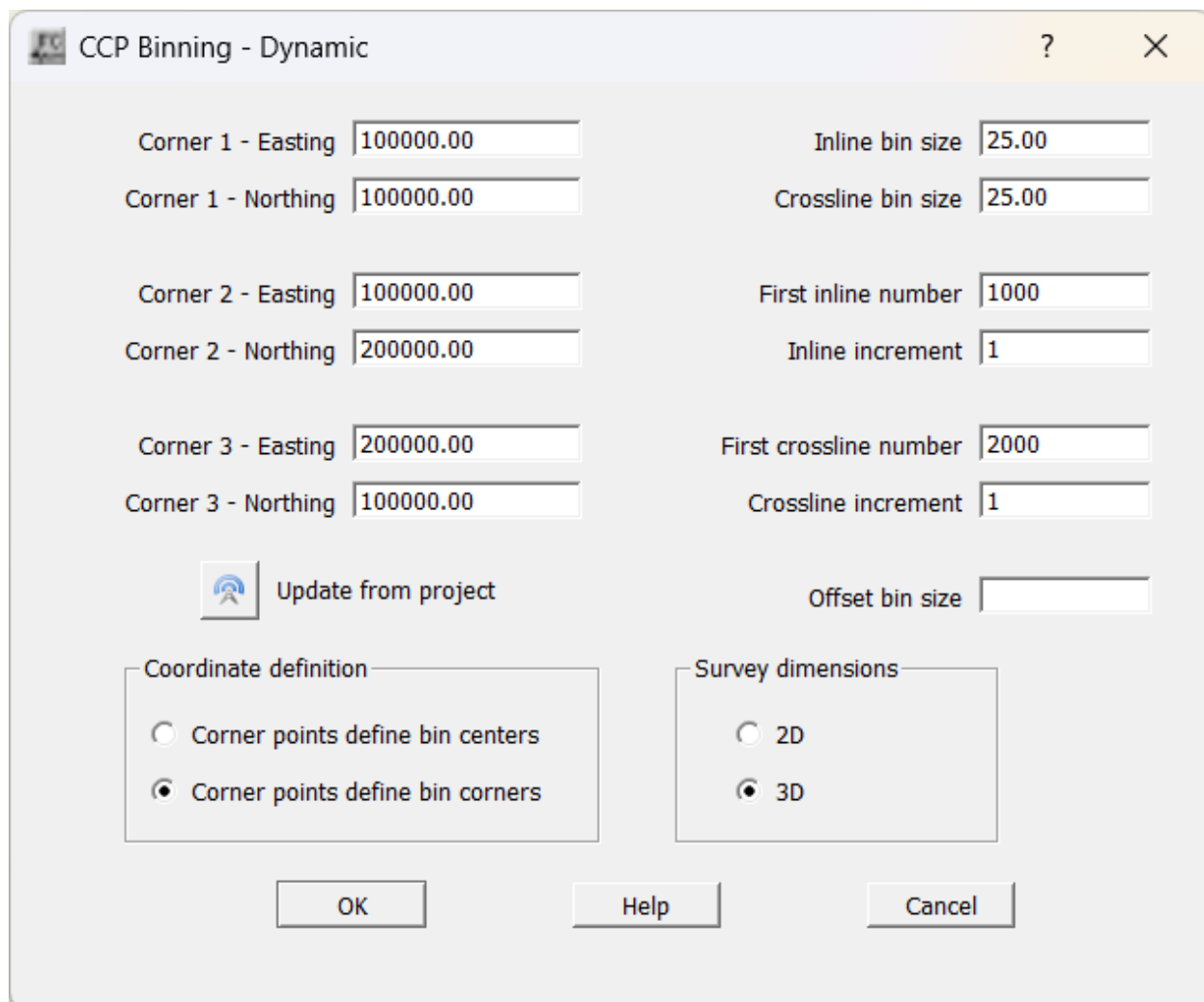
Output Links: 1) Converted wave data volume in any sort order (mandatory).

Reference: Yilmaz, 2001, 'Seismic Data Analysis', 2nd Ed.

Example Flowchart:



Step Parameter Dialog:



CCP Binning - Dynamic

Corner 1 - Easting

Corner 1 - Northing

Corner 2 - Easting

Corner 2 - Northing

Corner 3 - Easting

Corner 3 - Northing

Inline bin size

Crossline bin size

First inline number

Inline increment

First crossline number

Crossline increment

Offset bin size

 Update from project

Coordinate definition

☐ Corner points define bin centers

☒ Corner points define bin corners

Survey dimensions

☐ 2D

☒ 3D

OK Help Cancel

Parameter Description:

Corner 1 - Easting — Enter the easting (x) of the first corner of the bin grid (2D or 3D).

Corner 1 - Northing — Enter the northing (y) of the first corner of the bin grid (2D or 3D).

Corner 2 - Easting — Enter the easting (x) of the second corner of the bin grid (2D or 3D).

Corner 2 - Northing — Enter the northing (y) of the second corner of the bin grid (2D or 3D).

Corner 3 - Easting — Enter the easting (x) of the third corner of the bin grid (3D).

Corner 3 - Northing — Enter the northing (y) of the third corner of the bin grid (3D).

Inline bin size — Enter the size of a bin in the inline direction in meters or feet (2D or 3D).

Crossline bin size — Enter the size of a bin in the crossline direction in meters or feet (3D).

Line number — Enter the line number (2D).

First inline number — Enter the first inline number (3D).

Inline increment — Enter the inline increment (3D).

First CMP number — Enter the first CMP number (2D).

First crossline number — Enter the first crossline number (3D).

CMP increment — Enter the CMP increment (2D).

Crossline increment — Enter the crossline increment (3D).

Update from project — If clicked, update geometry parameters directly from the project geometry settings.

Gamma — Enter the gamma parameter value. Gamma is the ratio of V_p/V_s velocities. This parameter defines the curve of the conversion point.

The **Coordinate definition** specifies whether the corner points define the bin centers or corners following the figure below.

Corner points define bin centers — If selected, specify that corner points define bin centers.

Corner points define bin corners — If selected, specify that corner points define bin corners.

The **Survey dimensions** specifies whether the dimensions of the survey are 2D or 3D.

2D — If selected, specify 2D line survey.

3D — If selected, specify a 3D grid survey.

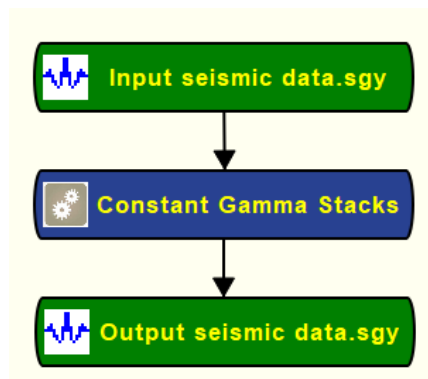
Constant Gamma Stacks

Usage: The Constant Gamma Stack step generates a file of constant gamma stack traces, where gamma is defined as the V_p/V_s ratio. A P-wave stacking velocity field must be supplied, as the number of gammas with which to stack the seismic data, the first gamma to apply, and the last gamma to apply. It is possible to apply a stretch mute. With the series of constant gamma stack traces, the user may page through these stacked panels in Display and interactively pick gamma functions that result in the most coherent stacked sections.

Input Links: 1) Seismic data pre-stack, in CMP sort order (mandatory); 2) Velocity card data file containing P-wave stacking velocity functions (mandatory).

Output Links: 1) Seismic data pre-stack, in CMP sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Gamma range** specifies the range of gammas to use in the analysis. A stacked section is calculated for each gamma linearly interpolated between the starting and ending input gamma. The gamma increment will be: $G_{inc} = (\text{last gamma} - \text{first gamma}) / (\text{Number of gammas} - 1)$.

First gamma — Enter the starting gamma for the analysis. This gamma will be used for non-hyperbolic NMO on the first output stack. {>0.0}

Last gamma — Enter the ending gamma for the analysis. This gamma will be used for non-hyperbolic NMO on the last output stack. {>0.0}

Gamma increment — Enter the number of velocities to use in the analysis. A stacked section is calculated for each velocity linearly interpolated between the starting and ending input velocities. The velocity increment will be: $V_{inc} = (\text{last velocity} - \text{first velocity}) / (\text{Number of velocities} - 1)$.

The **P-wave velocity field definition** defines the P-wave velocity field parameters.

Use velocity functions from data file — If checked, velocity functions will be applied from a data file.

Use velocity field from seismic file — If checked, a velocity field will be applied from a seismic file.

Use constant velocity — If checked, a constant velocity will be applied to the data.

Constant velocity — Enter the NMO velocity. This constant velocity will be used if a set of velocity function cards is NOT linked to the NMO correction step.

Scale input velocities by (%) — Enter the amount by which the input velocities are scaled up or down. A value of 1.0 does not alter the velocity field.

The **Line range** specifies the line range.

First line to analyze — Enter the first CMP line number to analyze.

Last line to analyze — Enter the last CMP line number to analyze.

Line increment — Enter the CMP line increment between lines to analyze.

The **Location range** specifies the location range.

First location to analyze — Enter the first CMP location to analyze.

Last location to analyze — Enter the last CMP location to analyze.

Location increment — Enter the CMP location increment between groups of CMP locations to analyze.

Locations per analysis — Enter the number of CMP locations in each analysis panel. At each CMP location a range of constant velocity stacks will be generated from the first velocity to the last velocity in increments of V_{inc} .

The **Mute Control** specifies the parameters for the stretch mute definition.

Apply mute from data file — If checked, a mute will be applied to the NHMO corrected data from a data file.

Apply stretch mute — If checked, a stretch mute will be applied to the NHMO corrected data. Stretch muting restricts the stretching of the data due to the NMO correction. If not checked, the stretch mute must be supplied by an Early Mute card linked to the Constant Gamma Stack step.

Percentage — Enter the percent stretch mute. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Interpolation Type Selection** specifies the interpolation type (linear or quadratic). The moveout function causes trace data samples to be moved in time to new locations. Since these new time locations of the data sample values are not exactly at the sample interval of the data, the data is interpolated to the correct sample interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

The **Trace Amplitude Definition** specifies the trace amplitude definition.

Use relative amplitude traces — If selected, relative amplitude traces will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Use true amplitude traces — If selected, use true amplitude scaled traces in the analysis. True amplitude traces are scaled by one common factor per record.

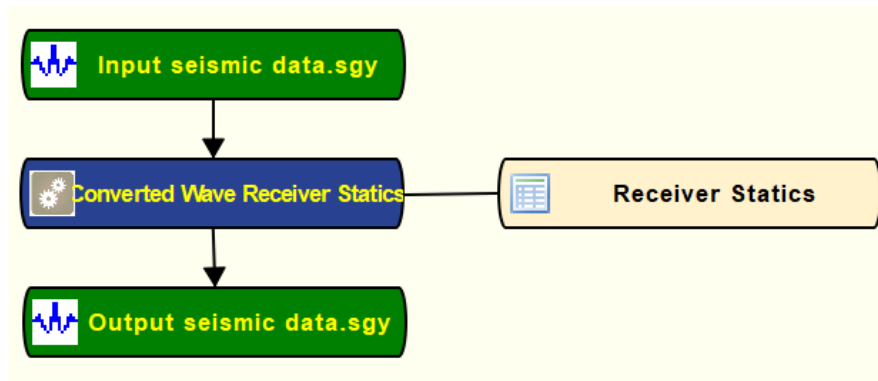
Converted Wave Receiver Statics

Usage: The Converted Wave Receiver Statics step uses a cross correlation and least squares fitting to calculate receiver statics for converted wave traces (P=S).

Input Links: 1) Seismic file containing converted wave data traces sorted in receiver order (mandatory); 2) Receiver statics file containing the calculated receiver statics (mandatory).

Output Links: 1) Seismic file containing converted wave data traces sorted in receiver order (mandatory);

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the 'Converted Wave Receiver Statics' dialog box with the following parameters:

Parameter	Value
Window start time (ms)	0.00
Window end time (ms)	1000.00
Number of traces in analysis window	7
Inversion stability factor	0.001000
Maximum allowable static	128.00

Buttons: OK, Help, Cancel

Parameter Description:

Window start time (ms) — Enter the start time for the analysis.

Window end time (ms) — Enter the end time for the analysis.

Number of traces in analysis window — Enter the minimum number of traces considered for the converted waver receiver statics.

Inversion stability factor — Enter a small value used to stabilize the matrix inversion and prevent inverting zeros which causes instability.

Maximum allowable static — Enter the maximum amount of static correction.

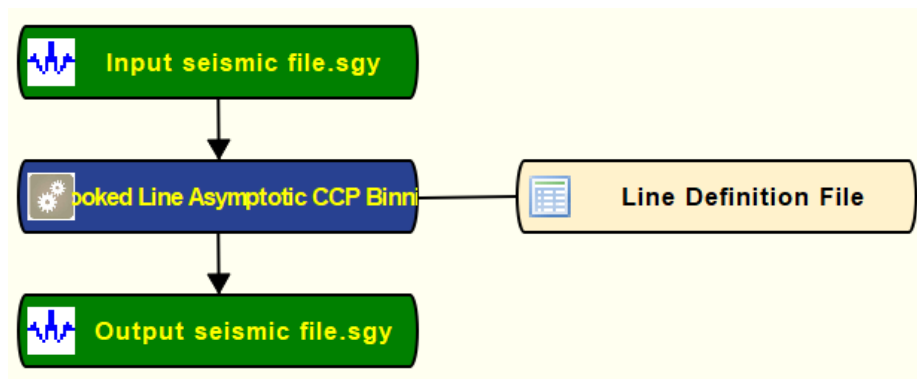
Crooked Line Asymptotic CCP Binning

Usage: The Crooked Line Asymptotic Common-Conversion Point (CCP) Binning step will split a converted wave (P-S) trace into pieces and place each piece into the correct crooked line bin location. The Gamma value (normally about 2.0) is used to calculate the curve defining the conversion P to S wave points.

Input Links: 1) Seismic file containing 3C or 4C data (mandatory); 2) Line Definition File containing the crooked line fit information (mandatory)

Output Links: 1) Seismic file containing 3C or 4C data with traces binned into common conversion points (mandatory)

Example Flowchart:



Step Parameter Dialog:

Crooked Line Asymptotic CCP Binning

Number of first midpoint: 1000

Inline bin dimension: 25.00

Line width: 200.00

Gamma: 2.0

Source and receiver binning

☐ Bin source locations ☐ Bin receiver locations

Bin coordinates

☒ Line coordinates ☐ Midpoint coordinates

OK Help Cancel

Parameter Description:

Number of first midpoint — Enter the first midpoint to be considered for the Asymptotic CCP binning.

Inline bin dimension — Enter the bin dimension in the inline direction.

Line width — Enter the line width to be considered for the asymptotic CCP.

Gamma — Enter a value for gamma parameter as defined by V_p/V_s ratio.

The **Source and receiver binning** defines the bin for sources and/or receiver locations.

Bin source locations — If checked, bin source locations.

Bin receiver locations — If checked, bin receiver locations.

The **Bin coordinates** define bin coordinates. Bin coordinates can be either defined as line or midpoints.

Line coordinates — If selected, bin coordinates are line coordinates.

Midpoint coordinates — If selected, bin coordinates are midpoint coordinates.

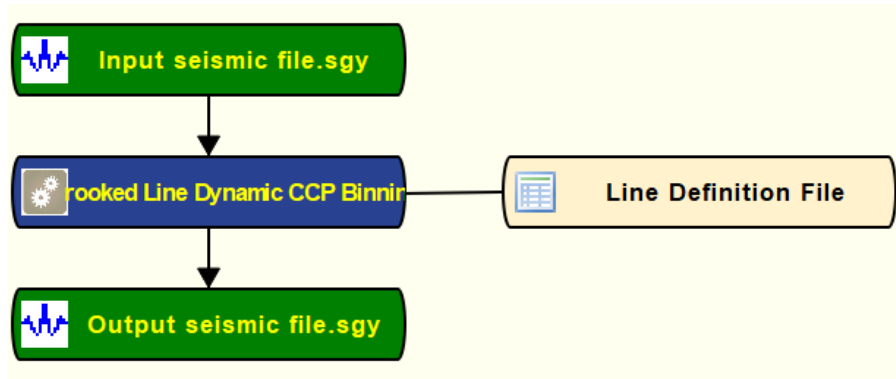
Crooked Line Dynamic CCP Binning

Usage: The Crooked Common-Conversion Point (CCP) binning - Dynamic step assigns CCP numbers to mode-converted PS data as a function of the source-receiver offset and a constant or time-variable V_p/V_s ratio (γ) for 2D crooked lines.

Input Links: 1) Converted wave data volume in any sort order (mandatory); 2) Line definition file (mandatory); 3) Auxiliary gamma card data file (optional); 4) Auxiliary P-wave velocity card data file (optional).

Output Links: 1) Seismic file (mandatory).

Example Flowchart:



Step Parameter Dialog:

Crooked Line Dynamic CCP Binning

Number of first midpoint

Inline bin dimension

Line width

Offset bin size

Gamma

☐ Use gamma field from data file

☒ Use constant gamma

Constant gamma

Compressional-wave velocity

☐ Use velocity field from data file

☒ Use constant velocity

Constant velocity

Source and receiver binning

☐ Bin source locations ☐ Bin receiver locations

Bin coordinates

☒ Line coordinates ☐ Midpoint coordinates

OK Help Cancel

Parameter Description:

Number of first midpoint — Enter the number of the first midpoint to be binned.

Inline bin dimension — Enter the bin dimension in the inline direction.

Line width — Enter the line width for the binning.

Offset bin size — Enter the offset bin size.

The **Gamma** defines parameters related to the gamma parameter. Gamma is defined as the V_p/V_s ratio.

Use gamma field from data file — If checked, use gamma field from an auxiliary data

Use constant gamma — If checked, use a constant gamma value.

Constant gamma — Enter constant gamma value.

The **Compressional-wave velocity** defines parameters related to the P-wave velocity.

Use velocity field from data file — If checked, use a velocity P-wave file.

Use constant velocity — If checked, use a constant P-wave velocity for the entire survey.

Constant velocity — Enter the value for the constant P-wave velocity.

The **Source and receiver binning** defines bin for sources and/or receiver locations.

Bin source locations — If checked, bin source locations.

Bin receiver locations — If checked, bin receiver locations.

The **Bin coordinates** define bin coordinates. Bin coordinates can be either defined as line or midpoints.

Line coordinates — If selected, bin coordinates are line coordinates.

Midpoint coordinates — If selected, bin coordinates are midpoint coordinates.

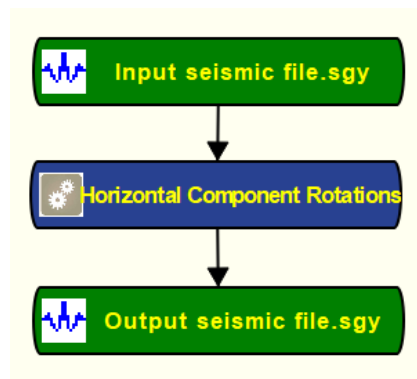
Horizontal Component Rotations

Usage: The Horizontal Component Rotations step rotates the horizontal components of a multi-component data volume through rotation angles determined by the Two Component Horizontal Rotation step. The rotation angles are read from a Rotation Card file. In the case of 2D data acquisition with field oriented 3C receivers, an option exists to limit the rotation angle to a user-specified range.

Input Links: 1) Seismic data in common receiver order (mandatory). The trace header must be updated with source-receiver azimuth and source- and receiver-component types. The common-receiver gathers should be sorted by (1) receiver number; (2) source-receiver offset; (3) receiver component; 2) Rotation Card file containing the estimated rotation angles (optional).

Output Links: 1) Seismic data in common receiver order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Horizontal Rotations

Input type

☒ Three components ☐ Two horizontal components

Orientation type

☐ Fixed orientation ☒ Orientation defined in header

Orientation angles

Orientation of inline component (deg)

Orientation of crossline component (deg)

Orientation trace header

Orientation units

Component labels

Vertical component value

Inline component value

Crossline component value

Radial component value

Transverse component value

OK Help Cancel

Parameter Description:

The **Input type** defines the type of multicomponent data.

Three components — If selected, the input multi-component seismic data is three components.

Two horizontal components — If selected, the input multi-component seismic data is considered two horizontal components.

The **Orientation type** defines the type or orientation.

Fixed orientation — If selected, entire data have a fixed orientation.

Orientation defined in header— If selected, the orientation of the data varies and must be defined in the header.

The **Orientation angles** define the orientation angles.

Orientation of inline component (deg.) — If fixed orientation, enter the orientation (azimuth) of the inline component in degrees.

Orientation of crossline component (deg.) — If fixed orientation, enter the orientation (azimuth) of the crossline component in degrees.

Orientation trace header — If orientation defined in header, select the location of the header key word with the orientation (azimuth) value.

Orientation units — If orientation defined in header, select the units for orientation (azimuth) (degrees or radians)

The **Component labels** define the components labels.

Vertical component value — Enter the label value corresponding to the vertical component.

Inline component value — Enter the label value corresponding to the inline component.

Crossline component value — Enter the label value corresponding to the crossline component.

Radial component value — Enter the label value corresponding to the radial component.

Transverse component value — Enter the label value corresponding to the transverse component.

Mutes Steps

This section documents the processing steps available in the Mutes category.

The types of mutes currently available are:

Mutes
 Processing Categories
Apply Early Mute
Apply Surgical Mute
Apply Tail Mute
Build Mask Model

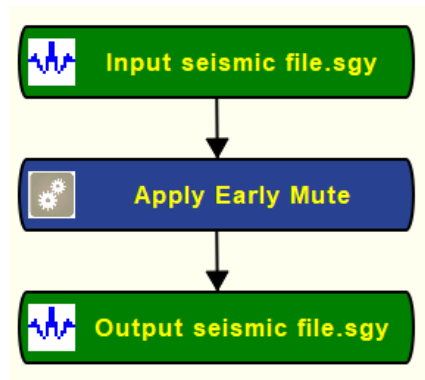
Apply Early Mute

Usage: The Apply Early Mute step allows to apply mute definitions to the seismic data from different sources. The step allows to interpolate mute functions for the records between the picked mute records or to just mute the records associated with the picked mutes. Mute function may be defined by auxiliary mute card data file or using a constant velocity linearly versus offset. The user has a choice of applying a Hanning, Hamming, or Blackman type of mute taper, or none. The user may also specify in samples the length of the mute taper and scale the input offsets by a value. Early mutes may be interactively defined using first the Display menu to select the file, then the Picking menu to select the type of mute.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Early Mute Function card (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Apply Early Mute

Mute definition

- ☒ Velocity Velocity
- ☐ Early mute file
- ☐ First arrivals files
- ☐ VSP first arrivals files

Samples shift at zero offset

Samples shift at maximum offset

☐ Apply value from header

Mute header

Mute taper type

- ☒ Hanning ☐ Hamming
- ☐ Blackman ☐ No taper

Mute taper length (samples)

Mute record interpolation

☒ Mute interpolation between input records

- ☒ Field File order ☐ Receiver order
- ☐ Source order ☐ CMP order

Scale input offsets by

OK Help Cancel

Parameter Description:

The **Mute definition** specifies the parameterization for the early mute function.

Velocity — If selected, the mute function is defined linearly with the offset using a constant velocity.

Velocity — Enter the constant velocity value to be used to define the mute functions.

Early mute file — If selected, an auxiliary Early Mute auxiliary card data file is used to define the mute definition.

First arrivals files — If selected, an auxiliary First Break Times auxiliary card data file is used to define the mute function.

VSP first arrivals files — If selected, an auxiliary VSP First Arrival Time Picks auxiliary card data file is used to define the mute function.

Samples shift at zero offset — Enter the number of samples to be shifted at the zero-offset when applying the mute.

Samples shift at maximum offset — Enter the number of samples to be shifted at the maximum offset when applying the mute.

Apply value from header — If selected, the mute function is defined by values stored in a specific trace header locations.

Mute header — Select the location of the trace header with the mute value.

The **Mute Taper Type** specifies the type of taper to use when applying the mute function.

Hanning — Is selected, a Hanning taper is specified by the equation:

$$x(n) = 0.5 - 0.5 * \cos \left(2 * \pi * \frac{n}{N} \right)$$

Hamming — Is selected, a Hamming taper is specified by the equation:

$$x(n) = 0.54 - 0.46 * \cos \left(2 * \pi * \frac{n}{N} \right)$$

Blackman — Is selected, a Blackman taper is specified by the equation:

$$x(n) = 0.42 - 0.5 * \cos \left(2 * \pi * \frac{n}{N} \right) + 0.08 * \cos \left(4 * \pi * \frac{n}{N} \right)$$

No taper — Is selected, no taper will be applied to the mute. This may result in problems in later processing steps due to Gibbs effect.

Mute taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Mute record interpolation** specifies the interpolation parameters of the mute function.

Mute interpolation between input records — If checked, the early mutes will be interpolated between the control points where picks were made.

Field File order — If selected, interpolation between input records is done in the field file order.

Receiver order — If selected, interpolation between input records is done in the receiver order.

Source order — If selected, interpolation between input records is done in the source order.

CMP order — If selected, interpolation between input records is done in the CMP order.

Scale input offsets by — Enter a value to scale the input offsets.

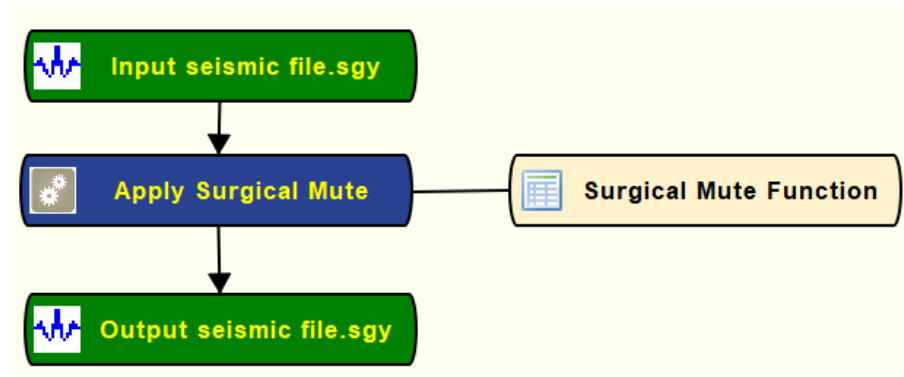
Apply Surgical Mute

Usage: The Apply Surgical Mute step allows to apply mute definitions to the seismic data from the attached Surgical Mute Function auxiliary card data file. The user may choose to interpolate mute functions for the records between the picked mute records or to just mute the records associated with the picked mutes. The user has a choice of applying a Hanning, Hamming, or Blackman type of mute taper, or none at all. The user may also specify in samples the length of the mute taper and scale the input offsets by a value. Surgical mutes may be interactively defined using first the Display menu to select the file, then the Picking menu to select the type of mute.

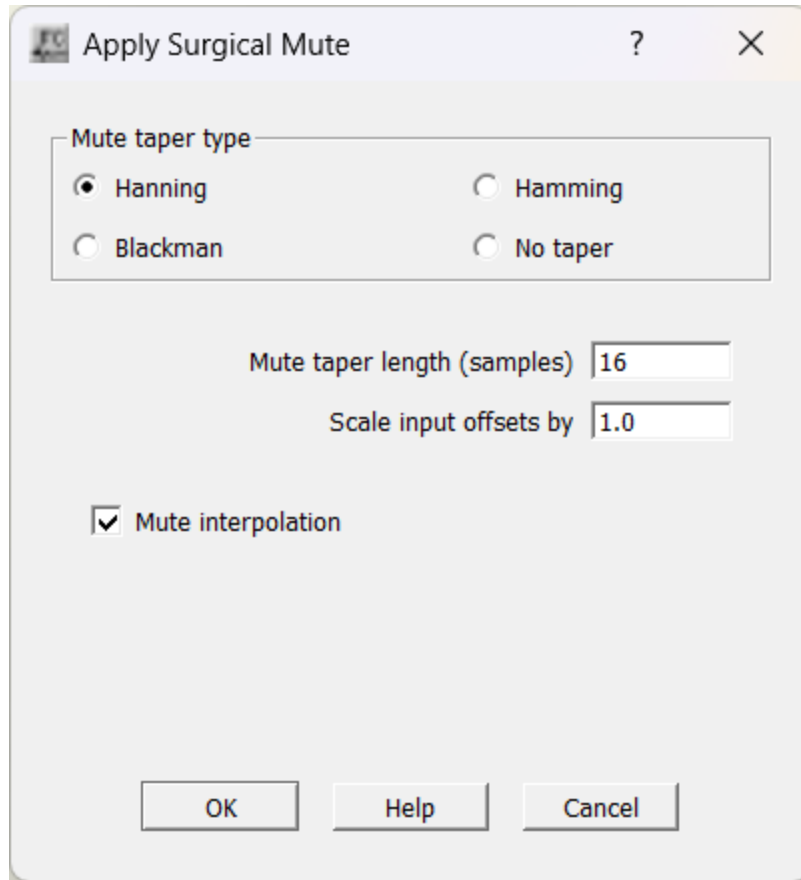
Input Links: 1) Seismic data in any sort order (mandatory). 2) Surgical Mute Function card (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Mute taper type** specifies the type of taper to use when applying the mute function.

Hanning — A Hanning taper is specified by the equation:

$$x(n) = 0.5 - 0.5 * \cos \left(2 * \pi * \frac{n}{N} \right)$$

Hamming — A Hamming taper is specified by the equation:

$$x(n) = 0.54 - 0.46 * \cos \left(2 * \pi * \frac{n}{N} \right)$$

Blackman — A Blackman taper is specified by the equation:

$$x(n) = 0.42 - 0.5 * \cos \left(2 * \pi * \frac{n}{N} \right) + 0.08 * \cos \left(4 * \pi * \frac{n}{N} \right)$$

No taper — No taper will be applied to the mute. This may result in problems in later processing steps due to Gibbs effect.

Mute taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

Scale input offsets by — Enter a value to scale the input offsets.

Mute Interpolation — If checked, the surgical mutes will be interpolated between the control points where picks were made.

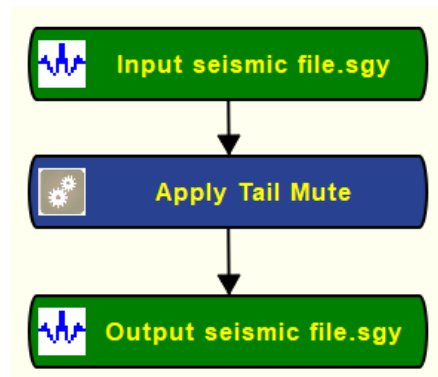
Apply Tail Mute

Usage: The Apply Tail Mute step allows to apply mute definitions to the seismic data from the attached Tail Mute Function auxiliary card data file or using a linear function of constant velocity versus offset. The user may choose to interpolate mute functions for the records between the picked mute records or to just mute the records associated with the picked mutes. The user has a choice of applying a Hanning, Hamming, or Blackman type of mute taper, or none. The user may also specify in samples the length of the mute taper and scale the input offsets by a value. Tail mutes may be interactively defined using first the Display menu to select the file, then the Picking menu to select the type of mute.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Surgical Mute Function card (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Mute taper type** specifies the type of taper to use when applying the mute function.

Hanning — A Hanning taper is specified by the equation:

$$x(n) = 0.5 - 0.5 * \cos \left(2 * \pi * \frac{n}{N} \right)$$

Hamming — A Hamming taper is specified by the equation:

$$x(n) = 0.54 - 0.46 * \cos \left(2 * \pi * \frac{n}{N} \right)$$

Blackman — A Blackman taper is specified by the equation:

$$x(n) = 0.42 - 0.5 * \cos \left(2 * \pi * \frac{n}{N} \right) + 0.08 * \cos \left(4 * \pi * \frac{n}{N} \right)$$

No taper — No taper will be applied to the mute. This may result in problems in later processing steps due to Gibbs effect.

Mute taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

Scale input offsets by — Enter a value to scale the input offsets.

Mute Interpolation — If checked, the surgical mutes will be interpolated between the control points where picks were made.

Velocity — If selected, the mute function is defined linearly with the offset using a constant velocity.

Velocity — Enter the constant velocity value to be used to define the mute functions.

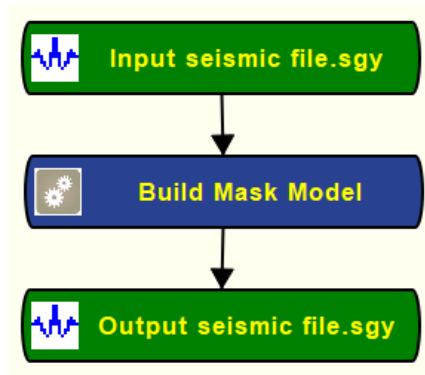
Build Mask Model

Usage: The Build Mask Model step allows to build an output seismic file with zeros and ones that can be used to set to null specific samples or as auxiliary file for the Simultaneous Iterative Refraction Tomography (SIRT) analysis. The geometry of the output file may be defined manually by an auxiliary seismic file. The masked region may be defined using a surgical mute card file.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data in any sort order to define geometry (optional); 3) Surgical Mute Function card (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Build mask model

Define geometry

☒ Define geometry manually

Number of lines Number of locations

Sampling interval (ms) Number of samples

☐ Define geometry from auxiliary seismic file

Define masked interval

☒ Use constant time gate

Top limit (ms)

Bottom limit (ms)

☐ Use surgical mute file

Define masked area

☒ Mask inside ☐ Mask outside

OK Help Cancel

Parameter Description:

The **Define geometry** specifies the parameters related to the geometry of the output seismic file.

Define geometry manually — If selected, the output seismic file with the mask has a geometry as defined manually with the parameters below.

Number of lines — Enter the number of lines of the output mask file.

Number of locations — Enter the number of locations of the output mask file.

Sampling interval (ms) — Enter the sampling interval in milliseconds of the output mask file.

Number of samples — Enter number of samples of the output mask file.

Define geometry from auxiliary seismic file — If selected, the geometry of the output seismic file with the mask will have the geometry of an auxiliary seismic file.

The **Define masked interval** specifies the spatial extent of the mask (locations defined with zero values).

Use constant time gate — If selected, masked interval is defined with a time gate defined by constant top and bottom.

Top limit (ms) — Enter the location of the top boundary of the time gate in milliseconds.

Bottom limit (ms) — Enter the location of the bottom boundary of the time gate in milliseconds.

Use surgical mute file — If selected, masked interval is defined with an auxiliary surgical mute card data file.

The **Define masked area** specifies if mask inside or outside the are defined in the masked interval

Mask inside — If selected, mask inside the region.

Mask outside — If selected, mask outside the region.

Nodes Steps

This section documents the processing steps available in the Nodes category.

The types of nodes currently available are:

Nodes
 Processing Categories
Galperin Component Rotations
Node 3D Stack
Node Average Spectra
Node Noise Spectra
Node Offset Check
Node RMS AGC Checks
Node RMS Amplitude Checks
Node RMS Amplitude Plot
Node Tide Correction
Node TimeDrift Check
Node Vibroseis Correlation
PZ Difference
PZ Summation
SEGD GSX Files Import
SEGY Manta Files Import

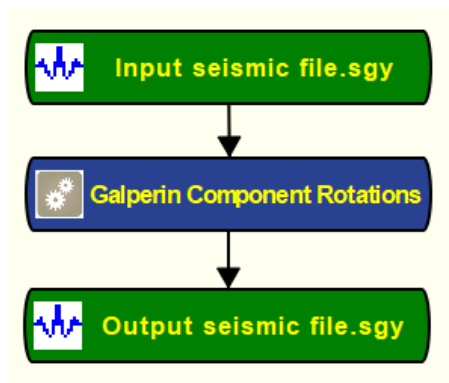
Galperin Component Rotations

Usage: The Galperin Component Rotations step applies rotations from Galperin configurations to Cartesian or Final inline, crossline geometry.

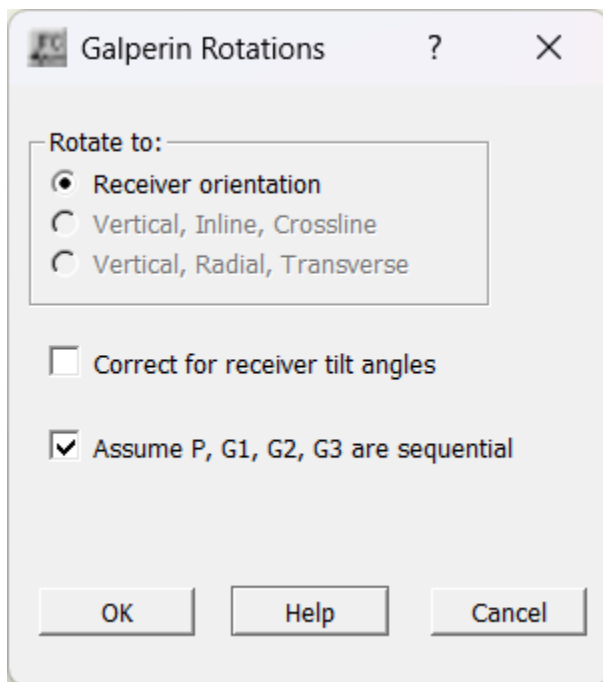
Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Rotate to:** specifies the rotation parameterization.

Receiver orientation — If selected, rotate from the Galperin configuration to standard X, Y, Z orientation.

Vertical, Inline, Crossline — If selected, rotate from the Galperin configuration to the survey in-line and crossline orientation.

Vertical, Radial, Transvers — If selected, rotate from the Galperin configuration to the Radial, Transverse and vertical orientation using the azimuth of the receiver from the source.

Correct for receiver tilt angles — If checked, correct for any tilt of the Galperin receiver in performing the rotation.

Assume P, G1, G2, G3 are sequential — If checked, multiple node components are sequential.

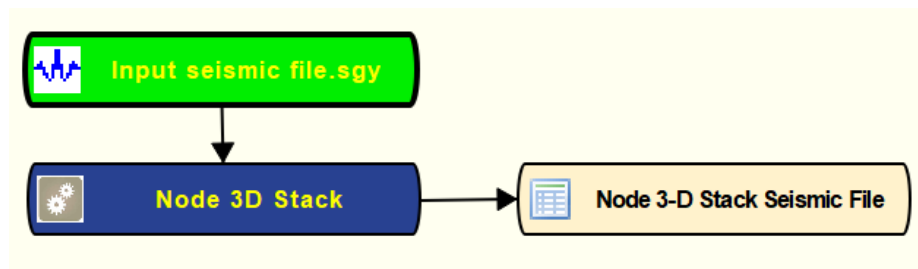
Node 3D Stack

Usage: The Node 3D stack step generates a three-dimensional node data stack. The stack is computed based on an apparent velocity and is an approximation that can be computed in near-real-time in the field for quality control without breaking a processing flow.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Node 3-D Stack Seismic File (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled 'Node 3D CMP Stack'. It features several configuration options: a checked 'Apply frequency bandpass' checkbox with input fields for 'Initial freq. (Hz.)' (6) and 'Final freq. (Hz.)' (75), and 'dB/octave attenuation' (18) for both; a checked 'Remove Sample Mean' checkbox; a 'Trace amplitude definition' section with radio buttons for 'Use true amplitude traces' (selected) and 'Use relative amplitude traces'; a 'Stack Normalization exponent' field set to 1.0; a checked 'Apply front end mute' checkbox with an 'Apparent velocity' field set to 1500; and an unchecked 'Limit trace offsets' checkbox with 'Minimum Offset' (0.00) and 'Maximum Offset' (3000.00) fields. At the bottom are 'OK', 'Help', and 'Cancel' buttons.

Parameter Description:

Apply frequency bandpass — If checked, apply a frequency bandpass before the node 3D stack.

Initial freq. (Hz) — Enter the low pass frequency of the frequency bandpass filter in Hertz.

Final freq. (Hz) — Enter the high pass frequency of the frequency bandpass filter in Hertz.

dB/octave attenuation — Enter the low pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

dB/octave attenuation — Enter the high pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

Remove Sample Mean — If checked, removes the amplitude samples mean before calculation.

Stack Normalization exponent — Enter the stack normalization exponent.

The **Trace amplitude definition** specifies the type of amplitude to be considered.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude traces will be summed in the stacking process. Relative amplitude traces are scaled independently of one another..

Apply front end mute — If checked, applies a front end mute given an apparent velocity.

Apparent velocity — Enter the apparent velocity for the front end mute.

Limit traces offsets — If checked, limits the number of traces considered by offset.

Minimum offset — Enter the minimum offset to be considered in project units.

Maximum offset — Enter the maximum offset to be considered in project units.

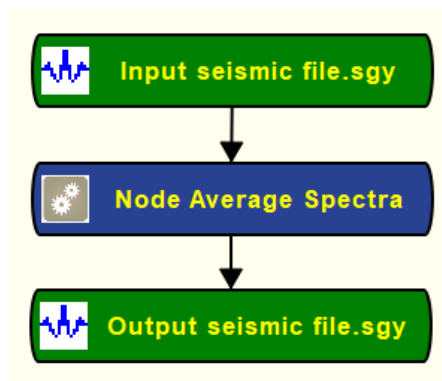
Node Average Spectra

Usage: The Node Average Spectra step creates and saves Amplitude/Power spectra images. The Node Average Spectra step can be used for real-time for quality control.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the 'Spectra Plotter' dialog box with the following settings:

- ☐ Start time limit (ms): 0
- ☐ End time limit (ms): 6000
- ☐ Min offset limit (m): 300
- ☐ Max offset limit (m): 3000
- ☒ Use remove DC bias filter
- ☐ Apply low-cut filter
 - Low-cut corner frequency (Hz): 1
 - Low-cut rolloff rate (dB/oct): 18
- ☐ Apply high-cut filter
 - High-cut corner frequency (Hz): 72
 - High-cut rolloff rate (dB/oct): 18
- ☐ Smooth the spectra - window size: 0
- ☒ Plot a trace a header value next to the title: User defined 9
- ☐ Fixed Scale
 - ☒ Power Spectra
 - Reference Amplitude: 1
 - Minimul value: 0
 - Maximum value: 100
 - Vertical Ticks: 20
 - ☐ Aplitude Spectra
- ☒ Power Spectra - Max dB Down
 - Maximum dB level: 0.00

Buttons: OK, Help, Cancel

Parameter Description:

Start time limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the start time of the window in milliseconds.

End time limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the end time of the window in milliseconds.

Min offset limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the start offset of the window in project units.

Max offset limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the end offset of the window in project units.

Use remove DC bias filter — If checked, applies a Remove DC bias step to the input seismic file. The filter is not stored in the output seismic file, it is only applied before the calculations of the spectra.

Apply low-cut filter — If checked, applies to the input seismic file a zero-phase Butterworth filter to the input seismic data before computing the spectral semblance. The filter is only applied to the input file and not store in the output seismic file.

Apply low-cut filter — If checked, a low-cut filter will be applied to the seismic data.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Smooth the spectra – window size — If checked, smooths the spectra given a number of traces. Enter the number of traces to smooth the spectra.

Plot a trace header value next to the title — If checked, plots the information stored at a seismic trace header word.

Fixe Scale — If selected, uses a fixed vertical scale for all plots.

Power Spectra — If selected, computes the power spectra.

Amplitude Spectra — If selected, computes the amplitude spectra.

Reference Amplitude — Enter the reference amplitude to scale the spectra.

Minimum value — Enter the minimum value for plotting.

Amplitude Spectra — Enter the maximum value for plotting.

Vertical Ticks — Enter the number of vertical ticks for plotting.

Power Spectra – Max dB Down — If selected, computes a power spectrum with a reference maximum dB level.

Maximum dB level — Enter the maximum dB level to scale the power spectra.

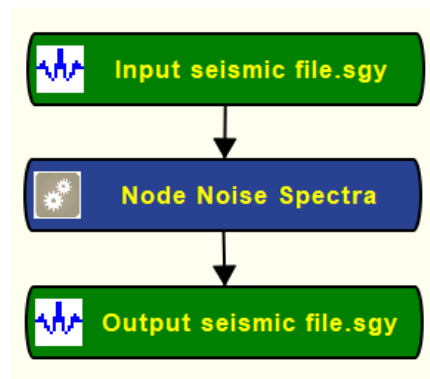
Node Noise Spectra

Usage: The Node Noise Spectra step creates and saves Amplitude/Power spectra images for a noise window. The Node Noise Spectra step can be used for real-time for quality control.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Spectra Plotter' dialog box is shown with the following settings:

- ☒ Start time limit (ms): 0
- ☒ End time limit (ms): 100
- ☒ Min offset limit (m): 1000
- ☒ Max offset limit (m): 3000
- ☒ Use remove DC bias filter
- ☐ Apply low-cut filter
 - Low-cut corner frequency (Hz): 1
 - Low-cut rolloff rate (dB/oct): 18
- ☐ Apply high-cut filter
 - High-cut corner frequency (Hz): 72
 - High-cut rolloff rate (dB/oct): 18
- ☐ Smooth the spectra - window size: 56477553
- ☒ Plot a trace a header value next to the title: User defined 9
- ☐ Fixed Scale
 - ☒ Power Spectra
 - ☐ Aplitude Spectra
 - Reference Amplitude: 1
 - Minimul value: 0
 - Maximum value: 100
 - Vertical Ticks: 20
- ☒ Power Spectra - Max dB Down
 - Maximum dB level: 0.00

Buttons: OK, Help, Cancel

Parameter Description:

Start time limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the start time of the window in milliseconds.

End time limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the end time of the window in milliseconds.

Min offset limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the start offset of the window in project units.

Max offset limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the end offset of the window in project units.

Use remove DC bias filter — If checked, applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the spectra.

Apply low-cut filter — If checked, applies to the input seismic file a zero-phase Butterworth filter to the input seismic data before computing the spectral semblance. The filter is only applied to the input file and not store in the output seismic file.

Apply low-cut filter — If checked, a low-cut filter will be applied to the seismic data.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Smooth the spectra – window size — If checked, smooths the spectra given a number of traces. Enter the number of traces to smooth the spectra.

Plot a trace header value next to the title — If checked, plots the information stored at a seismic trace header word.

Fixe Scale — If selected, uses a fixed vertical scale for all plots.

Power Spectra — If selected, computes the power spectra.

Amplitude Spectra — If selected, computes the amplitude spectra.

Reference Amplitude — Enter the reference amplitude to scale the spectra.

Minimum value — Enter the minimum value for plotting.

Amplitude Spectra — Enter the maximum value for plotting.

Vertical Ticks — Enter the number of vertical ticks for plotting.

Power Spectra – Max dB Down — If selected, computes a power spectrum with a reference maximum dB level.

Maximum dB level — Enter the maximum dB level to scale the power spectra.

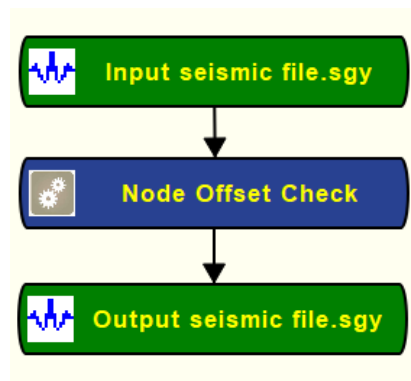
Node Offset Check

Usage: The Node Offset Check step create and save seismic plot with direct arrival picks overlay data and picks have LMO and are sorted by offset.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Node Offset Check
?
X

Trace type
Variable area wiggle
Polarity
Normal
Orientation
Right-to-left
Amplitudes
True
Dead Traces
UnMarked

Horiz scale
24.0
Vert scale
4.0
Display gain
0.0
AGC length (ms)
1000.0
Excursion
2.0

1st horz anno
1
2nd horz anno
20
Vertical anno
200
Major time lines
1000
Minor time lines
200

Color scale
grayscale.xml

Sensors Selection

☒ Hydrophone
☐ Vertical Geophone
☐ H1 Geophone
☐ H2 Geophone

☐ Record Plotting interval
☐ Time Limit
☐ Offset Limit
☐ Apply LMO/Shift
☐ Remove DC Bias

1

00

00

15000

☒ Plot offset overlay

Velocity (m/s)	Type	Color	size
1500	Solid Line	Blue	Cosmetic

OK
Help
Cancel

Parameter Description:

Trace type — Select the type of the seismic display between Variable area wiggle or Variable density.

Polarity — Select the type of polarity for the seismic display between Normal or Reverse.

Orientation — Select the orientation of the seismic display between Right-to-left or Left-to-right.

Amplitudes — Select the type of amplitudes to be plotted: true, relative or gain control.

Dead Traces — Select if dead traces are marked or unmarked during plot.

Horiz scale — Enter the horizontal scale for the seismic display.

Vert scale — Enter the vertical scale for the seismic display.

Display gain — Enter the display gain of the seismic display.

AGC length (ms) — Enter the length of the AGC operator, if Gain control is selected in Amplitudes.

Excursion — Enter the trace excursion gain of the seismic display

1 horz anno — Select the increment of the first horizontal annotation.

2 horz anno — Select the increment of the first horizontal annotation.

Vertical anno — Select the increment of the vertical annotation.

Major time lines — Select the increment major time lines.

Minor time lines — Select the increment major time lines.

Color scale — Select the color scale to be used.

The **Sensors Selection** specifies the sensor (component) to be plotted.

Hydrophone — If selected, plots the data from the hydrophone.

Vertical Geophone — If selected, plots the data from the vertical geophone.

H1 Geophone — If selected, plots the data from the first horizontal geophone.

H2 Geophone — If selected, plots the data from the second horizontal geophone.

Record plotting interval — If checked, enter the number of records to be plotted.

Time limit — If checked, enter the start and end time to be plotted.

Offset limit — If checked, enter the start and end offset to be plotted.

Apply LMO/Shift — If checked, enter the constant velocity to be used for LMO and the time shift in milliseconds.

Remove DC Bias — If checked applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the spectra.

Plot offset overlay — If checked, plots the offset calculation on top of the seismic, given a constant velocity, type, color and size of the line.

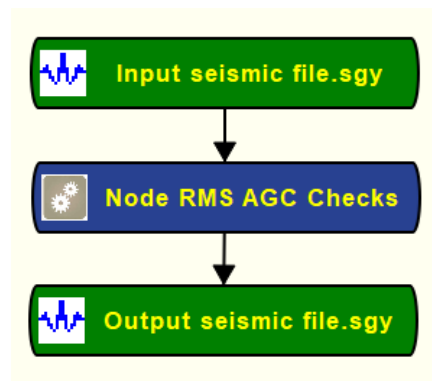
Node RMS AGC Checks

Usage: The Node RMS AGC Checks step compute the Root Mean Square (RMS) amplitude of the node data and applies and user defined AGC filter. By analyzing RMS values post-AGC it allows monitoring that amplitude normalization has not distorted true signal characteristics.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Node AGC Operators' and includes standard window controls (minimize, maximize, close) and a help icon. It contains a note: 'Note: output is gain operators'. Below this, there are four input fields with corresponding labels: 'Operator length (ms)' with a value of 500.0, 'Maximum hydrophone RMS' with a value of 8.0, 'Maximum vertical geophone RMS' with a value of 1.0, and 'Maximum horizontal geophone RMS' with a value of 1.0. At the bottom, there are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Operator length (ms) — Enter the length of the AGC operator in milliseconds.

Maximum hydrophone RMS — Enter the maximum RMS amplitude value for the hydrophone component.

Maximum vertical geophone RMS — Enter the maximum RMS amplitude value for the vertical geophone component.

Maximum horizontal geophone RMS — Enter the maximum RMS amplitude value for the horizontal geophone component.

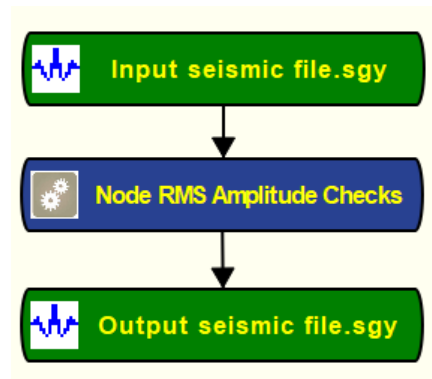
Node RMS Amplitude Checks

Usage: The Node RMS Amplitude Checks step computes RMS amplitude or Energy values within user-defined windows for quality control of the input node data.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "RMS Amplitude Checking" contains the following controls:

- Number of analysis:** A text box with the value "1" and a spinner.
- Window type:** Two radio buttons: "Static window" (selected) and "Sliding window (AGC) curve".
- Attribute:** Two radio buttons: "RMS" (selected) and "Energy".
- Table:** A table with 8 columns: Window, Start(ms), Length(ms), Filter, Low pass(Hz), Low slope(dB), High pass(Hz), and High slope(dB). It contains one row with the following values: 1, 0.00, 1000.00, ☐, 6.0, 18.0, 80.0, 72.0.
- Buttons:** "OK", "Help", and "Cancel" at the bottom.

Window	Start(ms)	Length(ms)	Filter	Low pass(Hz)	Low slope(dB)	High pass(Hz)	High slope(dB)
1	0.00	1000.00	☐	6.0	18.0	80.0	72.0

Parameter Description:

Number of analysis — Enter the number of windows to compute the RMS amplitude. {1, 10}

The **Window type** specifies the type of window to be considered.

Static window — If selected, uses static windows.

Sliding window (AGC) curve — If selected, uses sliding windows.

The **Attribute** specifies the attribute to be calculated.

RMS — If selected, computes the RMS amplitude per window.

Energy — If selected, computes the Energy per window.

Window — Window index

Start (ms) — Enter the start time of the window in milliseconds.

Length (ms) — Enter the length of the window in milliseconds.

Filter — If checked, applies a frequency filter to the data before calculation.

Low pass (Hz) — Enter the low pass frequency of the filter.

Low slope (dB/oct) — Enter the low slope of the filter.

High pass (Hz) — Enter the high pass frequency of the filter.

High slope (dB/oct) — Enter the high slope of the filter.

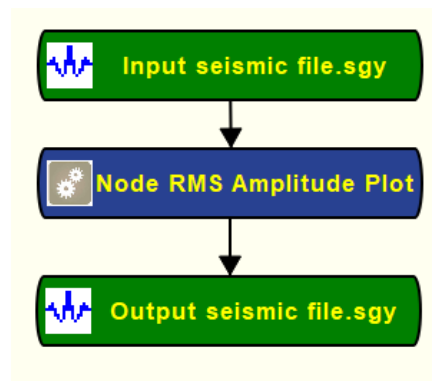
Node RMS Amplitude Plot

Usage: The Node RMS Amplitude step creates and saves RMS amplitude images. The Node RMS Amplitude step can be used for real-time for quality control.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Node RMS Amplitude Plot' and features a standard Windows-style title bar with a question mark and a close button. It is divided into two main sections. The first section, 'Color Scale and RMS Range', contains two checkboxes: 'minimum RMS amplitude' and 'maximum RMS amplitude', each followed by a text input field currently displaying the value '0'. The second section, 'Sensors Selection', contains four checkboxes: 'Hydrophone' (which is checked), 'Vertical Geophone', 'H1 Geophone', and 'H2 Geophone'. At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

The **Color Scale and RMS Range** specifies the minimum and maximum RMS amplitude values.

Minimum RMS amplitude— If selected, enter the minimum RMS amplitude value for the plot.

Maximum RMS amplitude — If selected, enter the maximum RMS amplitude value for the plot

The **Sensors Selection** specifies the sensor (component) to be plotted.

Hydrophone — If selected, plots the data from the hydrophone.

Vertical Geophone — If selected, plots the data from the vertical geophone.

H1 Geophone — If selected, plots the data from the first horizontal geophone.

H2 Geophone — If selected, plots the data from the second horizontal geophone.

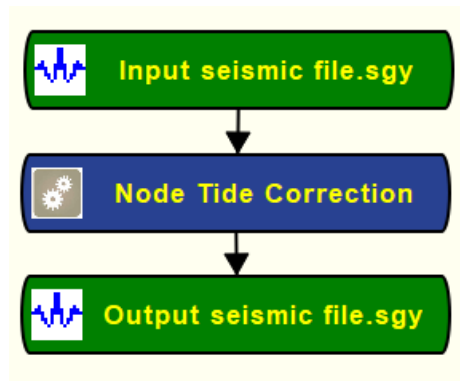
Node Tide Correction

Usage: The Node Tide Correction step applies a static correction to the data to filter the tide effect in real-time based on the tide information stored in the database.

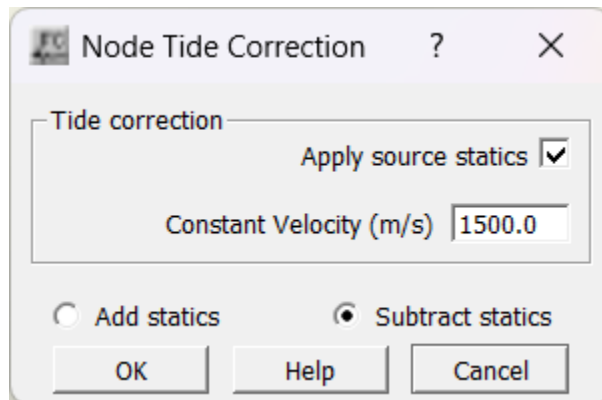
Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Tide correction** specifies the statics shift parameters.

Apply source statics — If checked, applies a statics correction (add or subtract) to source.

Constant Velocity (m/s) — Enter constant velocity in m/s to compute the source statics

Add statics— If selected, add statics correction to the data.

Subtract statics— If selected, subtract statics correction to the data.

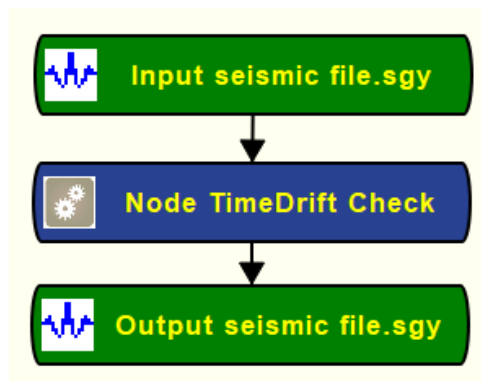
Node TimeDrift Check

Usage: The Node TimeDrift Check step creates and saves seismic plot with direct arrival picks overlay.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Node Time Drift Check

Trace type: Variable area wiggle Horiz scale: 24.0 1st horz anno: 1

Polarity: Normal Vert scale: 4.0 2nd horz anno: 20

Orientation: Right-to-left Display gain: 0.0 Vertical anno: 200

Amplitudes: True AGC length (ms): 1000.0 Major time lines: 1000

Dead Traces: UnMarked Excursion: 2.0 Minor time lines: 200

Color scale: grayscale.xml

Sensors Selection

☒ Hydrophone ☐ Record Plotting interval: 1
☐ Vertical Geophone ☐ Time Limit: 0 0
☐ H1 Geophone ☐ Offset Limit: 0 0
☐ H2 Geophone ☐ Remove DC Bias

Direct Arrival pick

Trace header	Type	Color	size
User defined 1	Solid Line	Blue	Cosmetic

OK Help Cancel

Parameter Description:

Trace type — Select the type of the seismic display between Variable area wiggle or Variable density.

Polarity — Select the type of polarity for the seismic display between Normal or Reverse.

Orientation — Select the orientation of the seismic display between Right-to-left or Left-to-right.

Amplitudes — Select the type of amplitudes to be plotted: true, relative or gain control.

Dead Traces — Select if dead traces are marked or unmarked during plot.

Horiz scale — Enter the horizontal scale for the seismic display.

Vert scale — Enter the vertical scale for the seismic display.

Display gain — Enter the display gain of the seismic display.

AGC length (ms) — Enter the length of the AGC operator, if Gain control is selected in Amplitudes.

Excursion — Enter the trace excursion gain of the seismic display

1 horz anno — Select the increment of the first horizontal annotation.

2 horz anno — Select the increment of the first horizontal annotation.

Vertical anno — Select the increment of the vertical annotation.

Major time lines — Select the increment major time lines.

Minor time lines — Select the increment major time lines.

Color scale — Select the color scale to be used.

The **Sensors Selection** specifies the sensor (component) to be plotted.

Hydrophone — If selected, plots the data from the hydrophone.

Vertical Geophone — If selected, plots the data from the vertical geophone.

H1 Geophone — If selected, plots the data from the first horizontal geophone.

H2 Geophone — If selected, plots the data from the second horizontal geophone.

Record plotting interval — If checked, enter the number of records to be plotted.

Time limit — If checked, enter the start and end time to be plotted.

Offset limit — If checked, enter the start and end offset to be plotted.

Apply LMO/Shift — If checked, enter the constant velocity to be used for LMO and the time shift in milliseconds.

Remove DC Bias — If checked applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the spectra.

Direct arrival pick — If checked, plots the direct arrival picks on top of the seismic, given a seismic trace header location, type, color and size of the line.

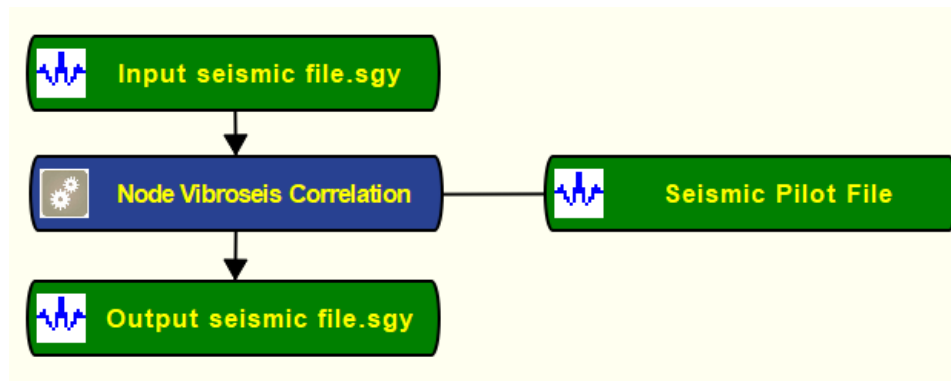
Node Vibroseis Correlation

Usage: The Node Vibroseis Correlation step does the correlation of the data with a pilot vibroseis file.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data file with pilot (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box for the Vibroseis Correlation step contains the following parameters:

- EBCDIC**
 - ☐ Overwrite EBCDIC Header
 - Text field: [] [...]
- Correlation options**
 - ☐ Minimum phase compensate data
 - Pre-whitening (%) [0.01]
 - Pilot length (ms) [10000]

Buttons: OK, Help, Cancel

Parameter Description:

The **EBCDIC** specifies EBCDIC header parameters to replace in the file.

Overwrite EBCDIC Header— If checked, allows overwrite the EBCDIC header by a user-defined file.

The **Correlation options** specifies the vibroseis correlation parameters.

Minimum phase compensate data — If checked, compensate data for minimum phase.

Pre-whitening (%) — Enter the pre-whitening percentage to be applied to the data before correlation.

Pilot length (ms) — Enter the length of the pilot.

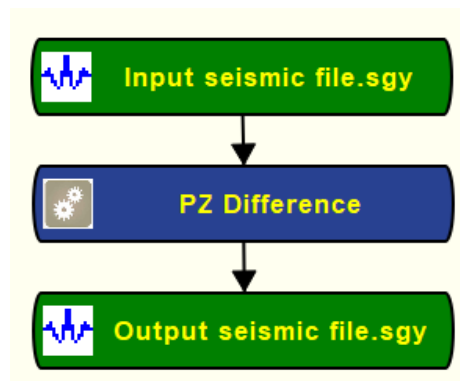
PZ Difference

Usage: The PZ Difference step compute the Pressure and Vertical components difference for node data.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'P and Z Components Difference'. It contains the following sections and controls:

- PZ Comparison window specification**
 - Refraction velocity: 1500.0
 - Window length (ms.): 1000.0
 - Window start below refractions (ms.): -100.0
- P/Z scalar weighting**
 - ☐ Debias P and Z components
 - ☐ Smooth 'n' adjacent trace weightings: 5
 - ☒ Assume input P, G1, G2, G3 are sequential
- Buttons:** Set diagnostics, OK, Help, Cancel

Parameter Description:

The **PZ comparison window specification** defines the P and Z components window comparison parameters.

Refraction velocity — Enter the refraction velocity to be considered in m/s.

Window length (ms.) — Enter the comparison window length in milliseconds.

Window start below refractions (ms.) — Enter a time difference between refractions and the window start.

The **P/Z scalar weighting** defines the P and Z scalar weights.

Debias P and Z components — If checked, applies a debias operator before summation.

Smooth 'n' adjacent trace weightings — If checked, enter the number adjacent traces for the calculation.

Assume input P, G1, G2, G3 are sequential — If checked assumes these components are sequential.

Set diagnostics — Select to define the PZ combination diagnostics headers, such as pressure mean amplitude, vertical component mean amplitude, P-Z mean amplitude ratio, smooth P-Z mean amplitude ratio, where the information will be stored.

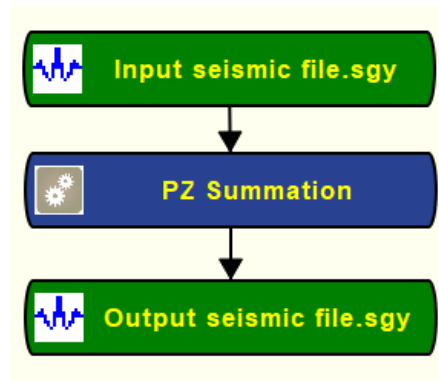
PZ Summation

Usage: The PZ Summation step compute the Pressure and Vertical components summation for node data.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'P and Z Components Summation'. It contains the following sections and controls:

- PZ Comparison window specification**
 - Refraction velocity: 1500.0
 - Window length (ms.): 1000.0
 - Window start below refractions (ms.): -100.0
- P/Z scalar weighting**
 - ☐ Debias P and Z components
 - ☐ Smooth 'n' adjacent trace weightings: 5
 - ☒ Assume input P, G1, G2, G3 are sequential
- Buttons:** Set diagnostics, OK, Help, Cancel

Parameter Description:

The **PZ comparison window specification** defines the P and Z components window comparison parameters.

Refraction velocity — Enter the refraction velocity to be considered in m/s.

Window length (ms.) — Enter the comparison window length in milliseconds.

Window start below refractions (ms.) — Enter a time difference between refractions and the window start.

The **P/Z scalar weighting** defines the P and Z scalar weights.

Debias P and Z components — If checked, applies a debias operator before summation.

Smooth 'n' adjacent trace weightings — If checked, enter the number adjacent traces for the calculation.

Assume input P, G1, G2, G3 are sequential — If checked assumes these components are sequential.

Set diagnostics — Select to define the PZ combination diagnostics headers, such as pressure mean amplitude, vertical component mean amplitude, P-Z mean amplitude ratio, smooth P-Z mean amplitude ratio, where the information will be stored.

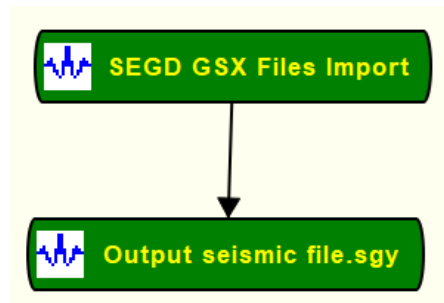
SEG GSX File Import

Usage: The SEG GSX File Import step loads a GeoSpace GSX SEG-D format file into a seismic file.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "GeoSpace GSX SEG-D Field Files Import". It contains the following sections:

- GeoSpace GSX SEG-D files**: Includes a "Base directory path" text field with a "Browse..." button, and a "Set Date for Input" button next to a "Date of input directory" text field.
- Seismic source type**: Includes four radio buttons: "Airgun", "Vibroseis" (selected), "Sparker", and "Explosive".
- Cmp Line/Loc**: Includes a checkbox labeled "Assign cmp Line/Loc" which is checked.
- Amplitude scalar**: Includes a checkbox labeled "Apply a scalar to the data" which is unchecked, and a text field with the value "1".

At the bottom are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **GeoSpace GSX SEG-D files** defines the path for the SEG-D file.

Browse — Select the base directory where the SEG-D files are located.

Set Date for input — Set date for input.

The **Seismic source type** specifies the type of source.

Airgun — If selected, considers an airgun as source type.

Vibroseis — If selected, considers a vibroseis as source type.

Sparker — If selected, considers a sparker as source type (not yet implemented).

Explosive — If selected, considers explosives as source type (not yet implemented).

The **CMP Line/Loc** specifies the CMP as line/location.

Assigned cmp Line/Loc — If checked, assigns CMP line and location.

The **Amplitude scalar** specifies the amplitude scalar to be applied to the data.

Apply a scalar to the data — If checked, applies a scalar to the data and enter the amplitude scalar.

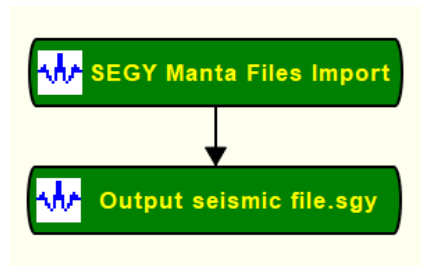
SEG Y Manta Files Import

Usage: The SEG Y Manta Files Input step loads a Manta seismic file format into a seismic file.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Manta SEG Y Files Import

Manta SEG Y files

Base directory path

Date of input directory

☐ Override input data directory

Override Input Directory

/01_Received//04_OBN_Raw_Vibroseis/

Seismic source type

☐ Airgun ☒ Vibroseis ☐ Sparker ☐ Explosive

DC Check

☐ Remove DC

Maximum hydrophone allowed DC Maximum geophone allowed DC

QC Check

☐ Perform position and tilt checks

Maximum allowed position variation (m)

Maximum allowed tilt variation in X or Y (degrees)

Parameter Description:

The **Manta SEG-Y files** defines the path for the SEG-Y file.

Browse — Select the base directory where the SEG-D files are located.

Set Date for directories — Set date for input.

Override input data directory — If checked override input directory.

Browse — Select to override Input Directory.

The **Seismic source type** specifies the type of source.

Airgun — If selected, considers an airgun as source type.

Vibroseis — If selected, considers a vibroseis as source type.

Sparker — If selected, considers a sparker as source type (not yet implemented).

Explosive — If selected, considers explosives as source type (not yet implemented).

The **DC Check** specifies DC bias filter parameters.

Remove DC — If checked, applies a DC bias filter to the data.

Maximum hydrophone allowed DC — Enter the maximum hydrophone allowed DC.

Maximum geophone allowed DC — Enter the maximum geophone allowed DC.

The **QC Check** specifies QC check parameters.

Perform position and tilt checks — If checked, perform position and tilt checks.

Maximum allowed position variation (m) — Enter the maximum allowed position variation.

Maximum allowed tilt variation in X or Y (degrees) — Enter the maximum allowed tilt variation in X or Y.

Quality Analysis Steps

This section documents the processing steps available in the Quality Analysis category.

The types of quality analysis currently available are:

Quality Analysis
↑ Processing Categories
Amplitude Analysis
Amplitude Spectrum
Attribute Map
Autocorrelation
Dead Traces Analysis
Frequency Analysis
Header Display Plotter
Marine Amplitude Analysis
Navigation Check
Offset Check
RMS Amplitude Log
Real-time Amplitude Spectra
Signal to Noise
Signal to Noise Attribute
Slant Cable Check
Source Energy Estimation
Spectra Display Plotter
Spectral Comparison
Trace Analysis Report

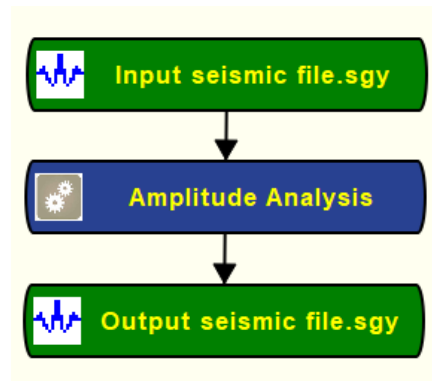
Amplitude Analysis

Usage: The Amplitude Analysis step performs single- or multi-channel- or single-channel average analysis of sample amplitudes and updates a user specified trace header with the results of the analysis. Attribute types include RMS amplitude, Average magnitude, Maximum amplitude, Energy, Median magnitude, and Maximum magnitude. Results may be output to a report file.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data in any order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Amplitude Analysis" and contains the following sections:

- Analysis type:** Radio buttons for "Single-channel" (selected) and "Multi-channel".
- Attribute type:** Radio buttons for "RMS amplitude" (selected), "Average magnitude", "Maximum amplitude", "Energy", "Median magnitude", and "Maximum magnitude".
- Time-space window:** A table with columns: Window, Start(ms), Length (ms), Apply LMO, Velocity value, Limit offset, Minimum, Maximum, Absolute, and Output trace header.

Window	Start(ms)	Length (ms)	Apply LMO	Velocity value	Limit offset	Minimum	Maximum	Absolute	Output trace header
☒ 1	0	1000	☐ Apply	2000	☐ Limit	0	0	☐ Yes	User defined 1
☐ 2	1000	1000	☐ Apply	2000	☐ Limit	0	0	☐ Yes	User defined 2
☐ 3	2000	1000	☐ Apply	2000	☐ Limit	0	0	☐ Yes	User defined 3
- Report file:** A checkbox "Output results to a report file" and a text field with a "File Browse..." button. The text field contains "C:/DATA/Documentation/Report/AmplitudeAnalysisReport.txt".

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Analysis type** specifies whether the amplitude analysis will be single-channel, multi-channel or single-channel average. Single-channel attributes are calculated per trace. Multi-channel attributes are calculated from the ensemble of traces in an input gather.

Single-channel — Select single-channel amplitude analysis.

Multi-channel — Select multi-channel amplitude analysis.

The **Attribute type** specifies the type of amplitude attribute.

RMS amplitude — If selected, calculate the root-mean-squared value in the analysis window.

Average magnitude — If selected, calculate the average of the absolute values in the analysis window.

Maximum amplitude — If selected, determine the maximum of the absolute values in the analysis window.

Energy — If selected, calculate the sum of the squares of sample values in the analysis window.

Median magnitude — If selected, determine the median value in the analysis window.

Maximum magnitude — If selected, determine the maximum value in the analysis window.

The **Time-space window** specifies the number of analysis windows per trace for a single- or multi-channel analysis.

Window — Specify the number of windows to use.

1 — The first window is checked by default for use in the calculations.

2 — Check to use a second window in the calculations.

3 — Check to use a third window in the calculations.

Start time (ms) — Enter the start time in milliseconds for the window to use.

Length (ms) — Enter the length in milliseconds for the window to use.

Apply LMO — Specify whether a linear moveout will be applied to the start time of the analysis window.

Apply — If checked, a linear moveout will be applied to the start time of the analysis window.

Velocity value — If linear moveout is to be applied, enter the moveout velocity.

Limit offset — If offset is to be limited, specify minimum and maximum values. Absolute values may be specified.

Limit — If checked, the offset will be limited, specify minimum and maximum values.

Minimum — Enter minimum offset value.

Maximum — Enter maximum offset value.

Absolute — Specify if absolute value is desired.

Yes — If checked, an absolute value will be used.

Output trace header — Select the trace header for each window that will be updated with the results of the analysis.

The **Report file** specifies whether to save results to a report file and browse to locate or create an amplitude analysis report file.

Output results to a report file — If checked, results will be saved to a report file.

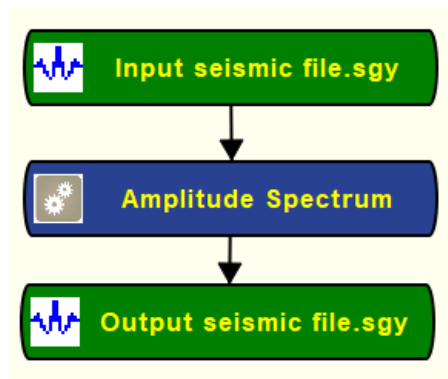
Amplitude Spectrum

Usage: The Amplitude Spectrum step inputs seismic data and outputs the amplitude spectrum of each trace into the output seismic file.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data amplitude spectrum attribute traces (mandatory).

Example Flowchart:



Step Parameter Dialog:

Amplitude Spectrum

Trace window

☐ Specify time window

Start time (ms)

Length (ms)

☐ Apply LMO to window start time

Linear moveout velocity

Amplitude scale

☐ dB down ☒ Absolute amplitude

dB scale control

☐ Use this value as the 0 dB value

Zero dB amplitude

Real time display

☐ Display in real time

Plot last N records

☒ Write spectra in text file

write last N records

Remove DC bias

☐ Use remove DC bias filter

DC calculation method

☐ Mean ☒ Median ☐ (Min+Max)/2

Filtering

☐ Apply low-cut filter

Low-cut corner frequency (Hz)

Low-cut rolloff rate (dB/oct)

☐ Apply high-cut filter

High-cut corner frequency (Hz)

High-cut rolloff rate (dB/oct)

Spectrum averaging

☐ Average spectra

First trace

Number of traces

OK Help Cancel

Parameter Description:

The **Trace window** specifies the parameters related to the

Specify trace window — If checked, the specified trace window will be used for calculating the amplitude spectrum.

Start time (ms) — Enter the start time of the trace window to use in milliseconds.

Length (ms) — Enter the length of the trace window to use in milliseconds.

Apply LMO to window start time — If checked, a linear moveout will be applied to the start time of the trace window.

Linear moveout velocity — If linear moveout is to be applied, specify the moveout velocity.

The **Amplitude scale** specifies the amplitude scale of the spectra either amplitude or dB.

dB down — If selected, use decibels down for the amplitude scale.

Absolute amplitude — If selected, use absolute amplitude for the amplitude scale.

The **dB scale control** specifies the dB scale by specifying a zero decibel value.

Use this value as the 0 dB value — If checked, the value entered will be used to control the dB scale.

Zero dB amplitude — Specify the zero decibel amplitude.

The **Real time display** specifies parameters for real-time amplitude spectra display and output text file.

Display in real time — If checked, display spectra in real time (not implemented).

Plot last N records — Enter the number of last records to plot.

Write spectra in text file — If checked, outputs the amplitude spectra in a text file.

Write last N records — Enter the number of last records to write.

The **Remove DC bias** specifies if a DC remove bias filter will be applied to the input seismic file before computing the spectral semblance.

Use remove DC bias filter — If checked, applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the amplitude spectra.

The **DC calculation method** specifies the method to estimate the DC bias.

Mean — If selected, estimates the DC bias as the mean of the seismic samples considered.

Median — If selected, estimates the DC bias as the median of the seismic samples considered.

(Min+Max)/2 — If selected, estimates the DC bias as central value between the min and max of the seismic samples considered.

The **Filtering** specifies the bandpass filter parameters to be applied to the data before the spectra calculation.

Apply low-cut filter — If checked, a low-cut filter will be applied to the seismic data.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

The **Spectrum averaging** specifies the number of spectra to be average based on the trace number.

Average spectra — If checked, the spectrums of the specified traces will be averaged.

First trace — Enter the first trace number in the window to be averaged.

Number of traces — Enter the number of traces to averaged.

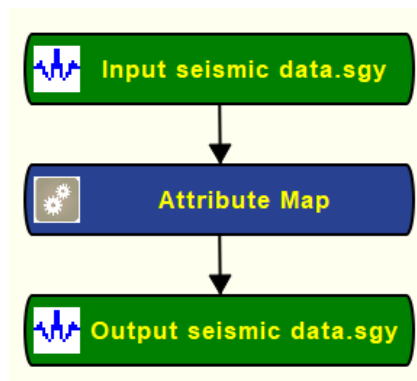
Attribute Map

Usage: The Attribute Map set plots a give attribute (dominant frequency or noise) in a map projected with the seismic trace easting and northing.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Attribute Map

Define window

☐ Start time limit (ms) ☐ Min offset limit (m)

☐ End time limit (ms) ☐ Max offset limit (m)

Filtering

☐ Apply low-cut filter ☐ Apply high-cut filter

Low-cut corner frequency (Hz) High-cut corner frequency (Hz)

Low-cut rolloff rate (dB/oct) High-cut rolloff rate (dB/oct)

Attribute type

☒ Dominant frequency ☐ Energy

Window

☒ Signal ☐ Noise

Define extents manually

☒ Automatically define extents ☐ Manually define extents

Easting minimum Northing minimum

Easting maximum Northing maximum

SPS Receiver file

SPS File name:

Parameter Description:

The **Define window** specifies the window parameterization where the analysis is performed.

Start time limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the start time of the window in milliseconds.

End time limit (ms) — If checked, limit the spatial extent of the spectra calculation and enter the end time of the window in milliseconds.

Min offset limit (m) — If checked, limit the spatial extent of the spectra calculation and enter the start offset of the window in project units.

Max offset limit (m) — If checked, limit the spatial extent of the spectra calculation and enter the end offset of the window in project units.

The **Filtering** specifies the bandpass filter parameters.

Apply low-cut filter — If checked, a low-cut filter will be applied to the seismic data.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

The **Attribute type** specifies the type of attribute to be computed.

Dominant frequency — If selected, calculates the dominant frequency of the signal.

Energy — If selected, calculates the energy of the signal.

The **Window** specifies the type window to be considered for the analysis.

Signal — If selected, considers the window as signal.

Noise — If selected, considers the window as noise.

The **Define extents manually** specifies manually the spatial extents of the area where the analysis will happen.

Automatically define extents — If selected, the spatial extents are computed from the input data.

Manually define extents — If selected, the spatial extents are defined manually.

Easting minimum — Enter the minimum easting of the spatial extent.

Easting maximum — Enter the maximum easting of the spatial extent.

Northing minimum — Enter the minimum northing of the spatial extent.

Northing maximum — Enter the maximum northing of the spatial extent.

The **SPS receiver file** specifies the location of the SPS receiver file.

File Browse — Select the location of the SPS receiver file.

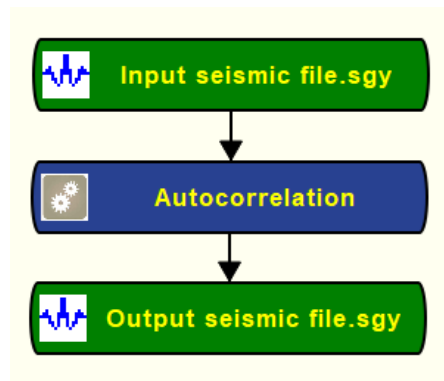
Autocorrelation

Usage: The Autocorrelation step computes a single trace autocorrelation for each input data trace. The autocorrelation trace will have the same length as the input trace, and the zero lag value can be shift in time if the user want to view both positive and negative lags.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Autocorrelation' and features a question mark icon and a close button (X) in the top right corner. It contains the following parameters:

- 'Autocorrelation window start (ms)' with a text input field containing '0.00'.
- 'Autocorrelation window length (ms)' with a text input field containing '1000.00'.
- An unchecked checkbox labeled 'Apply LMO to autocorrelation window start time'.
- 'Linear moveout velocity' with a text input field containing '2000.00'.

At the bottom, there are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Autocorrelation window start (ms) — Enter the start time in milliseconds for computing the trace autocorrelation.

Autocorrelation window length (ms) — Enter the length in milliseconds for computing the trace autocorrelation. The autocorrelation function will be generated from data samples between the start time and the start time + window length.

Apply LMO to autocorrelation window start time — If checked, the autocorrelation window start time will be a function of offset: $\text{Start time} = (\text{source} - \text{receiver offset} / \text{velocity}) + \text{Autocorrelation window start time}$.

Linear moveout velocity — Enter the linear moveout velocity.

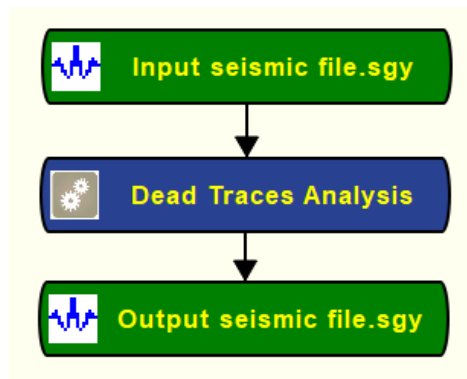
Dead Trace Analysis

Usage: The Dead Trace Analysis step allows to kill traces based on a user-defined trace header key word, and receiver lines or entire records based on the number and the relative location of dead traces.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Kill Traces Analysis

☐ Kill traces based on header values

None == Constant 0.00000

☐ Kill receiver lines based on adjacent dead trace limit

Receiver line adjacent dead trace limit 5

☐ Kill receiver lines based on percent of dead traces per line

Dead trace limit per receiver line (%) 10

☐ Kill entire records based on number of dead receiver lines

Dead receiver line limit 3

☐ Kill entire records based on percent of dead receiver lines

Dead receiver line limit per record (%) 20

☐ Kill entire records based on number of adjacent dead traces

Adjacent dead trace limit 5

☐ Kill entire records based on percent of dead traces per record

Dead trace limit per record (%) 10

☐ Display record kills report in separate window

OK Help Cancel

Parameter Description:

Kill traces based on header values — If checked, traces will be killed based on the value stored on a user-defined trace header key word. Traces can be killed after some mathematical operations are performed with the selected traces header key word.

Kill receiver lines based on adjacent dead trace limit — If checked, receiver lines will be killed depending on a limit of consecutive dead traces.

Receiver line adjacent dead trace limit — Enter the minimum number of consecutive dead traces a receiver line must have to be killed.

Kill receiver lines based on percent of dead trace per line — If checked, receiver lines will be killed depending on the percentage of dead traces.

Dead trace limit per receiver line (%) — Enter the minimum percentage of dead traces a receiver line must have to be killed.

Kill entire records based on number of dead receiver lines — If checked, records are killed depending on the number of dead receiver lines.

Dead receiver line limit per record (%) — Enter the minimum percentage of dead receiver lines a record must have to be killed.

Kill entire records based on number of adjacent traces — If checked, records are killed depending on a limit of consecutive dead traces.

Adjacent dead trace limit — Enter the minimum number of consecutive dead traces a record must have to be killed.

Kill entire records based on percent of dead traces per record — If checked, records are killed depending on the percentage of dead traces per record.

Dead trace limit per record (%) — Enter the minimum percentage of dead traces a record must have to be killed.

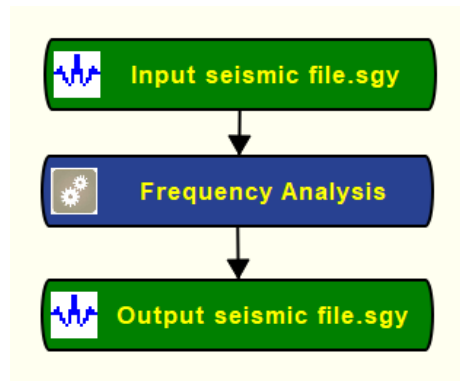
Frequency Analysis

Usage: The Frequency Analysis step computes frequency related seismic attributes in distinct time windows from an input seismic file. Seismic attributes may be compute from single or multi-channel. Available seismic attributes are dominant frequency, center frequency, average frequency, RMS frequency, bandwidth or peak amplitude. Computed attributes can be stored in

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Frequency Analysis". It contains three main sections: "Analysis type", "Attribute type", and "Time-space window".

Analysis type: Includes radio buttons for "Single-channel" (selected), "Single-channel average", and "Multi-channel".

Attribute type: Includes radio buttons for "Dominant frequency" (selected), "Center frequency", "Bandwidth", "Average frequency", "RMS frequency", and "Peak amplitude".

Time-space window: A table with columns: Window, Start(ms), Length (ms), Apply LMO, Velocity value, Limit offset, Minimum, Maximum, Absolute, and Output trace header.

Window	Start(ms)	Length (ms)	Apply LMO	Velocity value	Limit offset	Minimum	Maximum	Absolute	Output trace header
☒ 1	0	1000	☐ Apply	2000	☐ Limit	0	0	☐ Yes	User defined 1
☐ 2	1000	1000	☐ Apply	2000	☐ Limit	0	0	☐ Yes	User defined 2
☐ 3	2000	1000	☐ Apply	2000	☐ Limit	0	0	☐ Yes	User defined 3

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

The **Analysis Type** specifies if the analysis is to be performed in single- or multi-channel.

Single-channel — If selected, frequency analysis attribute will be computed on each single-channel of the current record.

Multi-channel — If selected, frequency analysis attribute will be computed on all the traces of the current record.

Single-channel average — Not yet available.

The **Attribute type** specifies the type of frequency attribute to be computed for the analysis.

Dominant frequency — If selected, computes the dominant frequency of the signal.

Center frequency — If selected, computes the center frequency of the signal.

Bandwidth — If selected, computes the bandwidth the signal.

Average frequency — If selected, computes the average frequency of the signal.

RMS frequency — If selected, computes the root mean square frequency of the signal.

Peak Amplitude — If selected, computes the peak amplitude of the signal.

The **Time space window** specifies the spatial/time extent where the calculation of the frequency attribute will be computed.

Window — Check how many windows will be used for the analysis. A maximum of three windows can be used.

Start (ms) — Enter the start time (upper boundary) in milliseconds where the calculation will be done.

Length (ms) — Enter the length of the time window in milliseconds where the calculation will be done.

Apply LMO — If checked a linear moveout (LMO) will be applied to the data before computing the analysis

Velocity value — Enter the velocity value to be used for the LMO correction.

Limit offset — If checked limit the selection of traces based on the offset.

Minimum — Enter the minimum offset where the calculation will be done.

Maximum — Enter the maximum offset where the calculation will be done.

Absolute — If checked uses the absolute value of the offset defined.

Output trace header — Select the trace header key word where the attribute calculation will be stored.

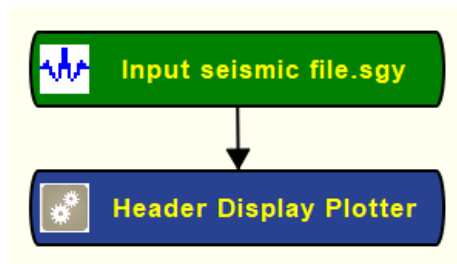
Header Display Plotter

Usage: The Header Display Plotter step creates a plot of a user-defined seismic trace header.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: N/A

Example Flowchart:



Step Parameter Dialog:


Header Display Plotter
?
×

Image Title

Header Plot

Horizontal Axis

FFID

Vertical Axis

Header Value

☐ Manual scale

☐ px per ffid/cmp

1

☐ Image Width (px)

1280

☐ Image Height (px)

800

☐ Manual Vertical labels

Min Value

0

Max Value

10

Vertical Ticks

1

☐ Acceptance Threshold

☐ Min Value

4

☐ Max Value

6

☐ Tolerance Threshold

☐ Min Value

3

☐ Max Value

7

Trace heder to plot

None

Trace heder for horizontal annotation

None

☒ Output image file inside JulianDay folder

☐ Sub-Folder

☐ Add suffix to the image file name

Suffix

☐ Output image file inside FileName folder

☒ Add timestamp to the image file name

Output Root Path

C:/

...

OK

Help

Cancel

Parameter Description:

Image Tile — Enter the image title.

Horizontal Axis — Enter horizontal axis label.

Vertical Axis — Enter vertical axis label.

Manual scale — If checked, the image scale is set manually.

px per ffid/cmp — If checked, enter the number of pixel per FFID or CMP.

Image Width (px) — If checked, enter the image width in number of pixels.

Image Height (px) — If checked, enter the image height in number of pixels.

Manual Vertical labels — If checked, set the vertical limits and number of ticks.

Min Value — If checked, enter the minimum vertical value.

Max Value — If checked, enter the maximum vertical value.

Vertical Ticks — If checked, enter the number of vertical ticks.

Acceptance threshold — If checked, set the limits for acceptance.

Min Value — If checked, enter the minimum acceptance threshold value.

Max Value — If checked, enter the maximum acceptance threshold value.

Tolerance threshold — If checked, set the tolerance threshold.

Min Value — If checked, enter the minimum tolerance threshold value.

Max Value — If checked, enter the maximum tolerance threshold value.

Trace header plot — Select the trace header to be plotted.

Trace header for horizontal annotation — Select the trace header for horizontal annotation.

Output image file inside JulianDay folder — If selected, creates and stores images in subfolders per Julian day.

Output image file inside FileName folder — If selected, creates a used-defined folder and stores images in that folder.

Add suffix to the image file name — If checked, enter the image file name suffix.

Add timestamp to the image file name — If checked, enter the timestamp to the image file name.

Output root path — Enter the root path where all images will be stored.

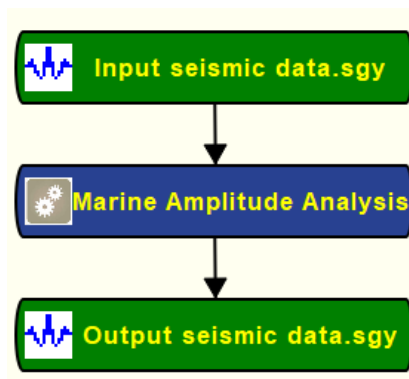
Marine Amplitude Analysis

Usage: The Marine Amplitude Analysis step automatically identifies the presence of bad traces given its amplitude content. The analysis can be performed vertically in multiple windows. A band-pass filter can be applied before the calculation but will not be stored in the output seismic file.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Marine Amplitude Analysis

Analysis Definitions

Header location for source number:

Number of sources:

Number of windows to use:

☐ Detailed console messages (** may cause failure on large files)

Filtering

☐ Apply low-cut filter

Low-cut corner frequency (Hz):

Low-cut rolloff rate (dB/oct):

☐ Apply high-cut filter

High-cut corner frequency (Hz):

High-cut rolloff rate (dB/oct):

Id	Amp. Threshold	Reject below	Start (ms)	Length (ms)	Apply LMO	Velocity value	Apply Shift	Shift	Limit range	Limit by	Minimum	Maximum	Output trace header
A	100000.0	☒	0.0	9.0	☒	1500.0	☒	2.0	☐	Rcv Loc	1	240	User defined 1

OK Help Cancel

Parameter Description:

The **Analysis Definitions** specifies the analysis parameterization.

Header location for source number — Select the trace header location that stores the source ID.

Number of sources — Enter the number of sources of the input data.

Number of windows to use — Enter the number of windows for the analysis.

Detailed console messages — If checked, writes in the command window information about the analysis. Depending on the parameterization this option might slow down the processing.

The **Filtering** specifies the bandpass filter parameters.

Apply low-cut filter — If checked applies to the input seismic file a zero-phase Butterworth filter to the input seismic data before computing the spectral semblance. The filter is only applied to the input file and not store in the output seismic file.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

ID — The unique identifier of the window where the analysis is performed.

Amp. Threshold — Enter the amplitude threshold to consider good/bad records.

Reject below — If checked, reject records with values below the Amp. Threshold.

Start (ms) — Enter the start time in milliseconds where the analysis will be done.

Length (ms) — Enter the window length in milliseconds where the analysis will be done.

Apply LMO — If checked, applies a linear moveout to the data before analysis.

Velocity value — Enter a constant velocity for the LMO calculation.

Apply shift — If checked, applies a bulk shift to the data before analysis.

Shift — Enter the constant shift to be applied.

Limit range — If checked, input data is limited by receiver location or offset.

Limit by — Select the domain where the data limit will happen.

Minimum — Enter the minimum value for limit.

Maximum — Enter the maximum value for limit.

Output trace header — Select the trace header location where the analysis value for that window will be stored.

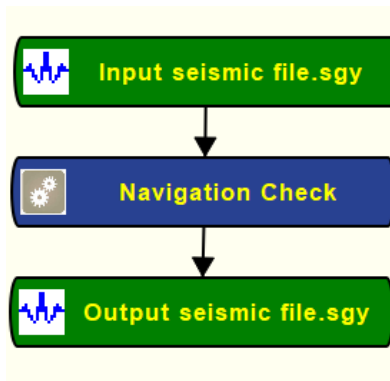
Navigation Check

Usage: The Navigation Check step checks theoretical geometry acquisition against the actual data. The step outputs images of data versus model for quality control.

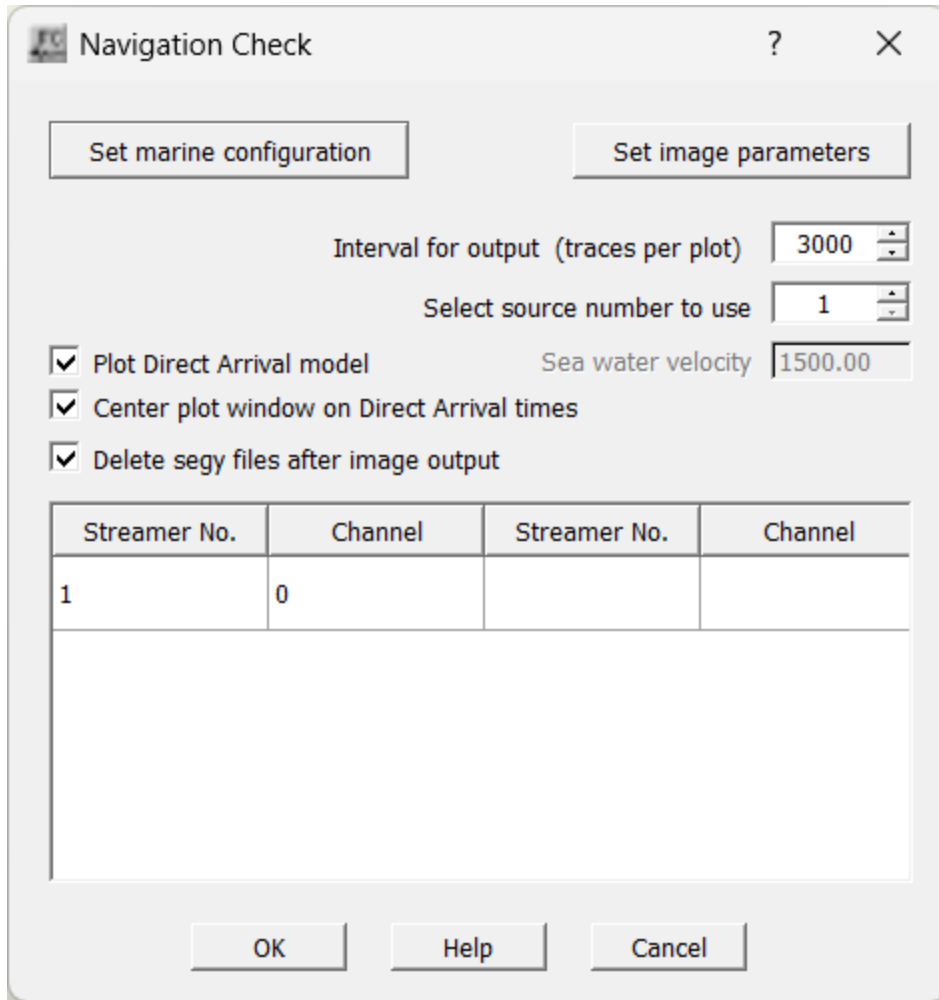
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The dialog box is titled "Navigation Check" and contains several configuration options. At the top, there are two buttons: "Set marine configuration" and "Set image parameters". Below these, there are three input fields: "Interval for output (traces per plot)" set to 3000, "Select source number to use" set to 1, and "Sea water velocity" set to 1500.00. There are three checked checkboxes: "Plot Direct Arrival model", "Center plot window on Direct Arrival times", and "Delete segy files after image output". At the bottom, there is a table with four columns: "Streamer No.", "Channel", "Streamer No.", and "Channel". The first row contains the values 1 and 0. Below the table are three buttons: "OK", "Help", and "Cancel".

Navigation Check

Set marine configuration Set image parameters

Interval for output (traces per plot) 3000

Select source number to use 1

Sea water velocity 1500.00

☒ Plot Direct Arrival model

☒ Center plot window on Direct Arrival times

☒ Delete segy files after image output

Streamer No.	Channel	Streamer No.	Channel
1	0		

OK Help Cancel

Parameter Description:

Set marine configuration — Select to set the marine acquisition geometry configuration.

Set image parameters — Select to set the output image parameters.

Interval for output (traces per plot) — Enter maximum number of traces per plot.

Select source number to use — Enter the number of sources to use.

Plot direct arrival model — If checked, plots predicted direct arrivals given a model.

Center plot window on Direct Arrival times — If checked, output plots are centered at predicted direct arrivals.

Delete segy files after image output — If checked, output SEG-Y files are not stored.

Streamer No. — Enter the minimum streamer number.

Channel — Enter the minimum channel number.

Streamer No. — Enter the maximum streamer number.

Channel — Enter the maximum channel number.

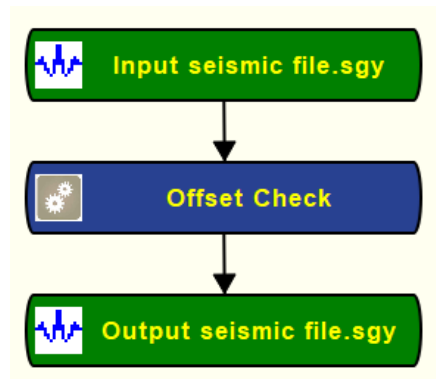
Offset Check

Usage: The Offset Check step plots the direct arrival given an acquisition geometry for quality control of the acquired data.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Offset Check

Set marine configuration Set image parameters

☒ Delete segy files after image output

☒ Output at start of line

☒ Output at interval in line Interval (field files) 1000

Number of shots per output 20

Select source number to use 1

☐ Flatten output using seabed picks

☒ Select input picks header User defined 7

Seabed nominal time (ms.) 20

☒ Linear Moveout Bulk Shift 0

Velocity 1500

OK Help Cancel

Parameter Description:

Set marine configuration — Select to set the marine acquisition geometry configuration.

Set image parameters — Select to set the output image parameters.

Delete segy files after image output — If checked, output SEG-Y files are not stored.

Output at start of line — If checked, generates a new plot at each start of line.

Output at interval in line — If checked, outputs at nth field file.

Interval (field files) — Enter field file interval used for plotting.

Number of shots per output — Enter the number of shots per output.

Select source number to use — Enter the number of sources to use.

Flatten output using seabed picks — If checked, the output considers a flatten seabed given its picks.

Select input picks header — If checked, select trace header location with seabed picks.

Seabed nominal time (ms.) — Enter the average nominal seabed time.

Linear Moveout — If checked, applied a linear moveout before calculation.

Bulk shift — Enter the bulk shift of the data before calculating the linear moveout.

Velocity — Enter the constant velocity to use in the linear moveout.

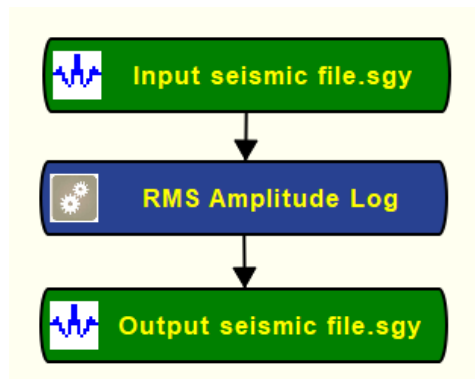
RMS Amplitude Log

Usage: The RMS Amplitude log step exports a text log file with the RMS amplitude values of the input seismic data within a vertical time window that can be scaled by an amplitude scalar.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'RMS Amplitude Log' with standard window controls (minimize, maximize, close). The dialog is organized into three sections:

- Analysis Time window:** Contains two checkboxes, 'Set Start Time' and 'Set Stop Time', each followed by a text input field. Both fields currently contain the value '0'.
- Amplitude Scalar:** Contains a checkbox 'Set Amplitude Scalar' followed by a text input field containing the value '0'.
- Log File:** Contains a text input field for the file path and a button with three dots (a file selection button).

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

The **Analysis Time window** specifies the start and end time of the window where the RMS amplitudes are calculated.

Set Start Time — If checked, enter the window start time.

Set Stop Time — If checked, enter the window end time.

The **Amplitude Scalar** specifies the amplitude scalar used for the calculation.

Set Amplitude Scalar — Enter the amplitude scalar used for the RMS amplitude calculation.

The **Log file** specifies the log file to be used.

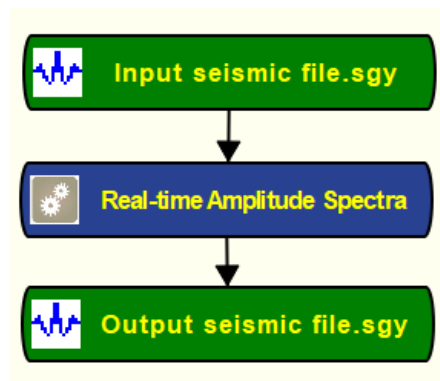
Real-time Amplitude Spectra

Usage: The Real-time Amplitude Spectra step computes amplitude spectra in real-time from the input seismic data and exports the corresponding images.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real-time amplitude spectra

?

×

Amplitude spectra

Source ID

Select source ID header location

User defined 9

Analysis window

☐ Change start analysis time

Time (ms)

0

☐ Change end analysis time

Time (ms)

0

☐ Limit by a trace header

None

Min

0

Max

0

Filtering

☐ Apply low-cut filter

Low-cut corner frequency (Hz)

9

Low-cut rolloff rate (dB/oct)

18

☐ Apply high-cut filter

High-cut corner frequency (Hz)

72

High-cut rolloff rate (dB/oct)

18

Remove DC bias

☐ Use remove DC bias filter

DC calculation method

☐ Mean

☒ Median

☐ (Min+Max)/2

Decimate - calculate and store every N(th) record

1000

☐ Display in real time

OK

Help

Cancel

Parameter Description:

The **Amplitude spectra** specifies the amplitude spectra calculation parameters.

The **Source ID** specifies the source identifier to be used.

Select source ID header location — Select the trace header location where the source identification is stored.

The **Analysis window** parameterize the window where the analysis will happen.

Change start analysis time — If checked, enters the start time of the analysis window.

Time (ms) — Enter the start time in milliseconds of the analysis window.

Change end analysis time — If checked, enters the end time in milliseconds of the analysis window.

Time (ms) — Enter the end time of the analysis window.

Limit by a trace header — If checked, limits the input data given a seismic trace header and user-defined parameters.

Min — Enter the minimum value stored in the trace header location to limit the input data.

Max — Enter the maximum value stored in the trace header location to limit the input data.

The **Filtering** specifies the bandpass filter parameters.

Apply low-cut filter — If checked applies to the input seismic file a zero-phase Butterworth filter to the input seismic data before computing the spectral semblance. The filter is only applied to the input file and not store in the output seismic file.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

The **Remove DC bias** specifies if a DC remove bias filter will be applied to the input seismic file before computing the spectral semblance.

Use remove DC bias filter — If checked, applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the amplitude spectra.

The **DC calculation method** specifies the method to estimate the DC bias.

Mean — If selected, estimates the DC bias as the mean of the seismic samples considered.

Median — If selected, estimates the DC bias as the median of the seismic samples considered.

(Min+Max)/2 — If selected, estimates the DC bias as central value between the min and max of the seismic samples considered.

Decimate – calculate and store every N(th) record — Enter the record interval used to generate a plot.

Display in real time — If checked, display amplitude spectra in real time.

Signal to Noise

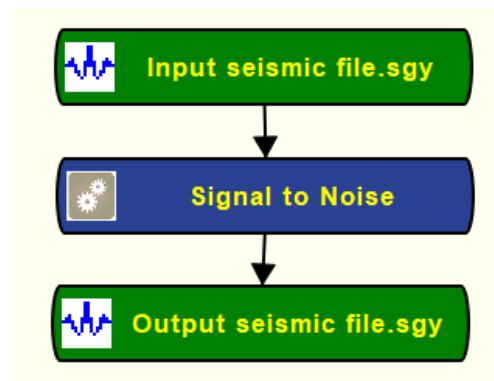
Usage: The Signal to Noise step provides a statistical estimate of the signal to noise ratio of the selected seismic data. The results of the process are output into a user-defined trace header key word.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Hatton, L., Worthington, M.H. and Makin, J. 1986, Seismic Data Processing, Theory and Practice.

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Signal to Noise' and features a standard Windows-style interface with a question mark icon and a close button (X). It contains three input fields: 'Window start time (ms)' with a value of '0.0', 'Window length in samples' with a value of '200', and 'Output Header' with a dropdown menu currently showing 'OWT'. At the bottom, there are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Window start time (ms) — Enter the starting time of the analysis window on the trace data.

Window length in samples — Enter the length of the analysis window in samples.

Output Header — Select the trace header field to store the results of the signal to noise calculation.

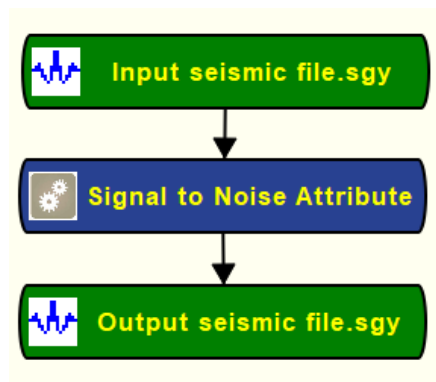
Signal to Noise Attribute

Usage: The Signal to Noise Attribute step provides a statistical estimate of the signal to noise ratio of the selected seismic data based on different metrics (average power, average RMS and average absolute) considering user-defined distinct signal and noise windows within the seismic data. The results of the process are output to user defined trace header locations and records can be automatically flagged depending on the computed attribute value.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data in any sort order corresponding to a noise record (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

S/N Attribute

Parameterization method

☒ **Specify windows**

Signal window start time (ms) Signal window minimum channel group
Signal window end time (ms) Signal window maximum channel group
Noise window start time (ms) Noise window minimum channel group
Noise window end time (ms) Noise window maximum channel group

☐ **Use auxiliary noise rec**

Signal window start time (ms) Signal window minimum channel group
Signal window end time (ms) Signal window maximum channel group

☐ **Compare S/N ratio in the frequency domain**

% of overlapping area Minimum frequency (Hz)
Maximum frequency (Hz)
Signal window start time (ms) Signal window minimum channel group
Signal window end time (ms) Signal window maximum channel group
Noise window start time (ms) Noise window minimum channel group
Noise window end time (ms) Noise window maximum channel group

☐ **Specify velocity**

Reference velocity
Signal window start time below velocity (ms) Signal window end time below velocity (ms)
Signal window length (ms) Noise window length (ms)
Signal window minimum channel group Signal window maximum channel group
Noise window minimum channel group Noise window maximum channel group

Output headers

Top mute length (ms) Bottom mute length (ms)
Minimum S/N ratio
Output average power header Output average power Flag
Output average RMS header Output average RMS Flag
Output average absolute header Output average absolute Flag

Calculation method

☒ **Record basis** ☐ Change noise window at each record
☐ **Trace by trace**

Report file

File Browse...
☐ Append to existing file

OK Help Cancel

Parameter Description:

The **Parameterization method** specifies the space/time extent of signal and noise windows.

Specify windows — If selected, specify signal and noise windows manually by defining start and end time interval and minimum and maximum channel group considered for the calculation. These windows will be fixed for all the records in the input seismic file.

Signal window start time (ms) — Enter the signal window start time (upper boundary) in milliseconds.

Signal window end time (ms) — Enter the signal window end time (lower boundary) in milliseconds.

Signal window minimum channel group — Enter the minimum channel to be considered in the signal window.

Signal window maximum channel group — Enter the maximum channel to be considered in the signal window.

Noise window start time (ms) — Enter the noise window start time (upper boundary) in milliseconds.

Noise window end time (ms) — Enter the noise window end time (lower boundary) in milliseconds.

Noise window minimum channel group — Enter the minimum channel to be considered in the noise window.

Noise window maximum channel group — Enter the maximum channel to be considered in the noise window.

Use auxiliary noise record — If selected, the noise window is computed from an auxiliary seismic file containing a single noise record. Signal window is defined manually and fixed for all input records.

Signal window start time (ms) — Enter the signal window start time (upper boundary) in milliseconds.

Signal window end time (ms) — Enter the signal window end time (lower boundary) in milliseconds.

Signal window minimum channel group — Enter the minimum channel to be considered in the signal window.

Signal window maximum channel group — Enter the maximum channel to be considered in the signal window.

Compare S/N ratio in the frequency domain — If selected, the signal-to-noise ratio is estimated from the overlap between the amplitude spectra of signal and noise windows.

% of overlapping area — Enter the percentage of overlapping area of frequency spectra where the estimate is going to be computed.

Minimum frequency (Hz) — Enter the minimum frequency in hertz of the spectra to be considered for the estimate.

Maximum frequency (Hz) — Enter the maximum frequency in hertz of the spectra to be considered for the estimate.

Signal window start time (ms) — Enter the signal window start time (upper boundary) in milliseconds.

Signal window end time (ms) — Enter the signal window end time (lower boundary) in milliseconds.

Signal window minimum channel group — Enter the minimum channel to be considered in the signal window.

Signal window maximum channel group — Enter the maximum channel to be considered in the signal window.

Noise window start time (ms) — Enter the noise window start time (upper boundary) in milliseconds.

Noise window end time (ms) — Enter the noise window end time (lower boundary) in milliseconds.

Specify velocity — If selected, signal and noise windows are defined based on a reference velocity varying linearly with the offset.

Reference velocity — Enter a reference velocity to be used to define the location of the start time of the signal and noise windows.

Signal window start time below velocity (ms) — Enter the start time in milliseconds below the initial time computed from the reference velocity

Signal window length (ms) — Enter the signal window length in milliseconds

Signal window minimum channel group — Enter the minimum channel to be considered in the signal window.

Signal window maximum channel group — Enter the maximum channel to be considered in the signal window.

Noise window start time below velocity (ms) — Enter the start time in milliseconds below the initial time computed from the reference velocity

Noise window length (ms) — Enter the signal window length in milliseconds

Noise window minimum channel group — Enter the minimum channel to be considered in the noise window.

Noise window maximum channel group — Enter the maximum channel to be considered in the noise window.

The **Calculation method** specifies how if the signal to noise ratio is computed either on a record or trace-by-trace basis.

Record basis — If selected, estimate is based on the current record as a whole.

Trace by trace — If selected, the estimate is based on a trace-by-trace calculation.

Change noise window at each record — If checked, the noise window changes at each record. If unchecked, noise window changes at each record.

The **Output headers** specifies the location of the trace header key words where the attribute will be stored.

Top mute length (ms) — Enter the length of the top mute to be applied to both windows.

Bottom mute length (ms) — Enter the length of the bottom mute to be applied to both windows.

Minimum S/N ratio — Enter the minimum signal-to-noise ratio for a record to be considered bad.

Output average power header — Select the trace header location where the signal-to-noise ratio computed using the average power will be stored.

Output average power flag — Select the trace header location where the record flag based on the signal-to-noise ratio computed using the average power will be stored.

Output average RMS header — Select the trace header location where the signal-to-noise ratio computed using the average RMS will be stored.

Output average RMS flag — Select the trace header location where the record flag based on the signal-to-noise ratio computed using the average RMS will be stored.

Output average absolute header — Select the trace header location where the signal-to-noise ratio computed using the average absolute will be stored.

Output average absolute flag — Select the trace header location where the record flag based on the signal-to-noise ratio computed using the average RMS will be stored.

Report file — Specify whether to save results to a report file and browse to locate or create an amplitude analysis report file.

Append to existing file — If checked, append report to existing report file.

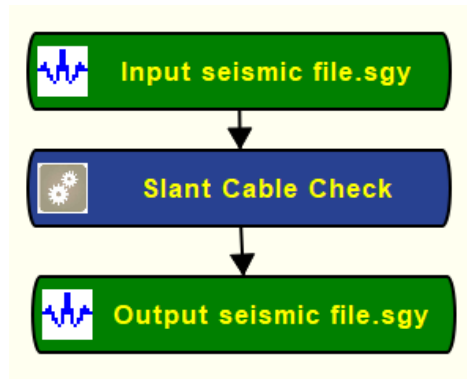
Slant Cable Check

Usage: The Slant Cable Check step writes output images for slant cable quality analysis.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Slant Cable Check' dialog box features a title bar with a question mark and a close button. It contains two tabs: 'Set marine configuration' and 'Set image parameters'. Under the 'Set image parameters' tab, there are several options: three checked checkboxes for 'Delete segy files after image output', 'Output at start of line', and 'Output at interval in line'; three numeric spinners for 'Interval (field files)' (1000), 'Number of shots per output' (20), and 'Select source number to use' (1); an unchecked checkbox for 'Flatten output using seabed picks'; a checked checkbox for 'Select input picks header' with a dropdown menu showing 'User defined 7'; and a numeric spinner for 'Seabed nominal time (ms.)' (20). At the bottom are 'OK', 'Help', and 'Cancel' buttons.

Parameter	Value
Delete segy files after image output	☒
Output at start of line	☒
Output at interval in line	☒
Interval (field files)	1000
Number of shots per output	20
Select source number to use	1
Flatten output using seabed picks	☐
Select input picks header	☒ User defined 7
Seabed nominal time (ms.)	20

Parameter Description:

Set marine configuration — Select to set the marine acquisition geometry configuration.

Set image parameters — Select to set the output image parameters.

Delete segy files after image output — If checked, output SEG-Y files are not stored.

Output at start of line — If checked, generates a new plot at each start of line.

Output at interval in line — If checked, outputs at nth field file.

Interval (field files) — Enter field file interval used for plotting.

Number of shots per output — Enter the number of shots per output image file.

Select source number to use — Enter the number of sources to use.

Flatten output using seabed picks — If checked, the output considers a flatten seabed given its picks.

Select input picks header — If checked, select trace header location with seabed picks.

Seabed nominal time (ms.) — Enter the average nominal seabed time in milliseconds.

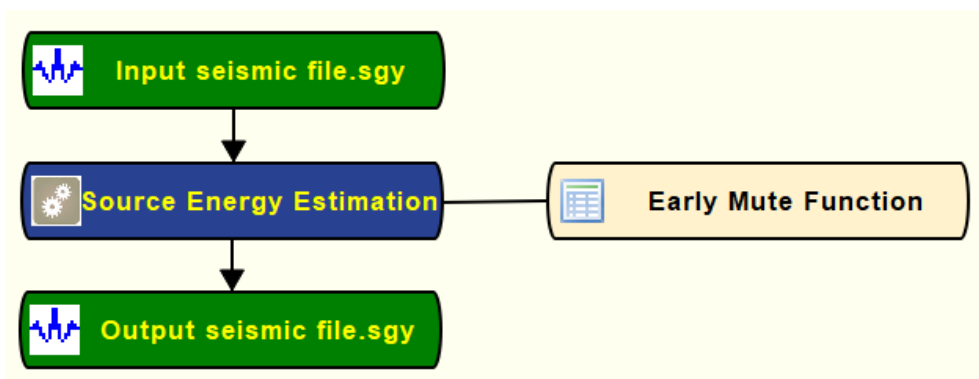
Source Energy Estimation

Usage: The Source Energy Estimation step computes an estimate of the source energy-to-noise ratio based on an analysis of samples values prior to and following the arrival of first break energy. A text file is output that contains, for each source location, an estimate of (1) the energy-to-noise ratio, (2) the average energy, and (3) the average noise

Input Links: 1) Seismic data in source order (mandatory); 2) An Early Mute card containing reference times to the start of analysis. Typically, these would be picked at the time of the first arrivals. (mandatory).

Output Links: 1) Seismic data in source order (mandatory).

Example Flowchart:



Step Parameter Dialog:

fcsourceenergyestimation

Noise window specification

Start time above mute (ms) 100.0

Window length in samples 32

Data window specification

Start time below mute (ms) 100.0

Window length in samples 32

Offset window specification

First offset in window 0.000

Last offset in window 000.000

Output header None

Report file

Browse... entation/Report/SourceEnergyEstimationReport.txt

☐ Display report in separate window

OK Help Cancel

Parameter Description:

The **Noise window specification** specifies the window for the analysis of noise.

Start Time above mute (ms) — Enter the time above the mute to start the analysis.

Window length in samples — Enter the number of samples used to determine the noise estimate.

The **Data window specification** specifies the window for the analysis of noise.

Start time below mute (ms) — Enter the time above the mute to start the analysis.

Window length in samples — Enter the number of samples used to determine the signal estimate.

The **Offset window specification** specifies the window in terms of offset for the analysis of noise.

First offset window — Enter the first offset where the noise analysis will be done.

Last offset window — Enter the last offset where the noise analysis will be done.

Output Header — Indicate the trace header field to store the results of the source-energy estimate.

The **Report file** specifies file name path for the report.

Browse — Specify the name of the text file (*.txt) that will contain the results of the analysis.

Display report in separate window — If checked, report file is automatically shown in a separate window.

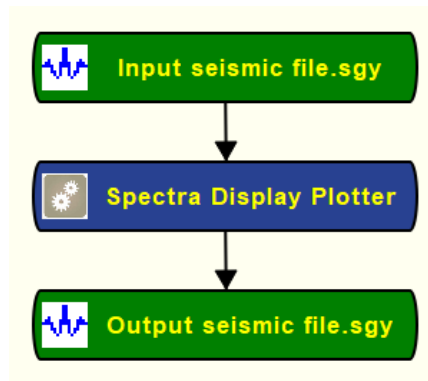
Spectra Display Plotter

Usage: The Spectra Display Plotter step plots in real-time amplitude spectra computed from the input seismic file.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the 'Spectra Plotter' dialog box with the following settings:

- ☐ Start time limit (ms): 0
- ☐ End time limit (ms): 0
- ☐ Min offset limit (m): 0
- ☐ Max offset limit (m): 0
- ☐ Use remove DC bias filter
- ☐ Apply low-cut filter
 - Low-cut corner frequency (Hz): 9
 - Low-cut rolloff rate (dB/oct): 18
- ☐ Apply high-cut filter
 - High-cut corner frequency (Hz): 72
 - High-cut rolloff rate (dB/oct): 18
- ☐ Smooth the spectra - window size: 0
- ☐ Plot a trace a header value next to the title: None
- ☒ Fixed Scale
 - ☒ Power Spectra
 - Reference Amplitude: 1
 - Minimul value: 0
 - Maximum value: 100
 - Vertical Ticks: 20
 - ☐ Aplitude Spectra
- ☐ Power Spectra - Max dB Down
 - Maximum dB level: 0.00

Buttons: OK, Help, Cancel

Parameter Description:

Start time limit (ms) — If checked, enter the starting limit of the vertical time extent of the input data to be considered.

End time limit (ms) — If checked, enter the end limit of the vertical time extent of the input data to be considered.

Min offset limit (ms) — If checked, enter the minimum offset of the input data to be considered.

Max offset limit (ms) — If checked, enter the maximum offset of the input data to be considered.

Use remove DC bias filter — If checked, applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the spectra.

Apply low-cut filter — If checked applies to the input seismic file a zero-phase Butterworth filter to the input seismic data before computing the spectral semblance. The filter is only applied to the input file and not store in the output seismic file.

Low-cut corner frequency (Hz) — Enter the low half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

Low-cut rolloff rate (dB/oct) — Enter the low rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Apply high-cut filter — If checked, a high-cut filter will be applied to the seismic data.

High-cut corner frequency (Hz) — Enter the high half-power frequency in Hertz to be applied to the seismic data. The amplitude of this frequency will be reduced by a factor of two relative to the input.

High-cut rolloff rate (dB/oct) — Enter the high rolloff filter slope in decibels per octave to be applied to the seismic data. Higher numbers give steeper rolloff.

Smooth the spectra – window size — If checked, enter the window size to smooth the computed spectra.

Plot a trace header value next to the title — If checked, plots a user-defined seismic trace header value next to the plot.

Fixed scale — If selected, all plots will have the same vertical scale.

Power spectra — If selected, computes and plots power spectra.

Amplitude spectra — If selected, computes and plots amplitude spectra.

Reference Amplitude — Enter the reference amplitude for the plot.

Minimum value — Enter the minimum value for the vertical axis of the plot.

Maximum value — Enter the maximum value for the vertical axis of the plot.

Vertical ticks — Enter the number of vertical ticks in the plot.

Power spectra – Max dB Down — If selected, all plots will be scaled to a maximum dB level.

Maximum dB level — Enter the reference dB level for plotting.

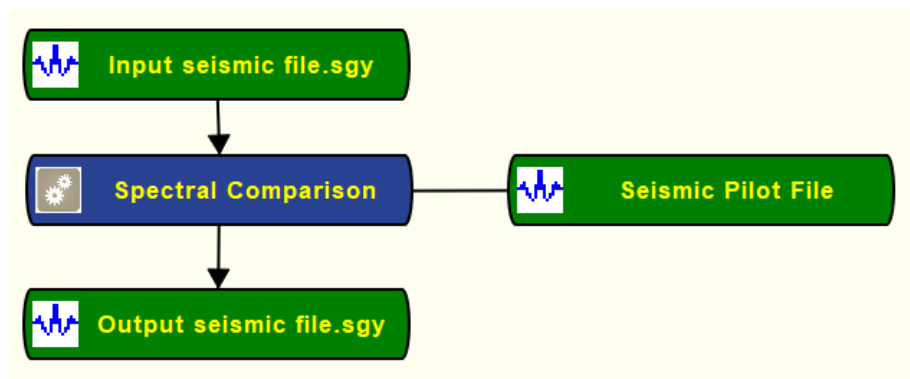
Spectral Comparison

Usage: The Spectral Comparison step computes the spectral semblance between an input seismic and a reference seismic trace as selected from the input record or from an auxiliary seismic file with a pilot signature. The comparison against a pilot signature can be done based on a user-defined trace header location. Traces are flagged as bad or good depending on the value of semblance.

Input Links: 1) Seismic data in source order (mandatory); 2) An auxiliary seismic file with a signature can be used for the comparison (optional).

Output Links: 1) Seismic data in source order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Spectral Comparison

Signature comparison input

- ☒ One signature per dataset from auxiliary seismic file
- ☐ One signature per record from input data file
Input channel number
- ☐ Match signature based on trace header
Header for source ID
Start time for signature analysis (ms)
End time for signature analysis (ms)

☐ Use remove DC bias filter

DC calculation method

- ☐ Mean
- ☒ Median
- ☐ (Min+Max)/2

Header for source ID

Output header for quality flag

Range limit comparison frequencies

Low frequency limit (Hz)
High frequency limit (Hz)

Analysis window

- ☐ Use header for start time (ms)
- ☒ Fixed start time analysis (ms)
Define window size (ms)

Spectral semblance cutoff (percent)

☒ Use spherical divergence

Time multiplier
Time exponent

Output header for spectral semblance

OK Help Cancel

Parameter Description:

The **Signature comparison input** specifies the signature to be used for comparison.

One signature per dataset from auxiliary seismic file — If selected, signature is defined by the first trace of the auxiliary pilot seismic file.

One signature per record from input data file — If selected, the signature is defined by the channel number of the input record from input seismic file.

Input channel number — Enter the channel number to be used as signature.

Match signature based on trace header — If selected, signature is from auxiliary pilot file and matched against current record based on the value of a user-defined trace header location.

Header for source ID — Select the location of the seismic trace header to be used as reference between signature and input seismic file.

Start time for signature analysis (ms) — Enter the start time (upper boundary) in milliseconds of the time window for the signature analysis.

End time for signature analysis (ms) — Enter the end time (lower boundary) in milliseconds of the time window for the signature analysis.

The **Remove DC bias** specifies if a DC remove bias filter will be applied to the input seismic file before computing the spectral semblance.

Use remove DC bias filter — If checked, applies a Remove DC bias step to the input seismic file. The filter is not store in the output seismic file, it is only applied before the calculations of the spectral semblance.

The **DC calculation method** select the method to estimate the DC bias.

Mean — If selected, estimates the DC bias as the mean of the seismic samples considered.

Median — If selected, estimates the DC bias as the median of the seismic samples considered.

(Min+Max)/2 — If selected, estimates the DC bias as central value between the min and max of the seismic samples considered.

Header for source ID — Enter the trace header location with the source ID.

The **Range limit comparison frequencies** specifies the frequencies range limits to be used for comparison.

Low frequency limit (Hz) — Define the low frequency limit to comparison, in Hertz.

High frequency limit (Hz) — Define the high frequency limit to comparison, in Hertz.

The **Analysis window** specifies the parameters of the window to be used in the comparison.

Use header for start time (ms) — Define the start time from the header in milliseconds.

Fixed start time analysis (ms) — Define a fixed start time for the analysis, in milliseconds.

Define window size (ms) — Define the window size in milliseconds.

Spectral semblance cutoff (percent) — Enter the semblance cutoff value in percentage to distinguish between good and bad traces.

Use spherical divergence — If checked, apply a spherical divergence in spectral comparison.

Time multiplier — Define a time multiplier for the spherical divergence.

Time exponent — Define a time exponent for the spherical divergence.

Output header for quality flag — Specify the output header for the quality flag.

Output header for spectral semblance — Specify the output header for the spectral semblance.

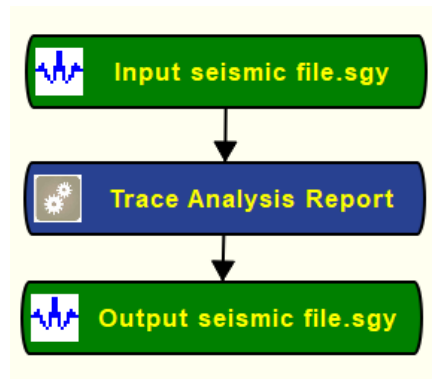
Trace Analysis Report

Usage: The Trace Analysis Report creates a text file that contains list bad records, and optionally, a list of traces that were killed in the geometry application step.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in source order (mandatory).

Example Flowchart:



Step Parameter Dialog:

 Trace Analysis Report ? ×

☒ Report traces killed by Geometry Definition step

☒ Report traces killed by Processing steps

☐ Use Geometry Definition dead traces in analysis

☒ Report bad records based on number of adjacent dead traces

Adjacent dead trace limit

☒ Report bad records based on number of dead traces per record

Dead trace limit per record (%)

☒ Report records killed by prior processes

☒ Kill bad records

Audio alarm

☐ Sound audio alarm for each bad record

Low  High

Alarm volume

 Volume test

Alarm Browse...

Report file

File Browse...

☐ Send file via ftp ☒ Append to existing file

☐ Display report in separate window

Parameter Description:

Report traces killed by Geometry Definition step — If checked, traces killed by a previous Geometry Definition step will be reported.

Report traces killed by processing steps — If checked, report traces killed by processing steps.

Use Geometry Definition dead traces in analysis — If checked, dead traces from Geometry Definition will be included in the analysis.

Report bad records based on adjacent dead traces — If checked, bad records are to be identified according to the number of adjacent dead traces.

Adjacent dead trace limit — Enter the number of adjacent dead traces that will cause the record to be considered “bad”, and therefore listed in the trace analysis report.

Report bad records based on number of dead traces per record — If checked, bad records are to be identified according to the number of adjacent dead traces.

Dead trace limit per record (%) — Enter the maximum percentage of dead traces that will cause the record to be considered “bad”, and therefore listed in the trace analysis report.

Report records killed by prior process — If checked, traces killed by previous steps, e.g. by geometry definition, will be included in the report.

Kill bad records — If checked, bad records are killed from the input seismic file.

The **Audio alarm** specifies alarm depending on the number of traces flagged as bad traces.

Sound audio alarm for each bad record — If checked, select the audio alarm for each bad record.

Alarm volume — Use slider to define the alarm volume.

Alarm browse... — Select an audio file to be used as alarm.

The **Report file** specifies whether to save results to a report file and browse to locate or create an amplitude analysis report file.

Send file via ftp — If checked, send a file via ftp.

Append to existing file — If checked, append report to existing report file.

Seismic Data Steps

This section documents the seismic data types in SPW and the processes currently available for creating those data types.

Seismic Data	
↑	Processing Categories
	Create Model Data
	Frequency Cubes
	Frequency Gathers
	Frequency Maps
	GeoNet Seismic Input
	Initialize 3D Vsp Cmp Data File
	Initialize Cmp Stack Data
	Intermediate Seismic Output
	MultiTrace 1GB Input
	MultiTrace Input
	Real Time Seismic Input
	Real Time TCP Seismic
	Rotate Volume
	SEG2 Export
	SEG2 Import
	SEGD Import
	SEGY Export
	SEGY Field Files Export
	SEGY Field Files Import
	SEGY Import
	Seismic File
	Select Traces
	Update SEGY Textheader
	Virtual Tape Input

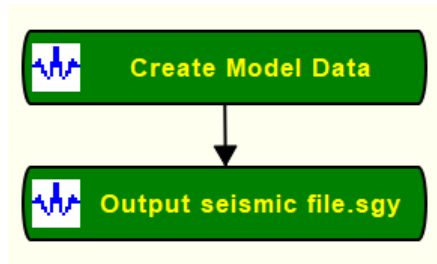
Create Model Data

Usage: The Create Model Data step is a utility for testing purposes. The step allows to create synthetic data with specific number of events per record, the wavelet type, the number of records, the number of traces per record, the sample interval, the trace length, record and trace labeling parameters, and wavelet parameters for setting filtering frequencies.

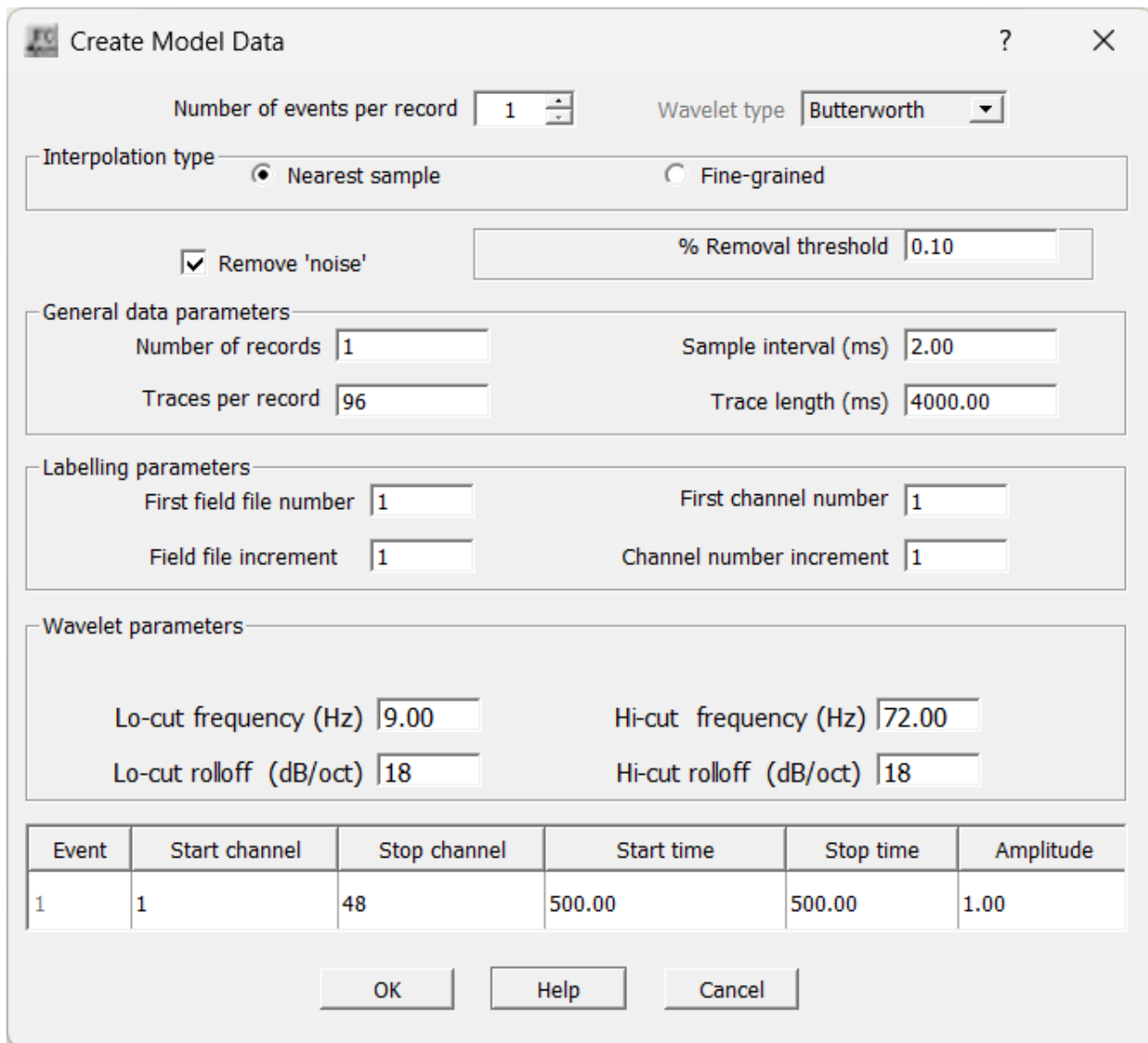
Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The dialog box is titled "Create Model Data" and contains several sections for configuring data parameters. At the top, there are fields for "Number of events per record" (set to 1) and "Wavelet type" (set to Butterworth). Below these is a section for "Interpolation type" with two radio buttons: "Nearest sample" (selected) and "Fine-grained". A checkbox labeled "Remove 'noise'" is checked, and next to it is a field for "% Removal threshold" (set to 0.10). The "General data parameters" section includes fields for "Number of records" (1), "Traces per record" (96), "Sample interval (ms)" (2.00), and "Trace length (ms)" (4000.00). The "Labelling parameters" section includes fields for "First field file number" (1), "Field file increment" (1), "First channel number" (1), and "Channel number increment" (1). The "Wavelet parameters" section includes fields for "Lo-cut frequency (Hz)" (9.00), "Lo-cut rolloff (dB/oct)" (18), "Hi-cut frequency (Hz)" (72.00), and "Hi-cut rolloff (dB/oct)" (18). At the bottom, there is a table with 6 columns: Event, Start channel, Stop channel, Start time, Stop time, and Amplitude. The table contains one row with the following values: 1, 1, 48, 500.00, 500.00, and 1.00. At the very bottom are three buttons: OK, Help, and Cancel.

Event	Start channel	Stop channel	Start time	Stop time	Amplitude
1	1	48	500.00	500.00	1.00

Parameter Description:

Number of events per record — Enter the number of events per record to create.

Wavelet type — Select the wavelet type to use.

The **Interpolation type** specify the interpolation to create the model.

Nearest sample — If selected, apply the nearest sample interpolation method. In this method the event time for any trace is placed at the nearest sample.

Fine-grained — If selected, apply the fine-grained interpolation method. In this method the the event times for each trace are placed at the correct times. but there

could be slight changes in the waveform and amplitudes from trace to trace if an event is dipping

Remove 'noise' — If checked, remove noise before creating the model.

% Removal threshold — Select the percentage of 'noise' to be removed.

The **General data parameters** specify the general data parameters.

Number of records — Enter the number of data records.

Traces per record — Enter the number of traces per record.

Sample interval (ms) — Enter the sample interval of the traces in milliseconds.

Trace length (ms) — Enter the trace length in milliseconds.

The **Labelling parameters** specify labelling parameters for field files and channels.

First field file number — Enter the first field file number.

Field file increment — Enter the field file increment number.

First channel number — Enter the first channel number.

Channel number increment — Enter the channel number increment.

The **Wavelet parameters** specify wavelet parameters.

Lo-cut frequency (Hz) — Enter the low-cut filter frequency in Hertz.

Lo-cut rolloff (dB/oct) — Enter the low-cut rolloff filter in decibels per octave.

Hi-pass frequency (Hz) — Enter the high-pass filter frequency in Hertz.

Hi-cut rolloff (dB/oct) — Enter the high-cut rolloff filter in decibels per octave.

Event — Event index number.

Start channel — Enter the first channel number to define the beginning of the seismic event.

Stop channel — Enter the last channel number to define the end of the seismic event I.

Start time — Enter the start time to define the beginning of the seismic event.

Stop time — Enter the end time to define the end of the seismic event.

Amplitude — Enter the amplitude of the event.

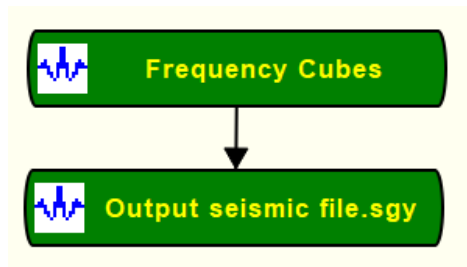
Frequency Cubes

Usage: The Frequency Cubes step computes frequency volumes from input seismic of SEG-Y files at specific frequencies. The output cubes are generated at specific frequencies inferred directly from the input seismic file or at user-defined frequencies. The output frequency volumes can also be sorted using user-defined sort order.

Input Links: None.

Output Links: 1) Seismic data in selected processing sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Frequency Cubes

Seismic file

Root file name: **File Browse...**

SEG-Y format

Format name: **Format Browse...**

Create new SEG-Y format **View existing SEG-Y format**

SEG-Y index

Customize Index Map **View trace headers** **View trace header map** **Save headers to a file**

General dataset properties

Number of frequency cubes		Sample format	
Number of traces per cube		Sample interval	
First output frequency		Samples per trace	
Last output frequency		Start time (ms)	
Output frequency increment		End time (ms)	

Processing sort order

		Range limit	Minimum value	Maximum value
Primary sort key	CMP line	☐		
Secondary sort key	CMP location	☐		
Tertiary sort key	None	☐		
Quaternary sort key	None	☐		
Create record at	Last trace			

OK **Help** **Cancel**

Parameter Description:

The **Seismic file** specifies the location of the input seismic or SEG-Y file.

Root file Browse... — Select the input root file name. All the files sharing the same root name will be used as input.

The **SEG-Y format** specifies the input SEG-Y format.

Format Browse... — Select saved SEG-Y format. Browse for format file.

Create new SEG-Y format — Select to create a new SEG-Y format.

View existing SEG-Y format — Select to view current SEG-Y format.

The **SEG-Y index** specifies SEG-Y index parameters. If needed index file parameterization may be changed here.

Customize Index Map — Select to customize the index map of the input SEG-Y file.

View trace headers — Select to view the trace headers of the input SEG-Y file.

View trace header map — Select to view trace header map of the input SEG-Y file.

Save headers to a file — Select to save headers from input SEG-Y file into a file.

The **General dataset properties** specify general properties of the input SEG-Y dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Number of frequency cubes — Enter number of frequency cubes to be generated.

Number of traces per cube — Enter the number of traces per cube.

First output frequency — Enter first output frequency.

Last output frequency — Enter last output frequency.

Output frequency increment — Enter output frequency increment.

Sample format — Enter sample format.

Sample interval — Enter sample interval in milliseconds.

Samples per trace — Enter number of samples per trace.

Start time (ms) — Enter start time of the input dataset in milliseconds.

End time (ms) — Enter end time of the input dataset in milliseconds.

The **Processing sort order** specifies the processing sort order. Output dataset will have selected sort order.

Primary sort key — Select primary sort key to be used during processing.

Range limit — If checked, limit range based on primary sort key.

Minimum value — Enter minimum value to limit the range

Maximum value — Enter the maximum value to limit the range.

Secondary sort key — Select secondary sort key to be used during processing.

Range limit — If checked, limit range based on secondary sort key.

Minimum value — Enter minimum value to limit the range

Maximum value — Enter the maximum value to limit the range.

Tertiary sort key — Select tertiary sort key to be used during processing.

Range limit — If checked, limit range based on tertiary sort key.

Minimum value — Enter minimum value to limit the range

Maximum value — Enter the maximum value to limit the range.

Quaternary sort key — Select quaternary sort key to be used during processing.

Range limit — If checked, limit range based on quaternary sort key.

Minimum value — Enter minimum value to limit the range

Maximum value — Enter the maximum value to limit the range.

Create record at — Select criteria to create record.

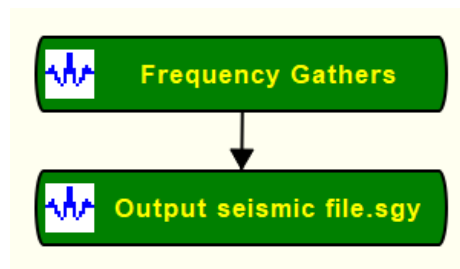
Frequency Gathers

Usage: The Frequency Gather step computes frequency gathers from input seismic of SEG-Y files at specific frequencies. The output cubes are generated at specific frequencies inferred directly from the input seismic file or at user-defined frequencies. The output frequency volumes can also be sorted using user-defined sort order.

Input Links: None.

Output Links: 1) Seismic data in selected processing sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows the "Frequency Gathers" dialog box with the following sections:

- Seismic file:** A text field for "File name:" and a "File Browse..." button.
- SEG-Y index:** Four buttons: "Rebuild index", "Customize Index Map", "View trace headers", and "Trace header ranges".
- General dataset properties:** A grid of input fields for:
 - Number of gathers, Freq. increment, Sample format
 - Freq. per gather, First output freq, Sample interval
 - Number of traces, Last output freq, Samples / trace
- Input sort and selection options:**
 - A "Reset to internal order" button.
 - Four rows for sort keys: Primary, Secondary, Tertiary, and Quaternary. Each row has a dropdown menu (all set to "None"), a "Limit" checkbox, and fields for "Min", "Max", "Interval", and "Group".
 - A "Create record at" dropdown menu (set to "Change in primary") and a "Regather groups into supergathers" checkbox.
- Trace header ranges:** A table with columns "Trace header", "Minimum", and "Maximum". It lists various headers for which ranges can be specified.

At the bottom are "OK", "Help", and "Cancel" buttons.

Trace header	Minimum	Maximum
Field file number		
Channel number		
CMP		
Inline		
Crossline		
Azimuth		
Offset		
CMP easting		
CMP northing		
CMP elevation		
Source line		
Source location		
Source easting		
Source northing		
Source elevation		
Source datum		
Source depth		
Source UHT		
Source component		
Receiver line		
Receiver location		

Parameter Description:

The **Seismic file** specifies the location of the input seismic file.

File Browse... — Select the input file name to be used in the analysis.

The **SEG-Y index** specifies the SEG-Y index parameters. If needed index file parameterization may be changed here.

Rebuild index — Select to rebuild the index file of the input seismic file.

Customize Index Map — Select to customize the index map of the input seismic file.

View trace headers — Select to view trace headers.

Trace header ranges — Select to update trace header ranges.

The **General dataset properties** specify general properties of the input dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Number of gathers — Enter the number of gathers of input seismic file.

Freq. per gather — Enter the number of frequencies per gather.

Number of traces — Enter the number of traces of the input seismic file to be analyzed

Freq. increment — Enter the frequency increment.

First output freq. — Enter the first output frequency.

Last output freq. — Enter the last output frequency

Sample format — Enter the sample format of the input seismic file.

Sample interval — Enter the sample interval of the input seismic file.

Samples/Trace — Enter the number of samples per trace.

The **Input sort and selection option** specifies the input sort order.

Reset to internal order — Select to reset the sort order to the internal sort order of the input seismic file.

Primary sort key — Select primary sort key to be used during processing.

Limit — If checked, limit range based on primary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to limit the range.

Group — Enter the group value.

Secondary sort key — Select secondary sort key to be used during processing.

Limit — If checked, limit range based on secondary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to limit the range.

Group — Enter the group value.

Tertiary sort key — Select tertiary sort key to be used during processing.

Limit — If checked, limit range based on tertiary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to limit the range.

Group — Enter the group value.

Quaternary sort key — Select quaternary sort key to be used during processing.

Limit — If checked, limit range based on quaternary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to limit the range.

Group — Enter the group value.

Create record at — Select criteria to create record.

Regather groups into supergathers — If checked, groups are regathers into supergathers.

The **Trace header ranges** specify the trace headers map into the index files and its ranges.

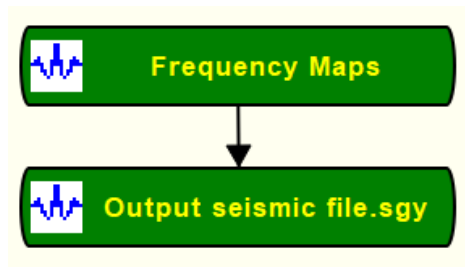
Frequency Maps

Usage: The Frequency Maps step computes frequency maps from input seismic of SEG-Y files at specific frequencies. The output cubes are generated at specific frequencies inferred directly from the input seismic file or at user-defined frequencies. The output frequency volumes can also be sorted using user-defined sort order.

Input Links: None.

Output Links: 1) Seismic data in selected processing sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Frequency Maps

SEGY file

Root file name **File Browse...**

SEGY format

Format name **Format Browse...**

Create new SEGY format **View existing SEGY format**

SEGY index

Customize Index Map **View trace headers** **View trace header map** **Save headers to a file**

General dataset properties

Sample format	Number of traces per map
Sample interval	Number of frequencies
Samples per trace	First output frequency
Number of times	Last output frequency

Processing sort order

	Range limit	Minimum	Maximum
Primary sort key CMP line	☐		
Secondary sort key CMP location	☐		
Tertiary sort key None	☐		
Quaternary sort key None	☐		
Create record at Last trace			

OK **Help** **Cancel**

Parameter Description:

The **SEGY file** specify the location of the input SEG-Y file.

File Browse... — Select the input root file name. All the files sharing the same root name will be used as input.

The **SEGY format** specifies the input SEG-Y format.

Format Browe... — Select saved SEG-Y format. Browse for format file.

Create new SEGY format — Select to create a new SEG-Y format.

View existing SEG-Y format — Select to view current SEG-Y format.

The **SEG-Y index** specifies SEG-Y index parameters. If needed index file parameterization may be changed here.

Customize Index Map — Select to customize the index map of the input SEG-Y file.

View trace headers — Select to view the trace headers of the input SEG-Y file.

View trace header map — Select to view trace header map of the input SEG-Y file.

Save headers to a file — Select to save headers from input SEG-Y file into a file.

The **General dataset properties** specifies the general properties of the input SEG-Y dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Sample format — Enter sample format.

Sample interval — Enter sample interval in milliseconds.

Samples per trace — Enter number of samples per trace.

Number of times — Enter the number of times where the analysis is going to be performed.

Number of traces per map — Enter the number of traces per map.

Number of frequencies — Enter number of frequencies to be generated.

First output frequency — Enter first output frequency.

Last output frequency — Enter last output frequency.

The **Processing sort order** specifies the processing sort order. Output dataset will have selected sort order.

Primary sort key — Select primary sort key to be used during processing.

Range limit — If checked, limit range based on primary sort key.

Minimum — Enter minimum value to limit the range

Maximum — Enter the maximum value to limit the range.

Secondary sort key — Select secondary sort key to be used during processing.

Range limit — If checked, limit range based on secondary sort key.

Minimum — Enter minimum value to limit the range

Maximum — Enter the maximum value to limit the range.

Tertiary sort key — Select tertiary sort key to be used during processing.

Range limit — If checked, limit range based on tertiary sort key.

Minimum value — Enter minimum value to limit the range

Maximum value — Enter the maximum value to limit the range.

Quaternary sort key — Select quaternary sort key to be used during processing.

Range limit — If checked, limit range based on quaternary sort key.

Minimum value — Enter minimum value to limit the range

Maximum value — Enter the maximum value to limit the range.

Create record at — Select criteria to create record.

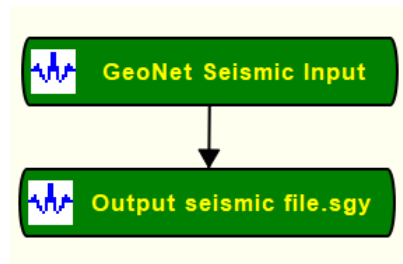
GeoNet Seismic Input

Usage: The GeoNet Seismic Input step import seismic data in the MicroTrace GeoNet format into seismic file.

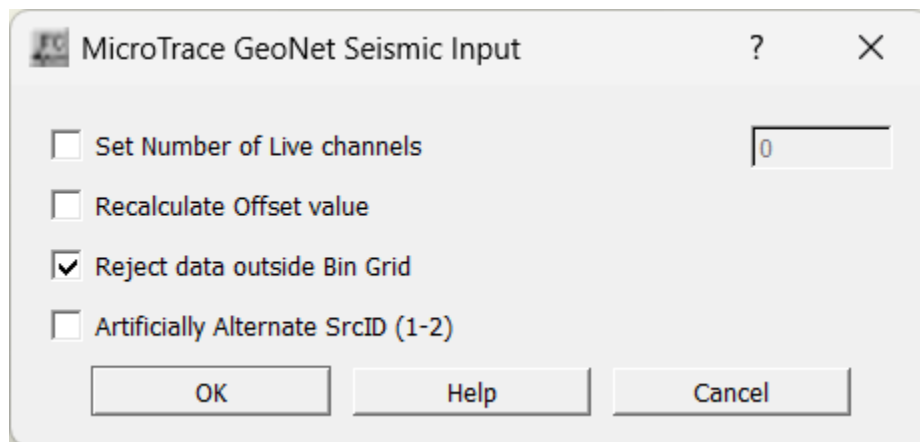
Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Set Number of Live Channels — If checked, set the number of live channels to override the auxiliary channels info from Geonet, all channels other than the first # live channels are going to be set as Auxiliary channels.

Recalculate Offset value — If checked, recalculate offset value using simple square root equation.

Reject data outside Bin Grid — If checked, reject data outside bin grid.

Artificially Alternate SrcID (1-2) — If checked, artificially alternates source id.

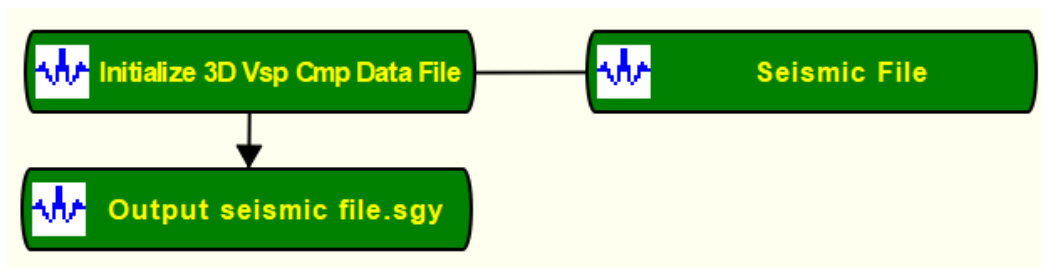
Initialize 3D Vsp CMP Data File

Usage: The Initialize 3D Vsp CMP Data File step generates zeroed cmp stack data for subsequent 3D VSP-CMP transform.

Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

 Initialize 3D VSP-CMP Data File ? X

Read VSP parameters

Use 3D bin size (m):

Set well inline number:

Set well crossline number:

☐ Set square grid length (m)

Set a square grid

Auxiliary file parameters

Sample interval

Samples per trace

Well Northing

Well Easting

Inline Azimuth

Set a tight grid

Required 3D dataset specifications

Sample interval 0	Samples per trace 0
Well Easting 0.00	Well Northing 0.00
Inline Azimuth 0.00	Crossline Azimuth 0.00
Bin size 0.00	
Number of Inlines 0	Number of Crosslines 0
Well at inline: 0	Well at crossline: 0
First inline: 0	First crossline: 0

Disk space required (Gb) **Update**

Reset

Parameter Description:

Read VSP parameters — To read the parameters for VSP from input VSP file.

Use 3D bin size (m) — Enter the 3D bin size.

Set well inline number — Enter the well inline number.

Set well crossline number — Enter the well crossline number.

Set square grid number (m) — If checked, enter the length of the square grid in meters.

The **Auxiliary file parameters** specifies the parameters of the auxiliary file.

Sample interval — Enter the sample interval.

Samples per trace — Enter the number of samples per trace.

Well Northing — Enter the northing coordination of the well.

Well Easting — Enter the easting coordination of the well.

Inline Azimuth — Enter the inline azimuth direction.

Set a square grid — Specify a square grid.

Set a tight grid — Specify a tight grid.

The **Required 3D dataset specifications** specifies the specifications of the 3D dataset.

Sample interval — Enter the sample interval.

Samples per trace — Enter the number of samples per trace.

Well Easting — Enter the easting coordination of the well.

Well Northing — Enter the northing coordination of the well.

Inline Azimuth — Enter the inline azimuth direction...

Crossline Azimuth — Enter the crossline azimuth direction.

Bin size — Enter the bin size.

Number of Inlines — Enter the number of inlines.

Number of Crosslines — Enter the number of crosslines.

Well at inline — Enter the inline number corresponding to the well location.

Well at crossline — Enter the crossline number corresponding to the well location.

First inline — Enter the first inline number.

First crossline — Enter the first crossline number.

Data space required (Gb) — Inform the disk space required, in gigabytes, to perform the VSP-CMP stack after selecting Update.

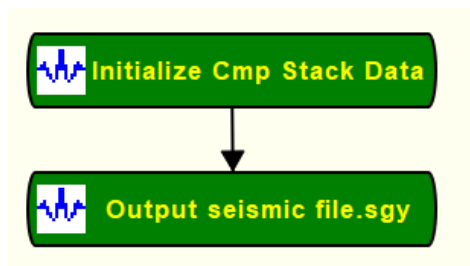
Initialize CMP Stack Data

Usage: The Initialize CMP Stack step generate zeroed CMP stack data for subsequent real time stacking

Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Initialize Cmp Stack Data" contains the following fields and controls:

- Dataset properties:**
 - Sample interval:
 - Samples per trace:
- Update from project:** (checked icon)
- CMP Line and Location:**
 - First CMP Line:
 - Last CMP Line:
 - First CMP Location:
 - Last CMP Location:
- Increments:**
 - CMP line incr.:
 - CMP loc. incr.:
- Disk space required (Gb):**
- Buttons:** OK, Help, Cancel

Parameter Description:

The **Dataset properties** specify the properties of the dataset and the parameters for the CMP stack.

Sample interval — Specify the sample interval of the dataset.

Sample per traces — Specify the number of samples per trace of the dataset.

Update from project — Update the geometry information directly from the project setting.

First CMP Line — Define first CMP line of the output dataset.

First CMP location — Define first CMP location of the output dataset.

Last CMP Line — Define last CMP line of the output dataset.

Last CMP location — Define last CMP location of the output dataset.

CMP line incr. — Define the CMP line increment of the output dataset.

CMP loc. incr. — Define the CMP location increment of the output dataset.

Disk space required (Gb) — Inform the disk space required, in gigabytes, to perform the defined CMP stack.

Update — Inform the disk space required, in gigabytes, after selecting Update.

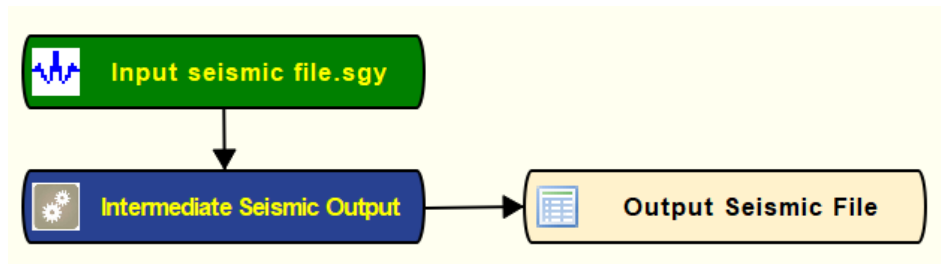
Intermediate Seismic Output

Usage: The intermediate Seismic Output step creates new seismic files from an input seismic file based on the line or record number

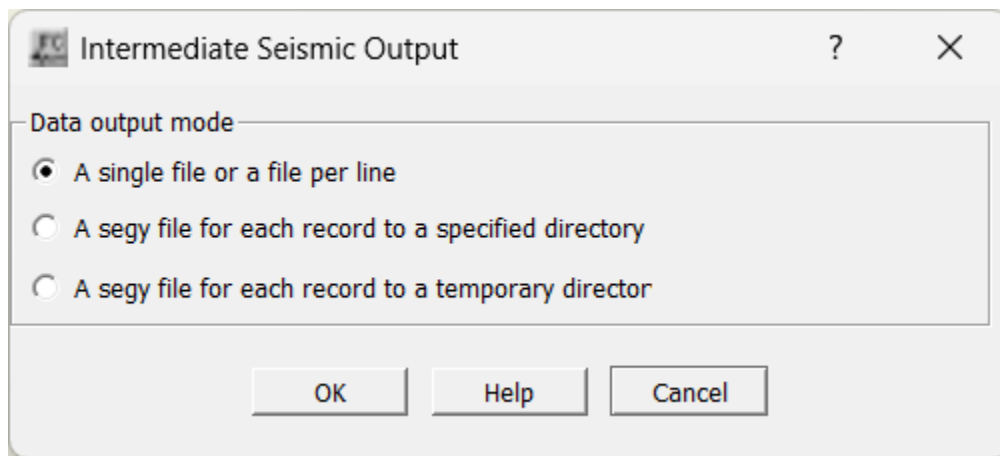
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Data output mode** specifies the type of output seismic data.

A single file or a file per line — If selected, outputs a single seismic file or file per line.

A segy file for each record to a specified directory — If selected, outputs a SEG-Y file per record into a specified directory.

A segy file for each record to a temporary directory — If selected, outputs a SEG-Y file per record into a temporary directory.

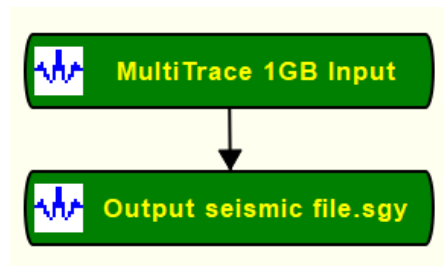
MultiTrace 1GB Input

Usage: The MultiTrace 1GB Input step import seismic data in the MultiTrace format into seismic file. Input files must be smaller than 1Gb, for larger files use the MultiTrace Input step.

Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled "MultiTrace 1GB SEG-Y Field Files Import". It has a standard Windows window with a question mark and close button in the title bar. The dialog is divided into two main sections. The first section, "MultiTrace 1GB SEG-Y files", contains an "Input Directory" text field and a "Directory Browse..." button. The second section, "General dataset properties", contains several input fields: "Number of files", "Samples per trace", "Record length (ms)", "Traces per record", "Sample interval", and "Number of traces", "Sample format". At the bottom, there is a field for "Enter current line number" with the value "1001" entered, and three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **MultiTrace 1Gb SEG-Y files** specifies the location of the input SEG-Y file.

Directory Browse... — Select the input root file name. All the files sharing the same root name will be used as input.

The **General dataset properties** specifies the properties of the seismic and SEG-Y files.

Number of files — Enter the number of files to be loaded.

Traces per record — Enter the number of traces per record.

Number of traces — Enter the total number of traces.

Samples per trace — Enter the number of samples per trace.

Sample interval — Enter the sample interval.

Sample format — Enter the sample format.

Record length (m) — Enter length of the record in meters.

Enter current line number — Enter current line number.

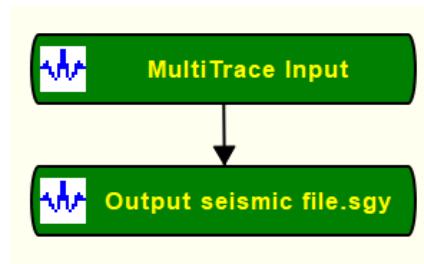
MultiTrace Input

Usage: The MultiTrace Input step import seismic data in the MultiTrace format into seismic file.

Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled "MultiTrace Seismic Input" with a question mark icon and a close button (X). The dialog has a tab labeled "Real Time MultiTrace Input". Inside the tab, there is a section for "TCP/IP address" with a text field containing "127.0.0.1". Below this, there are several input fields and checkboxes:

- Sample Interval (ms): 0.1
- Sample Format: 5
- Number of Samples: 500
- Number of Active Channels: 24
- Reject data outside of Bin Grid: NONE (dropdown menu)
- Number of Aux Channels: 0
- Dismiss Aux Channels: ☒
- Continuous recording (line after line): ☒

At the bottom of the dialog, there are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **Real Time MultiTrace Input** specifies the parameters of the multitrace server.

TCP/IP address — Enter the TCP/IP address of the input files.

Sample Interval (m) — Enter the sample interval in meters.

Number of Samples — Enter the total number of samples.

Reject data outside of Bin Grid — Select the data outside the bin grid to reject.

Samples Format — Specify the sample format.

Number of Active Channels — Enter the number of active channels.

Number of Aux Channels — Enter number of auxiliary channels.

Dismiss Aux Channels — If checked, dismiss auxiliary channels.

Continuous recording (line after line) — If checked, considers a continuous recording ignoring end of line flags.

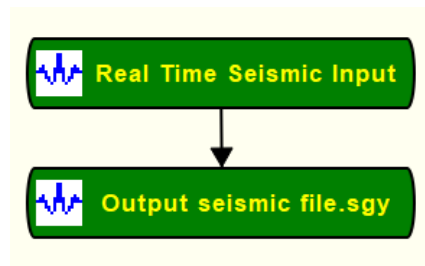
Real Time Seismic Input

Usage: The Real Time Seismic Input import seismic data automatically from a folder that is monitoring in real-time or from an initial seismic file. Seismic files are loaded sequentially as new files appear in the folder and converted into seismic data.

Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time Seismic Input

Input source

☒ Specify input directory ☐ Specify starting input file
☐ Specify input virtual tape device

Input directory...

File ordering

☒ Order files by timestamp ☐ Order files by name

☐ Sum common shots on input
☐ Override - set maximum trace length in milliseconds

Timing delay

☐ Delay processing of new records during real-time input

Length of time delay for each new file seconds (1 - 1000)

Data format

☒ Remove auxiliary traces (trace id code other than 1 or 11)
☒ Remove pressure sensor traces (trace id code 11) - ARAM
☐ Remove seismic traces (trace id code 1) ARAM format on

Parameter Description:

The **Input source** specify either the input seismic is all the files at a given directory or at a specific file within the directory.

Specify input directory — If selected, input data is defined as all the seismic files in the Input directory. Files will be loaded sequentially as defined in File ordering.

Specify input virtual tape device — Not yet implemented.

Specify starting input file — If selected, input data is defined starting from a user-defined seismic file. Files will be loaded sequentially as defined in File ordering.

Input directory... — Browse for input directory where seismic files are stored.

The **File ordering** specify the sequential order used to load the seismic files.

Order files by timestamp — If selected, seismic files will be loaded by its timestamp, from older to newer.

Order files by name — If selected, seismic files will be loaded alphabetically by its name.

Sum common shots on input — If checked, records with the same FFID will be summed together during the input.

Override – set maximum trace length in milliseconds — If checked, override the maximum trace length in milliseconds.

The **Timing delay** specify time delay of the input.

Delay processing of new records during real-time input — If checked, a delay will be added to the input of new records.

Check time sync... — Select to check time sync between acquisition and data input.

Length of time delay for each new file — Enter the delay time in seconds.

Data format — Enter the input data format from a set of standard data formats.

Remove auxiliary traces (traces id code other than 1 or 11) — If checked, traces flagged as auxiliary, with seismic trace type equal 1 or 11, will be removed during the input.

Remove pressure sensor traces (traces id code 11) — If checked, traces flagged as pressure sensor , with seismic trace type equal 11, will be removed during the input.

Remove seismic traces (traces id code 1) — If checked, traces flagged as seismic traces , with seismic trace type equal 1, will be removed during the input.

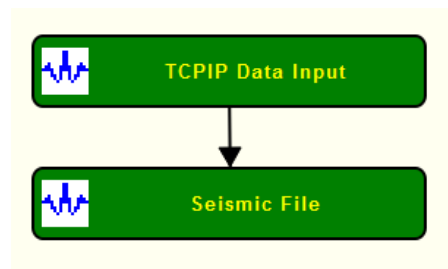
Real Time TCP Seismic

Usage: The Real Time TCP Seismic allows creating a SPW seismic file directly from the field through a TCP/IP protocol. Data received directly from the acquisition system and transmitted using the TCP/IP is then written as a seismic file along with its index file.

Input Links: None.

Output Links: 1) Seismic data in any sort order (mandatory). This seismic file will be sorted as the field data.

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Real Time Tcp Seismic" and has a standard Windows-style title bar with a question mark and a close button. It contains the following fields and controls:

- Server Ip Address:** A text input field.
- Port Number:** A text input field containing the value "22055".
- Seismic Format:** A dropdown menu with "Default" selected.
- Limit N Of Samples:** A checkbox followed by a text input field containing the value "0".
- Mode Selection:** Two radio buttons. "Sending mode" is selected, and "Receiving mode" is unselected.
- Buttons:** Three buttons at the bottom: "OK", "Help", and "Cancel".

Parameter Description:

Server IP address — Enter IP address where the acquired data will be transmitted.

Port Number — Enter port number of the IP address.

Seismic Format — Select format of the seismic file.

Limit N of Samples — If checked, enter the maximum number of samples.

Sending mode — If selected, use the sending mode.

Receiving mode — If selected, use the receiver mode.

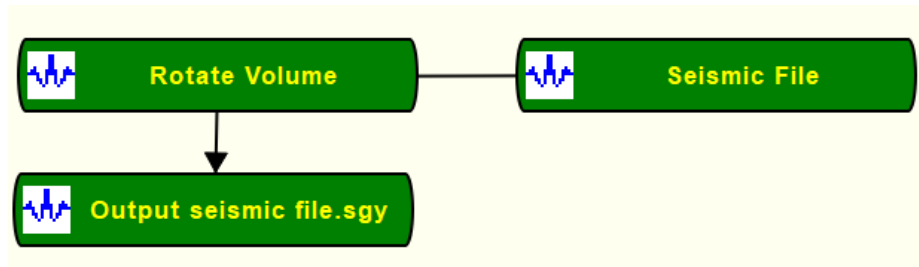
Rotate Volume

Usage: The Rotate Volume step rotates a CMP volume.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Rotate Volume' dialog box contains the following parameters:

- Read auxiliary data info**: A button to read geometry parameters from an auxiliary volume.
- Auxiliary data inline direction**: A text input field with the value '0.00'.
- New data inline direction**: A spin box with the value '0.00'.
- Centre of rotation**: A section containing:
 - CMP Line**: A spin box with the value '320'.
 - CMP Location**: A spin box with the value '320'.
- Data length (ms.)**: A spin box with the value '0'.

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Read auxiliary data info — Read geometry parameters from an auxiliary volume

Auxiliary data inline direction — Enter the direction of the auxiliary data inline.

New data inline direction — Enter direction of the new data inline.

The **Centre of rotation** specifies the CMP line and location for the rotation.

CMP Line — Enter CMP line.

CMP Location — Enter location of the CMP.

Data length (ms.) — Specify the length of the data in milliseconds.

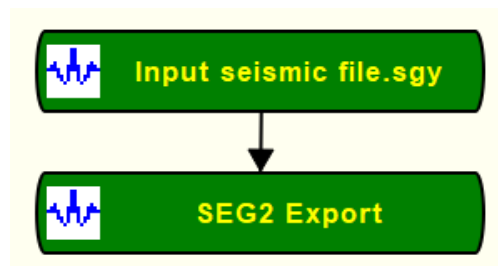
SEG 2 Export

Usage: The SEG2 Export step allows for exporting seismic data in SEG-2 formatted data into a disk file.

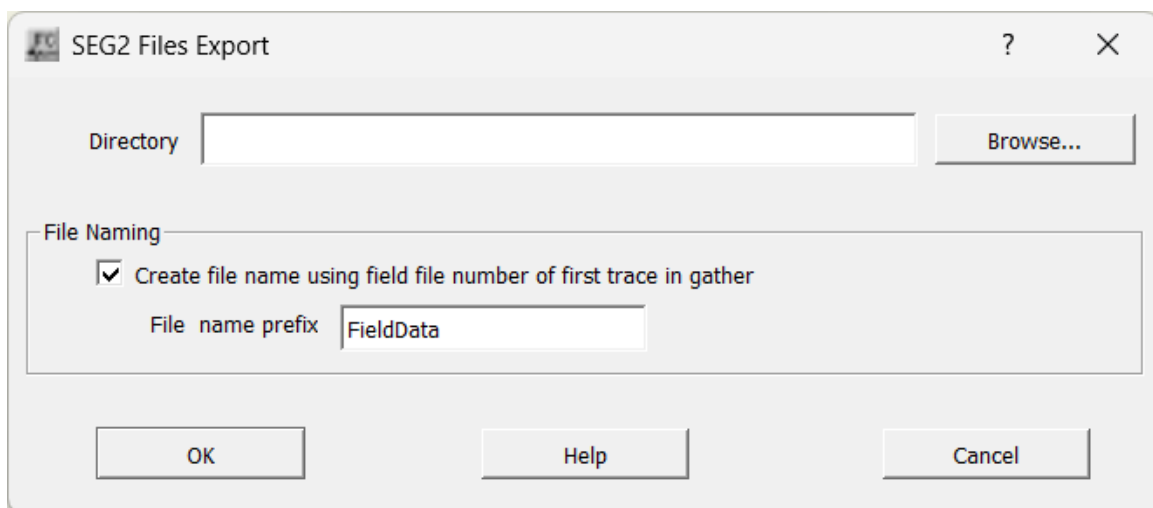
Input Links: 1) Seismic data file (mandatory).

Output Links: none

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Input directory: Specify input parameters.

Browse... — Select the SEG-2 disk file and set the input parameters. Click on the Browse button to select the SEG-2 disk file. Once the file has been selected, the values in the SEG-2 trace header indicating the number of records, the number of traces per record, the sample interval, and the number of samples per trace will be displayed in the SEG-2 File dialog. Be sure to confirm the verity of these values. If they are not as expected, an

option exists to override these values so that the SEG-2 file may be successfully reformatted.

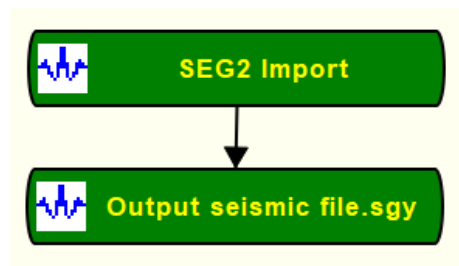
SEG 2 Import

Usage: The SEG2 Import step allows for input of SEG-2 formatted data from a disk file.

Input Links: None. The SEG-2 disk file is selected in the SEG2 File dialog by means of a Browse button.

Output Links: 1) Seismic data file (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "SEG2 Import" and has a standard Windows-style title bar with a question mark and a close button. It contains the following elements:

- SEG2 format:** A dropdown menu currently set to "Standard SEG2".
- Input directory:** A section containing a "Browse..." button, a "SEG2 analyzer" button, and an empty text input field.
- Dataset properties:** A section containing four input fields and a group of override checkboxes:
 - Number of records: [input field]
 - Number of channels: [input field]
 - Number of samples: [input field]
 - Sample interval: [input field]
 - Override:** A group containing three checkboxes, each labeled "Yes":
 - ☐ Yes
 - ☐ Yes
 - ☐ Yes
- Options:** Two checkboxes at the bottom:
 - ☐ Get field file number from filename
 - ☐ Ignore trace data block size in trace descriptor block
- Buttons:** "OK", "Help", and "Cancel" buttons at the bottom.

Parameter Description:

The **Input directory** specify input parameters.

Browse... — Select the SEG-2 disk file and set the input parameters. Click on the Browse button to select the SEG-2 disk file. Once the file has been selected, the values in the SEG-2 trace header indicating the number of records, the number of traces per record, the sample interval, and the number of samples per trace will be displayed in the SEG-2 File dialog. Be sure to confirm the verity of these values. If they are not as expected, an option exists to override these values so that the SEG-2 file may be successfully reformatted.

The **Dataset properties** specify parameters related to the input SEG-2 file.

Number of records — Enter the number of records in the SEG-2 disk file inferred from the SEG-2 file header.

Number of channels — Enter the number of traces per record stored in bytes 6 and 7 of the SEG-2 file descriptor block.

Override — If checked, enter a value to overwrite the number of traces per record stored in the input file.

Number of samples — Indicates the number of samples per trace stored in bytes 8-11 of the SEG-2 trace descriptor block.

Override — If checked, enter a value to overwrite the number of samples per trace stored in the input file.

Sample interval (ms) — Indicates the sample interval stored in the appropriate sub-string of the SEG-2 file descriptor block.

Override — If checked, enter a value to overwrite the sample interval in milliseconds stored in the input file.

Get field file number from filename — If checked, the field file number will be define from the filename.

Ignore trace data blocks size in trace descriptor block — If checked, ignore trace data blocks size as defined in trace descriptor block

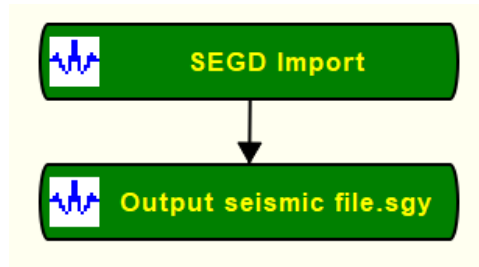
SEG D Import

Usage: The SEG-D Import step allows for direct input of SEG-D formatted data from a disk file. Different standard SEG-D formats are available for import.

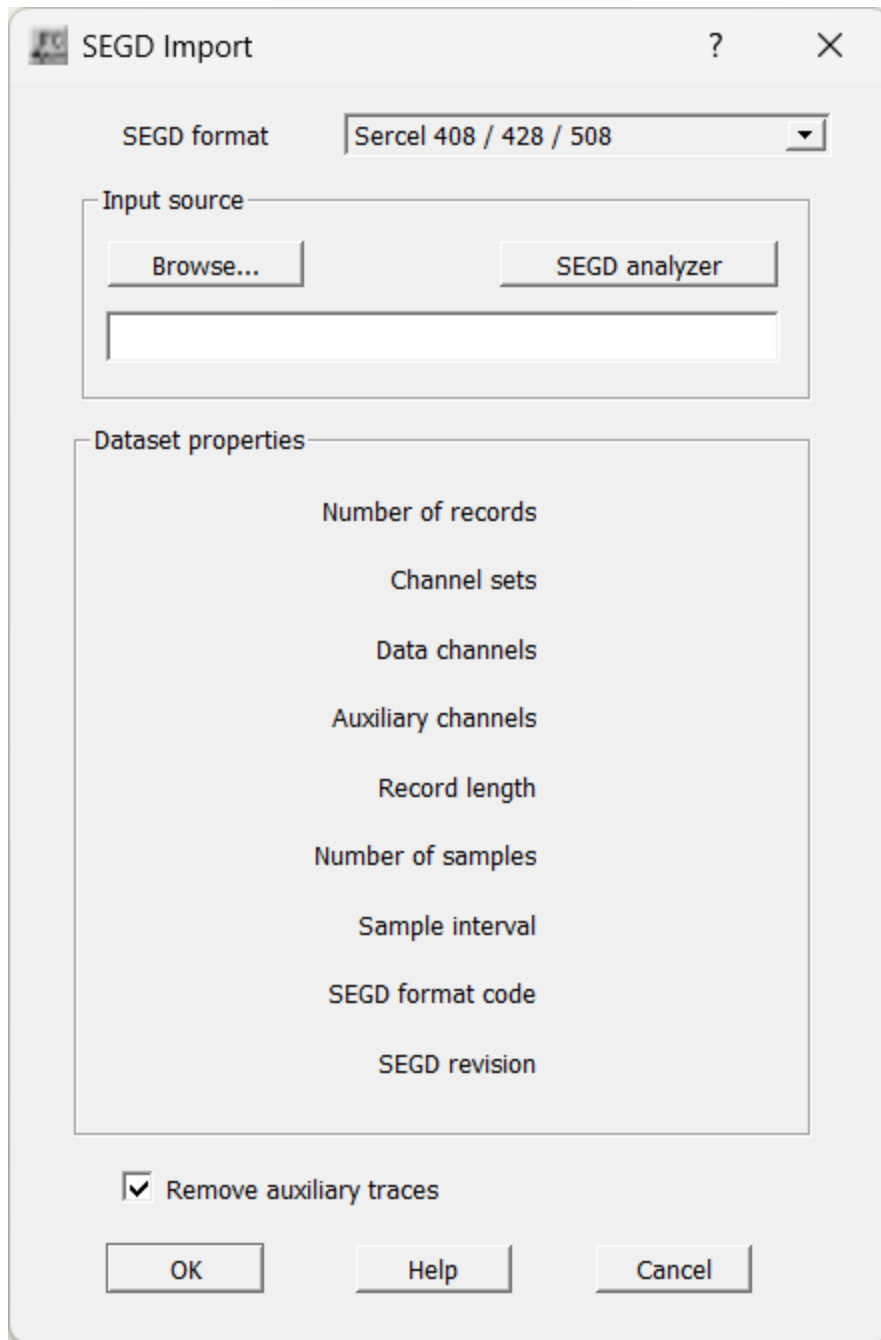
Input Links: None. The SEG-2 disk file is selected in the SEG2 File dialog by means of a Browse button.

Output Links: 1) Seismic data file (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

SEG2 format — Specify the format of the SEG2 files.

The **Input directory** specify the directory of the SEG2 files.

Browse... — Select the SEG-2 disk file and set the input parameters. Click on the Browse button to select the SEG-2 disk file. Once the file has been selected, the

values in the SEG-2 trace header indicating the number of records, the number of traces per record, the sample interval, and the number of samples per trace will be displayed in the SEG-2 File dialog. Be sure to confirm the verity of these values. If they are not as expected, an option exists to override these values so that the SEG-2 file may be successfully reformatted.

SEG2 analyzer — Select to scan the SEG2 files and automatically fill-in the dataset properties

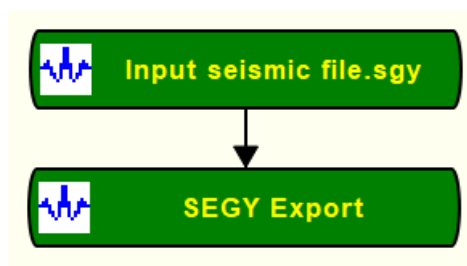
SEG Y Export

Usage: The SEG Y Export allows for direct output of seismic files into a formatted data SEG-Y.

Input Links: 1) Seismic data file (mandatory).

Output Links: None.

Example Flowchart



Step Parameter Dialog:

SEG Y Export

SEG Y file

File name

SEG Y format

Format name

Text header (3200 bytes)

General dataset properties

Number of records Samples per trace Data dimension

Traces per record Sample interval ☐ 2D survey

Number of traces Sample format ☐ 3D survey

Output options

☐ Create index file ☒ Remove dead traces ☐ Keep dead traces

Parameter Description:

The **SEG-Y file** specify the location and name for the output SEG-Y file.

SEG-Y File Browse... — Browse for the output directory and define output file name.

The **SEG-Y format** specify the input SEG-Y format.

Format Browse... — Select saved SEG-Y format. Browse for format file.

Text header Browse... — Select to create a new SEG-Y format.

View existing SEG-Y format — Select to view current SEG-Y format.

The **General dataset properties** specify general properties of the input dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Number of records — Enter the number of records in the input seismic file.

Traces per record — Enter the number of traces per record.

Number of traces — Enter the number of traces in the input seismic file.

Samples per trace — Enter the number of samples per trace in the input seismic file.

Sample interval — Enter the sample interval of the input seismic file in milliseconds

Sample format — Enter the sample format of the input seismic file.

The **Data dimension** specify the dimension of the input data.

2D survey — If selected, input data is two-dimensional.

3D survey — If selected, input data is three-dimensional.

The **Output options** specify options of the output SEG-Y file.

Create index file — If checked, create index file for output SEG-Y file.

Remove dead traces — If selected, traces flagged as dead are removed from the output SEG-Y file.

Keep dead traces — If selected, traces flagged as dead are not removed from the output SEG-Y file.

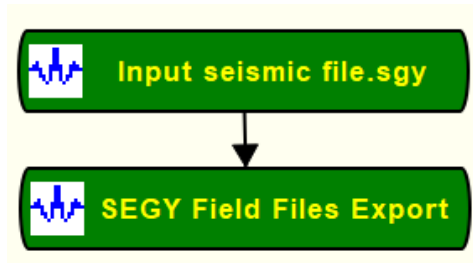
SEG Y Field Files Export

Usage: The SEG Y Field Export step allows for direct output of SEG Y formatted data from specific trace header fields of an input seismic file. It exports seismic files as field SEG-Y data

Input Links: 1) Seismic data file (mandatory).

Output Links: None.

Example Flowchart:



Step Parameter Dialog:

SEG Y Field Files Export

Directory

File Naming

- ☒ Create file name using receiver identifier of first trace in gather
- ☐ Create file name using field file number of first trace in gather
- ☐ Create file name using frequency of first trace in gather
- ☐ Create file name using data timestamp

File name prefix

SEG Y Format

Format Name

Parameter Description:

Browse... — Browse for the directory where the output SEG-Y files will be stored.

The **File naming** specify common file name for the output seismic files.

Create file name using receiver identifier of first trace in gather — If selected, file name of the output SEG-Y files uses the receiver number of the first trace in the gather as identified.

Create file name using field file number of first trace in gather — If selected, file name of the output SEG-Y files uses the field file number of the first trace in the gather as identified.

Create file name using frequency of first trace in gather — If selected, file name of the output SEG-Y files uses the frequency number of the first trace in the gather as identified.

Create file name using data timestamp — Not yet implemented.

File name prefix — Enter the file name prefix of the output SEG-Y files that will be written in the hard-drive.

The **SEG-Y Format** specify SEG-Y format of the output SEG-Y files.

Browse... — Browse for an existing SEG-Y format file.

Create New SEG-Y Format — Select to create a new SEG-Y format.

View Existing SEG-Y Format — Select to view current SEG-Y format.

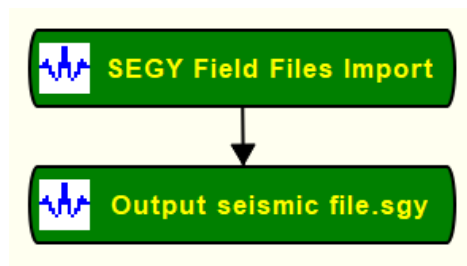
SEG Y Field Files Import

Usage: The SEG Y Filed Import step allows importing field SEG Y formatted data from a disk file into a seismic file.

Input Links: None.

Output Links: 1) Seismic data file (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a Windows-style dialog box titled "SEG Y Field Files Import". It has a standard title bar with a question mark and a close button. The dialog is divided into three main sections:

- SEG Y file:** Contains an "Input Directory" text field and a "Directory Browse..." button. Below these are two radio buttons: "Select input directory" (which is selected) and "Select first input file".
- SEG Y format:** Contains a "Format Name" text field with the path "C:/Users/leona/Documents/spw/SegyFormats/SEG Y Standard.xml" and a "Browse..." button. Below this are three buttons: "SEG Y analyzer", "Create new SEG Y format", and "View existing SEG Y format".
- General dataset properties:** Contains a grid of text fields for "Number of records", "Samples per trace", "Record length (ms)", "Traces per record", "Sample interval", "Number of traces", and "Sample format".

At the bottom of the dialog, there are two checkboxes: "Set field file number from input file name" and "Set line number from EBCDIC header (C 3 LI)". Below these are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **SEG-Y file** specify either the input seismic is all the files at a given directory or at a specific file within the directory.

Directory browse... — Browse for input directory where seismic files are stored.

Select input directory — If selected, all files in directory will be imported sequentially in alphabetic order.

Select first input file — If selected, input data is defined starting from a user-defined seismic file sequentially in alphabetic order.

The **SEG-Y Format** specify SEG-Y format of the input SEG-Y files.

Browse... — Browse for an existing SEG-Y format file.

SEG-Y analyzer — Select to access properties of the input SEG-Y file.

Create new SEG-Y format — Select to create a new SEG-Y format.

View existing SEG-Y format — Select to view current SEG-Y format.

The **General dataset properties** specify general properties of the input dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Number of records — Enter the number of records in the input seismic file.

Traces per record — Enter the number of traces per record.

Number of traces — Enter the number of traces in the input seismic file.

Samples per trace — Enter the number of samples per trace in the input seismic file.

Sample interval — Enter the sample interval of the input seismic file in milliseconds.

Sample format — Enter the sample format of the input seismic file.

Record length (ms) — Enter the record length of the input SEG-Y file in milliseconds.

Set field file number from input file name — If checked, field file number is retrieved from the name of the input file name.

Set line number from EBCDIC header (C 3 LINE) — If checked, line number is retrieved from the SEG-Y text header (EBCDIC header) at line position C3

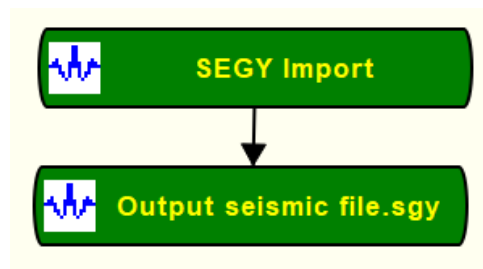
SEG Y Import

Usage: The SEG Y Import step allows for direct input of SEG Y formatted seismic data from a disk file into a seismic file in SPW format. It allows to select the SEG-Y trace header keys to be mapped into the index file which stores this information as part of the SPW format.

Input Links: None.

Output Links: 1) Seismic data file (mandatory).

Example Flowchart:



Step Parameter Dialog:

SEG Y file

File name: Browse...

SEG Y format

Format name: a:/Documents/spw/SegyFormats/SEG Y Standard.xml Browse...

SEG Y analyzer Create new format View existing format

SEG Y index

Build SEG Y Index View trace headers Trace header ranges

General dataset properties

Number of records: Samples per trace: Dimension: ☐ 2D ☐ 3D

Traces per record: Sample interval:

Number of traces: Sample format:

Input sort and selection options

Reset to internal order Range limit Min Max Interval Group

Primary sort key: None ☐ 1

Secondary sort key: None ☐ 1

Tertiary sort key: None ☐ 1

Quaternary sort key: None ☐ 1

Create record at: Change in primary

☐ Assign line number 0

Regather groups into supergathers ☐

SEG Y index fields

- ☒ Trace sequential number
- ☒ Field file number
- ☒ Channel number
- ☐ Source line number
- ☐ Source location number
- ☐ Receiver line number
- ☐ Receiver location number
- ☐ CMP location
- ☒ Inline number
- ☒ Crossline number
- ☐ Offset
- ☐ Azimuth
- ☐ Gather index
- ☐ Frequency
- ☒ Trace type
- ☐ CMP easting
- ☐ CMP northing
- ☐ CMP elevation
- ☐ CMP datum elevation
- ☐ Source easting
- ☐ Source northing

Trace header ranges

Trace header	Minimum	Maximum
Field file number		
Channel number		
CMP		
Inline		
Crossline		
Azimuth		
Offset		
Gather index		
CMP easting		
CMP northing		
CMP elevation		
Source line		
Source location		
Source easting		
Source northing		
Source elevation		
Source datum		
Source depth		
Source UHT		
Source component		
Receiver line		
Receiver location		

OK Help Cancel

Parameter Description:

The **SEG-Y File** specify input SEG-Y file by browsing it.

Browse... — Browse for the input SEG-Y file.

The **SEG-Y Format** specify the input SEG-Y format file and map trace headers to be stored in the SPW index file.

Browse... — Browse for an existing SEG-Y format file.

SEG-Y analyzer — Select to access properties of the input SEG-Y file.

Create new format — Select to create a new SEG-Y map format.

View existing format — Select to view the existing format, SEG-Y index fields are automatically updated.

The **SEG-Y index** specify SEG-Y index parameters. If needed index file parameterization may be changed here.

Build SEG-Y Index — Select to build the index file using the current SEG-Y format for the selected input SEG-Y file.

View trace headers — Select to view original trace headers from the input SEG-Y file.

Trace header ranges — Shows the range of the input SEG-Y trace headers.

The **General dataset properties** specify general properties of the input dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Number of records — Enter the number of records in the input seismic file.

Traces per record — Enter the number of traces per record.

Number of traces — Enter the number of traces in the input seismic file.

Samples per trace — Enter the number of samples per trace in the input seismic file.

Sample interval — Enter the sample interval of the input seismic file in milliseconds.

Sample format — Enter the sample format of the input seismic file.

The **Dimension** specify the dimension of the input data.

2D survey — If selected, input data is two-dimensional.

3D survey — If selected, input data is three-dimensional

The **Input sort and selection option** specify the input sort order.

Reset internal order — Select to reset the sort order to the internal sort order of the input seismic file.

Primary sort key — Select primary sort key to be used during processing.

Range limit — If checked, limit range based on primary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Secondary sort key — Select secondary sort key to be used during processing.

Range limit — If checked, limit range based on secondary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Tertiary sort key — Select tertiary sort key to be used during processing.

Range limit — If checked, limit range based on tertiary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Quaternary sort key — Select quaternary sort key to be used during processing.

Range limit — If checked, limit range based on quaternary sort key.

Min — Enter minimum value to limit the range

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Create record at — Select criteria to create record.

Regather groups into supergathers — If checked, groups are regathers into supergathers.

Assign line number — If checked, assign a line number.

SEGY index fields — Check/Uncheck SEG-Y trace headers to be mapped into the SPW index file.

Seismic File

Usage: The Seismic File step allows to select or create a SPW format seismic file on disk. It is the input SPW seismic format file and/or the output SPW seismic format file for almost all the processing steps.

Input Links: The Seismic File may receive input links from any processing step that requires an output seismic data file. In this case, execution of the flow will require that the user provides a file name for the Seismic File by left-clicking on the icon to open the Seismic File dialog and creating the output file name with the Browse button.

Output Links: Output links from the Seismic File may be directed to any processing step that requires as input a seismic data file. In this case, execution of the flow will require that the user provides a file name for the Seismic File by left-clicking on the icon to open the Seismic File dialog and selecting the input file name with the Browse button.

Example Flowchart:



Step Parameter Dialog:

Seismic File
?
×

Seismic file

File name

SEGY index

General dataset properties

Number of records

Samples per trace

Traces per record

Sample interval

Number of traces

Sample format

Dimension

☒ 2D
☐ 3D

Input sort and selection options

R

O

C

S

	Range limit	Min	Max	Interval	Group
Primary sort key	☐				
Secondary sort key	☐				
Tertiary sort key	☐				
Quaternary sort key	☐				

Create record at

☐ Regather groups into supergathers

Output options

☐ Append to existing dataset
☒ Remove dead traces
☐ Do not write data to file

☐ Do not overwrite an existing output file
☐ Keep dead traces
☐ Do not output index file

☐ Output separate files per shot line
☐ Export full input header

Parameter Description:

The **Seismic file** specifies location and name of the seismic file. Browse for existing file if seismic file is going to be used as input for other processing step or write select directory and write file name if seismic file is going to be used as output for a processing step.

File Browse... — Select to browse for input or output location and select file.

The **SEGY index** specify parameters related to the index file used as part of the SPW seismic format.

Rebuild index — Select to rebuild index file. Due to SPW updates there may be the need to update an existing index file.

Customize Index Map — Select to customize the index file. With this option the user can select which fields are stored in the index file.

View trace headers — Select to view trace header values with its ranges.

Trace header ranges — Select to open a table with the ranges for all the trace header in the seismic file.

The **General dataset properties** specify general properties of the input dataset. All these properties may be overwritten by the user. User-defined parameters will be used as parameter for the output seismic file.

Number of records — Enter the number of records in the input seismic file.

Traces per record — Enter the number of traces per record.

Number of traces — Enter the number of traces in the input seismic file.

Samples per trace — Enter the number of samples per trace in the input seismic file.

Sample interval — Enter the sample interval of the input seismic file in milliseconds.

Sample format — Enter the sample format of the input seismic file.

The **Dimension** specify the dimension of the input data.

2D survey — If selected, input data is two-dimensional.

3D survey — If selected, input data is three-dimensional.

The **Input sort and selection option** specify the input sort order.

R — Select to sort the seismic file by common receiver order: Primary sort key is set to none; Secondary sort key is set to none; Tertiary sort key is set to Offset; Quaternary sort key is set to none; Create record at is set to Change in secondary.

O — Select to sort the seismic file by common offset order: Primary sort key is set to Offset; Secondary sort key is set to none; Tertiary sort key is set to none; Quaternary sort key is set to none; Create record at is set to Change in primary.

C — Select to sort the seismic file by common midpoint order: Primary sort key is set to Offset; Secondary sort key is set to none; Tertiary sort key is set to none; Quaternary sort key is set to none; Create record at is set to Change in primary.

S — Select to sort the seismic file by common source order: Primary sort key is set to FFID; Secondary sort key is set to Channel; Tertiary sort key is set to none; Quaternary sort key is set to none; Create record at is set to Change in primary.

Reset to internal order — Select to reset the sort order to the internal sort order of the input seismic file.

Primary sort key — Select primary sort key to be used during processing.

Range limit — If checked, limit range based on primary sort key.

Min — Enter minimum value to limit the range.

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Secondary sort key — Select secondary sort key to be used during processing.

Range limit — If checked, limit range based on secondary sort key.

Min — Enter minimum value to limit the range.

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Tertiary sort key — Select tertiary sort key to be used during processing.

Range limit — If checked, limit range based on tertiary sort key.

Min — Enter minimum value to limit the range.

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Quaternary sort key — Select quaternary sort key to be used during processing.

Range limit — If checked, limit range based on quaternary sort key.

Min — Enter minimum value to limit the range.

Max — Enter the maximum value to limit the range.

Interval — Enter the interval value to the range.

Group — Enter the group number.

Create record at — Select criteria to create record.

Regather groups into supergathers — If checked, groups are regathers into supergathers.

The **Output options** specify options related to the output seismic file.

Append to existing dataset — If checked, current input file will be appended to existing file as defined in Seismic file.

Do not overwrite and existing output file — If checked, if the output file already exists this will not be overwritten. Instead, a new name will be automatically given to the output file.

Output separate files per shot line — If checked, the output files will be created per shot line.

Remove dead traces — If selected, traces from the input file flagged as dead will be removed and not written in the output seismic file.

Keep dead traces — If selected, traces from the input file flagged as dead will not be removed and will be written in the output seismic file.

Do not write data to file — If checked, no data will be written in the output file, only information related to the trace headers will be written.

Do not output index file — If checked, the index file will not be written.

Export full input header — If checked, the full trace header information will be exported along with the seismic data.

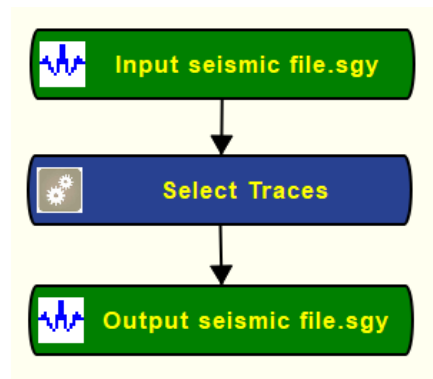
Select Traces

Usage: The Select Traces step allows selecting a user-defined range of traces from the input seismic file. The selection of traces is defined based on the ranges of primary, secondary and tertiary sort keys.

Input Links: 1) Seismic file in any sort order (mandatory).

Output Links: 1) Seismic file in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a window titled 'Select List of Traces'. At the top, there is a table with nine columns: 'Primary header', 'Primary start', 'Primary stop', 'Secondary header', 'Secondary start', 'Secondary stop', 'Tertiary header', 'Tertiary start', and 'Tertiary stop'. Below this table is a large empty rectangular area for data entry. At the bottom of the window, there are two rows of buttons. The first row contains 'Import', 'Export', 'Add Row', and 'Delete Row'. The second row contains 'OK', 'Help', and 'Cancel'.

Parameter Description:

Import — Select to import a Trace Select auxiliary card data file to be used as selection of traces from input seismic file.

Export — Select to export into a Trace Select auxiliary card data file the list of traces selected by the table above.

Add Row — Select to add a row to the list of selected traces.

Delete Row — Select to delete last row of the list of selected traces.

Primary header — Select the primary header key to be used for the trace selection as defined in the Primary start and Primary Stop.

Primary start — Enter the primary header key start value.

Primary stop — Enter the primary header key end value.

Secondary header — Select the secondary header key to be used for the trace selection as defined in the Secondary start and Secondary Stop.

Secondary start — Enter the secondary header key start value.

Secondary stop — Enter the secondary header key end value.

Tertiary header — Select the tertiary header key to be used for the trace selection as defined in the Tertiary start and Tertiary Stop.

Tertiary start — Enter the tertiary header key start value.

Tertiary stop — Enter the tertiary header key end value.

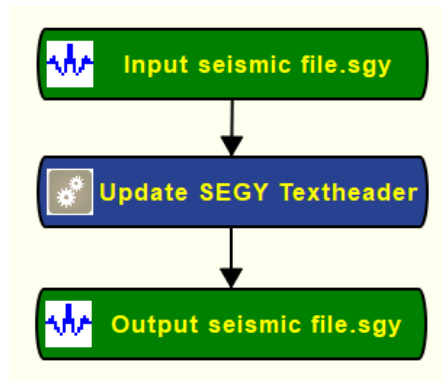
Update SEGY Textheader

Usage: The Update SEGY Textheader step adds a EBCDIC text header into a SEG-Y seismic file. The text header needs to be stored in an auxiliary text file.

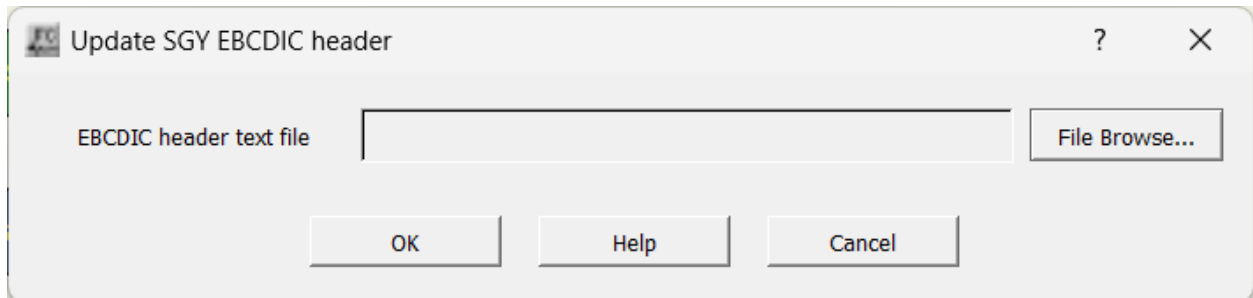
Input Links: 1) Seismic data file in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

File Browse... — Browse for the location of the text file with the EBCDIC header to be included in the seismic file.

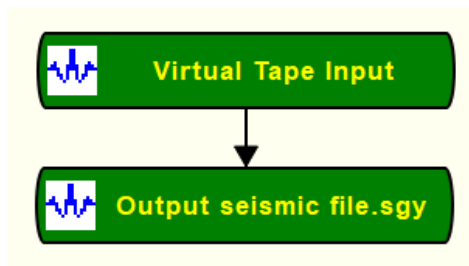
Virtual Tape Input

Usage: The Virtual Tape Input step allows importing seismic data from tapes into a seismic file. In order to access this step a tape drive must be connected using a SCSI connection.

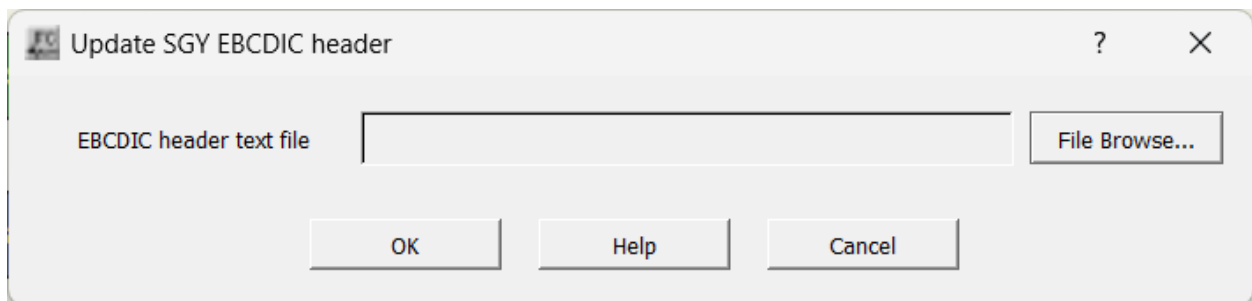
Input Links: None.

Output Links: 1) Seismic file in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Browse... — Browse for EBCDIC header text file.

Spectral Attributes Steps

This section documents the processing steps available in the Spectral Attributes Steps category. The types of Spectral Attributes Steps currently available are:

Spectral Attributes	
	Processing Categories
Bandwidth	
Center Frequency	
Kurtosis	
Mean Amplitude	
Minimum Amplitude	
Peak Amplitude	
Peak Amplitude Above Mean	
Peak Frequency	
Phase at Peak Frequency	
RMS Frequency	
Skewness	
Spectral Variance	

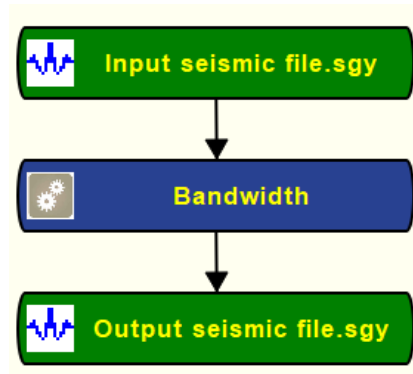
Bandwidth

Usage: The Bandwidth step estimates the bandwidth of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

A screenshot of the 'Bandwidth' parameter dialog box. The title bar reads 'Bandwidth' with a question mark and a close button. The dialog contains four input fields: 'Processing start time (ms)' with the value '0', 'Processing end time (ms)' with the value '2000', 'Analysis start frequency (Hz)' with the value '5', and 'Analysis end frequency (Hz)' with the value '80'. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the bandwidth analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the bandwidth analysis.

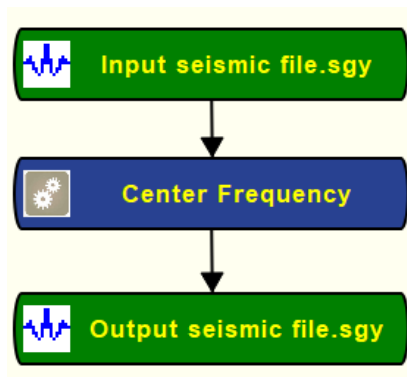
Center Frequency

Usage: The Center Frequency step estimates the center frequency of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Center Frequency" and has a question mark icon and a close button (X) in the top right corner. It contains four input fields with labels and values:

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

At the bottom of the dialog are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the center frequency analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the center frequency analysis.

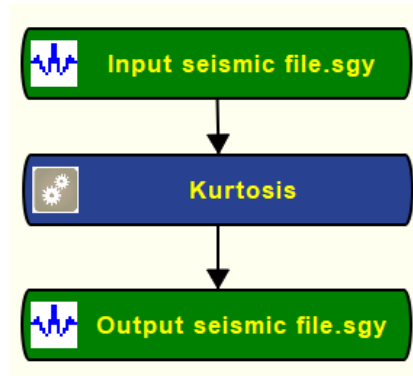
Kurtosis

Usage: The Kurtosis step estimates the kurtosis (measure of the skewness of the spectra) of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled 'Kurtosis' contains the following parameters and controls:

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the kurtosis analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the kurtosis analysis.

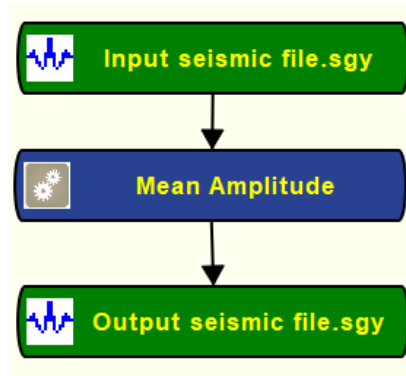
Mean Amplitude

Usage: The Mean amplitude step estimates the mean amplitude value of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

A screenshot of the 'Mean Amplitude' parameter dialog box. The title bar reads 'Mean Amplitude' with a question mark and a close button. The dialog contains four input fields: 'Processing start time (ms)' with the value '0', 'Processing end time (ms)' with the value '2000', 'Analysis start frequency (Hz)' with the value '5', and 'Analysis end frequency (Hz)' with the value '80'. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the mean amplitude analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the mean amplitude analysis.

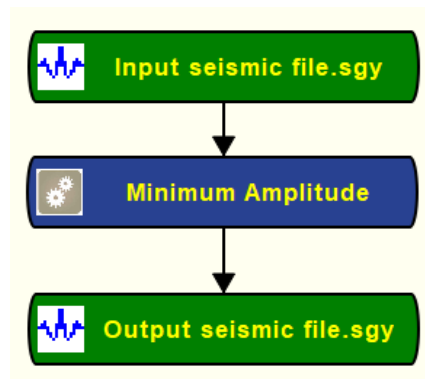
Minimum Amplitude

Usage: The Minimum amplitude step estimates the minimum amplitude value of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Minimum Amplitude' with a question mark icon and a close button (X). It contains four input fields for parameters: 'Processing start time (ms)' with value 0, 'Processing end time (ms)' with value 2000, 'Analysis start frequency (Hz)' with value 5, and 'Analysis end frequency (Hz)' with value 80. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the minimum amplitude analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the minimum amplitude analysis.

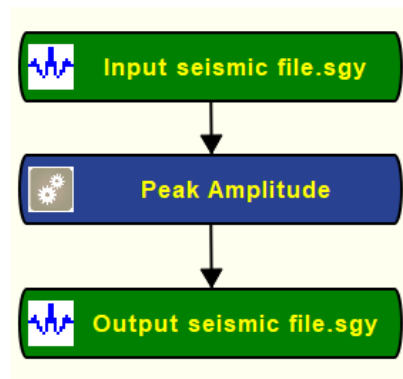
Peak Amplitude

Usage: The Peak amplitude step estimates the peak (maximum) amplitude value of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Peak Amplitude' and contains four input fields for configuring the analysis parameters. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the maximum (peak) amplitude analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the maximum (peak) amplitude analysis.

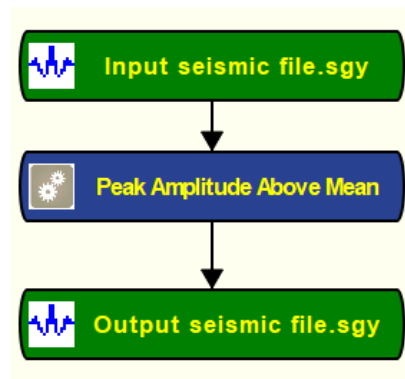
Peak Amplitude Above Mean

Usage: The Peak Amplitude step estimates the maximum amplitude above the mean of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box, titled 'Peak Amplitude Above Mean', contains four input fields for defining the analysis window. The 'Processing start time (ms)' field is set to 0, 'Processing end time (ms)' is set to 2000, 'Analysis start frequency (Hz)' is set to 5, and 'Analysis end frequency (Hz)' is set to 80. At the bottom, there are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the peak amplitude above mean analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the peak amplitude above mean analysis.

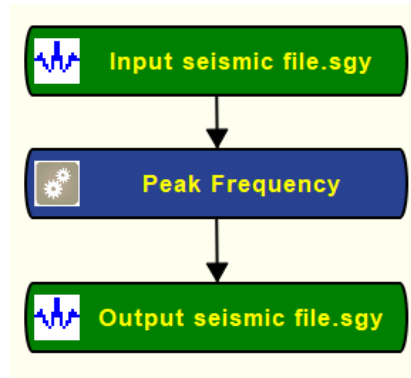
Peak Frequency

Usage: The Peak Frequency step estimates the dominant frequency value of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'Peak Frequency' with a question mark icon and a close button. It contains four input fields for time and frequency parameters, and three buttons at the bottom: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the peak frequency amplitude analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the peak frequency analysis.

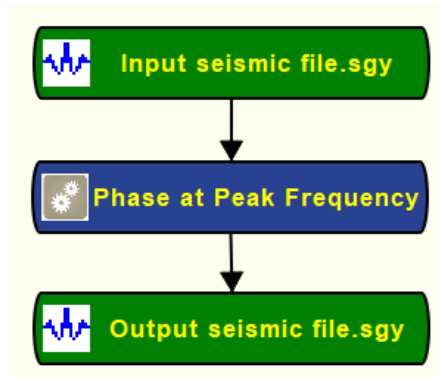
Phase at Peak Frequency

Usage: The Phase at Peak Frequency step estimates the phase of the dominant frequency of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Phase at Peak Frequency' and contains four input fields for time and frequency parameters. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the phase at peak frequency analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the phase at peak frequency analysis.

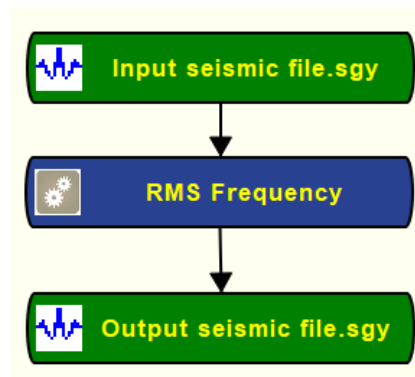
RMS Frequency

Usage: The RMS Frequency step estimates the root mean square (RMS) of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'RMS Frequency' and contains four input fields for time and frequency parameters. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the RMS frequency analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the RMS frequency analysis.

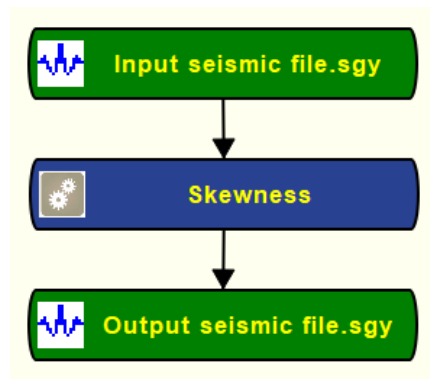
Skewness

Usage: The Skewness step estimates the skewness of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Skewness' and contains four input fields for configuring the analysis parameters. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the skewness amplitude analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the skewness amplitude analysis.

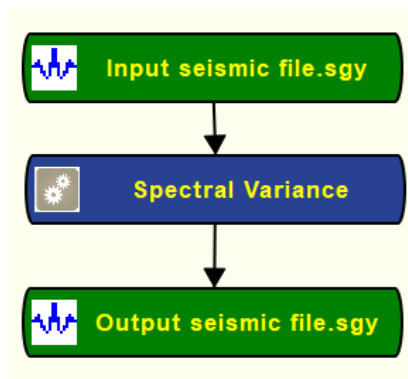
Spectral Variance

Usage: The Spectral Variance step estimates the variance of spectrally decomposed seismic data computed for example with Wigner-Ville Decomposition step using a user-defined time and frequency window.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Spectral Variance' and contains four input fields for time and frequency parameters. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter	Value
Processing start time (ms)	0
Processing end time (ms)	2000
Analysis start frequency (Hz)	5
Analysis end frequency (Hz)	80

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Analysis start frequency (Hz) — Enter the minimum frequency used in the spectral variance analysis.

Analysis end frequency (Hz) — Enter the maximum frequency used in the spectral variance analysis.

Spectral Decomposition Steps

This section documents the processing steps available in the Spectral Decomposition Steps category.

Processing steps currently available are:

Spectral Decomposition	
	Processing Categories
Band Aid	
Bandwidth Enhancement	
Cohen's Class	
Short-Time Fourier Transform	
Stockwell Transform	
Wavelet Recomposition	
Wavelet Transform	
Wigner-Ville Decomposition	
Windowed Wigner-Ville Decomposition	

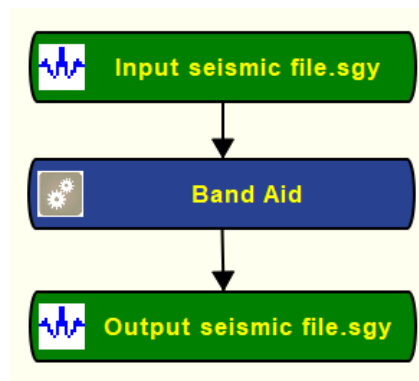
Band Aid

Usage: The Band Aid step performs a bandwidth enhancement based on wavelet decomposition.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

Band Aid

Processing start time (ms) 0.00

Processing end time (ms) 2000.00

Harmonic gain factor 0.00

Sub-harmonic gain factor 0.00

Number of harmonics 1

Number of sub-harmonics 0

Iterations per harmonic 1

Frequency of mother wavelet 128.0

Number of octaves 6

Number of tones per octave 12

Gaussian width factor 1.00

Center frequency of lowest wavelet 2.00

Wavelet type

☒ Morlet

☐ Ricker

Output type

☒ Output enhanced trace

☐ Output harmonic

Tapers

☒ Apply lo-cut

Harmonic lo-cut (dB/Oct) 36

☒ Apply hi-cut

Harmonic hi-cut (dB/Oct) 18

☐ Limit maximum frequency

Maximum frequency 128

OK Help Cancel

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Harmonic gain factor — Enter the harmonic gain factor.

Sub-harmonic gain factor — Enter the sub-harmonic gain factor.

Number of harmonics — Select the number of harmonics for the calculations. {0, 4}

Number of sub-harmonics — Select the number of sub-harmonics for the calculations. {0, 4}

Iterations per harmonic — Select the number of iterations per harmonic for the calculations. {1.0, 10}

Frequency of mother wavelet — Enter the central frequency of the reference wavelet in Hz.

Number of octaves — Enter the number of octaves.

Number of tones per octave — Enter the number of tones per octave.

Gaussian width factor — Enter the Gaussian width.

Center frequency of lowest wavelet — Enter the frequency of lower wavelet.

The **Wavelet type** specifies the type of wavelet for the calculation.

Morlet — If selected, uses a Morlet wavelet.

Ricker — If selected, uses a ricker wavelet (not yet implemented).

The **Output type** specifies the type of output data.

Output enhanced trace — If selected, outputs enhanced trace after calculation.

Output harmonic — If selected, outputs the harmonic.

The **Tapers** specifies the type of tapers to be used in the harmonics.

Apply lo-cut — If checked, applies a taper to the low harmonics.

Harmonic lo-cut (dB/oct) — Enter the slope of the low-cut taper.

Apply hi-cut — If checked, applies a taper to the high harmonics.

Harmonic hi-cut (dB/oct) — Enter the slope of the high-cut taper.

Limit maximum frequency — If checked, limits the maximum frequency of the analysis.

Maximum frequency — Enter the maximum frequency in Hz.

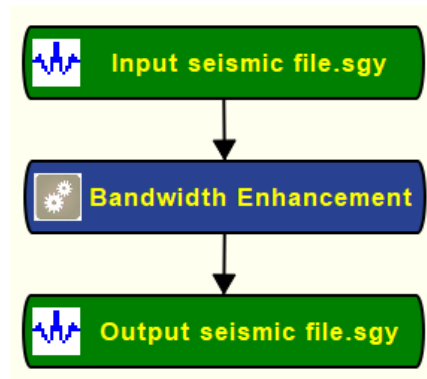
Bandwidth Enhancement

Usage: The Bandwidth Enhancement step increases the frequency of the input seismic data by continuous wavelet transform.

Input Links: 1) Spectrally decomposed seismic data (mandatory).

Output Links: 1) Spectrally decomposed seismic data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled 'Bandwidth Enhancement'. It contains two columns of input fields. The left column includes 'Processing start time (ms)' (0.00), 'Processing end time (ms)' (2000.00), 'Harmonic decay factor' (0.00), 'Sub-harmonic decay factor' (0.00), 'Number of harmonics' (dropdown set to 1), and 'Number of sub-harmonics' (dropdown set to 0). The right column includes 'Frequency of mother wavelet' (128.0), 'Number of octaves' (6), 'Number of tones per octave' (12), 'Gaussian width factor' (1.00), 'Center frequency of lowest wavelet' (2.00), and 'Wavelet type' (dropdown set to 'Complex Morlet'). At the bottom are 'OK', 'Help', and 'Cancel' buttons.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds (not yet implemented).

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Harmonic gain factor — Enter the harmonic gain factor.

Sub-harmonic gain factor — Enter the sub-harmonic gain factor.

Number of harmonics — Select the number of harmonics for the calculations. {0, 4}

Number of sub-harmonics — Select the number of sub-harmonics for the calculations. {0, 2}

Iterations per harmonic — Select the number of iterations per harmonic for the calculations. {1.0, 10}

Frequency of mother wavelet — Enter the central frequency of the reference wavelet in Hz.

Number of octaves — Enter the number of octaves.

Number of tones per octave — Enter the number of tones per octave.

Gaussian width factor — Enter the Gaussian width.

Center frequency of lowest wavelet — Enter the frequency of lower wavelet.

Wavelet type — Select the wavelet type to be used from the list: Morlet wavelet.

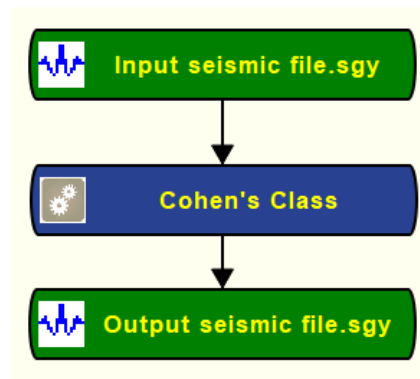
Cohen's Class

Usage: The Cohen's Class step applies time-frequency distributions that belong to the Cohen's class of bilinear transforms. These transforms are used to analyze seismic signals in both time and frequency domains simultaneously.

Input Links: 1) Seismic data in any CMP order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box, titled 'Cohen's Class', contains the following parameters and controls:

- Processing start time (ms):
- Processing end time (ms):
- First output frequency (Hz):
- Last output frequency (Hz):
- Output frequency increment (Hz):
- Kernel width:
- Kernel height:
- Output type: (dropdown menu)
- Buttons: OK, Help, Cancel

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds (not yet implemented).

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

First output frequency (Hz) — Enter the first output frequency to be considered in the output.

Last output frequency (Hz) — Enter the last output frequency to be considered in the output.

Output frequency increment (Hz) — Enter the frequency increment to be considered in the output.

Kernel width — Enter the kernel width.

Kernel height — Enter the kernel height.

Output type — Select the output type to be used from the list: Magnitude.

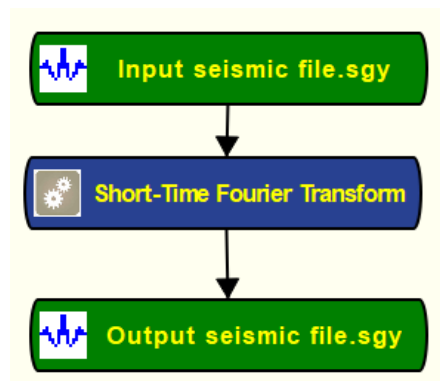
Short-Time Fourier Transform

Usage: The Short-Time Fourier Transform step applies a Fourier transform to the input seismic data.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box, titled 'Short-Time Fourier Transform', contains the following parameters and controls:

- Processing start time (ms):
- Processing end time (ms):
- First output frequency (Hz):
- Last output frequency (Hz):
- Output frequency increment (Hz):
- Window length (ms):
- Window type:
- Output type:
- Buttons: OK, Help, Cancel

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds (not yet implemented).

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

First output frequency (Hz) — Enter the first output frequency to be considered in the output.

Last output frequency (Hz) — Enter the last output frequency to be considered in the output.

Output frequency increment (Hz) — Enter the frequency increment to be considered in the output.

Window length (ms) — Enter the window length in milliseconds.

Window type — Select the window type to be used from the list: Gaussian; Papoulis; Blackman; Hanning; Hamming; Rectangle.

Output type — Select the output type to be used from the list: Magnitude.

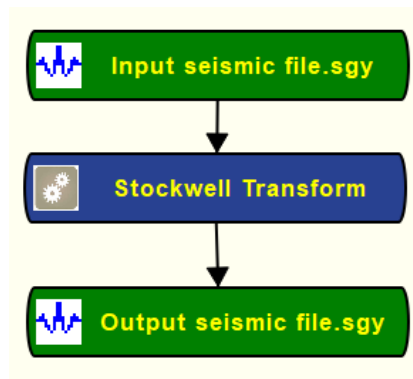
Stockwell Transform

Usage: The Stockwell Transform step is a frequency analysis technique that combines the localization Short-Time Fourier Transform (STFT) with the multi-resolution capabilities of wavelet transforms, allowing for detailed spectral decomposition of seismic signals.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled 'Stockwell Transform' and contains the following parameters:

- Processing start time (ms): 0.0
- Processing end time (ms): 2000.0
- First output frequency (Hz): 5
- Last output frequency (Hz): 80
- Output frequency increment (Hz): 1
- K Value: 1.0
- Output type: Magnitude (dropdown menu)

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds (not yet implemented).

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

First output frequency (Hz) — Enter the first output frequency to be considered in the output.

Last output frequency (Hz) — Enter the last output frequency to be considered in the output.

Output frequency increment (Hz) — Enter the frequency increment to be considered in the output.

K value — Enter the K value.

Output type — Select the output type to be used from the list: Magnitude; Phase.

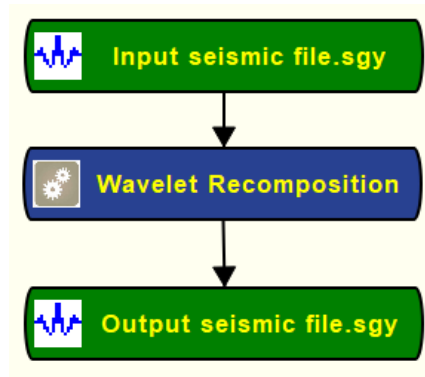
Wavelet Recomposition

Usage: The Wavelet Recomposition step is a bandwidth enhancement processing step based on wavelet recomposition.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Wavelet Recomposition" and contains the following parameters:

Parameter	Value
Processing start time (ms)	0.00
Processing end time (ms)	2000.00
Frequency of mother wavelet	128.0
Number of octaves	6
Number of tones per octave	12
Gaussian width factor	1.00
Center frequency of lowest wavelet	2.00
Number of harmonics	1
Apply harmonic lo-cut	☒
Apply gain limit	☐
Gain limit (dB)	42.00
Limit maximum frequency	☐
Maximum frequency	128
Output type	☒ Output enhanced trace ☐ Output harmonic ☐ Output scalar model ☐ Output phase model

Buttons: OK, Help, Cancel

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

Number of harmonics — Select the number of harmonics for the calculations. {0, 4}

Frequency of mother wavelet — Enter the central frequency of the reference wavelet in Hz.

Number of octaves — Enter the number of octaves.

Number of tones per octave — Enter the number of tones per octave.

Gaussian width factor — Enter the Gaussian width.

Center frequency of lowest wavelet — Enter the frequency of lower wavelet.

Apply harmonic lo-cut — If checked, applies a taper to the low harmonics.

Apply gain limit — If checked, applies a gain limit.

Gain limit (dB) — Enter gain limit in dB.

Limit maximum frequency — If checked, limits the maximum frequency of the analysis.

Maximum frequency — Enter the maximum frequency in Hz.

The **Output type** specifies the type of output data.

Output enhanced trace — If selected, outputs enhanced trace after calculation.

Output harmonic — If selected, outputs the harmonic.

Output scalar model — If selected, outputs scalar model.

Output phase model — If selected, outputs phase model.

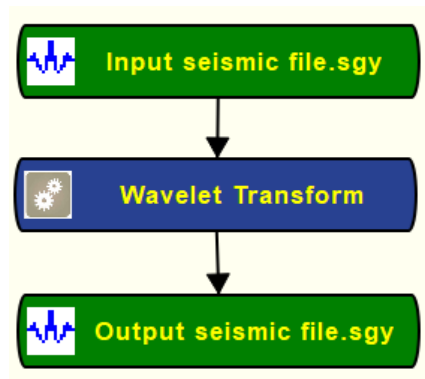
Wavelet Transform

Usage: The Wavelet Transform step decomposes the input seismic with a wavelet transform.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a 'Wavelet Transform' dialog box with the following parameters:

Parameter	Value
Processing start time (ms)	0.0
Processing end time (ms)	2000.0
First output frequency (Hz)	5
Last output frequency (Hz)	80
Output frequency increment (Hz)	1
Frequency of mother wavelet	128.0
Number of octaves	6
Number of tones per octave	12
Gaussian width factor	1.0
Output type	Magnitude
Wavelet type	Complex Morlet

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

First output frequency (Hz) — Enter the first output frequency to be considered in the output.

Last output frequency (Hz) — Enter the last output frequency to be considered in the output.

Output frequency increment (Hz) — Enter the frequency increment to be considered in the output.

Frequency of mother wavelet — Enter the central frequency of the reference wavelet in Hz.

Number of octaves — Enter the number of octaves.

Number of tones per octave — Enter the number of tones per octave.

Gaussian width factor — Enter the Gaussian width. Blackman; Hanning; Hamming; Rectangle.

Output type — Select the output type to be used from the list: Magnitude; Phase; Phase and Magnitude; Wavelet.

Wavelet type — Select the wavelet type to be used from the list: Complex Morlet.

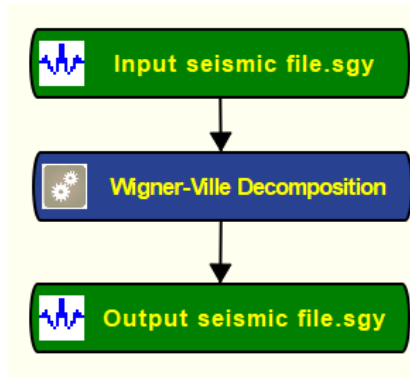
Wigner-Ville Decomposition

Usage: The Wigner-Ville Decomposition step apply the Wigner-Ville distribution (WVD) to analyze seismic signals in the joint time-frequency domain with high resolution.

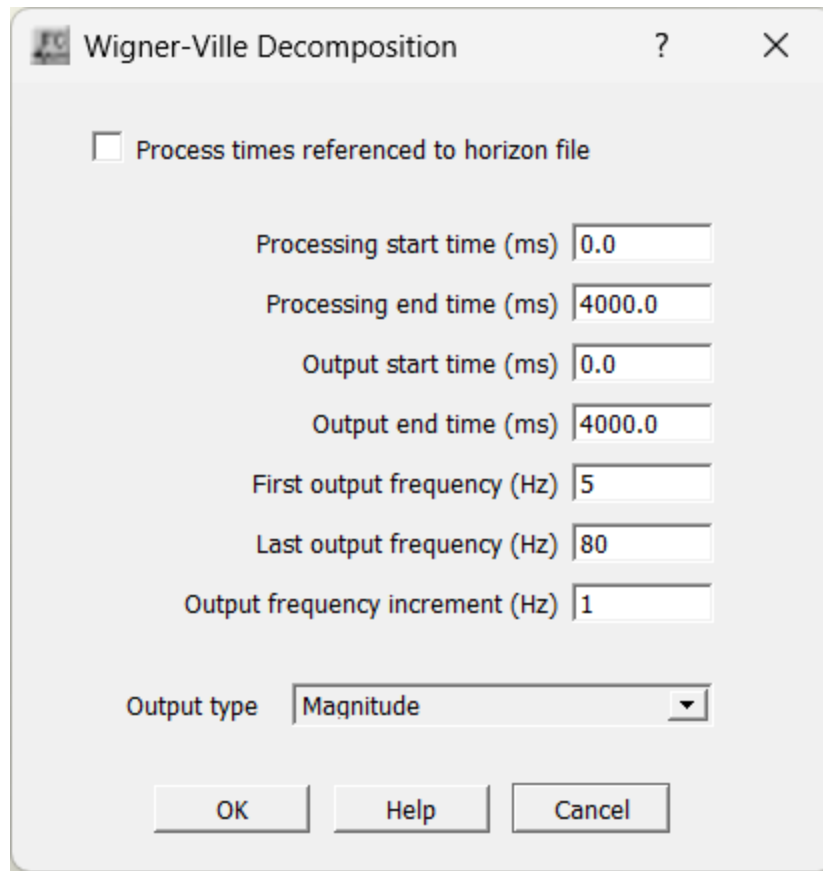
Input Links: 1) Seismic data in any order (mandatory); 2) Seismic horizon card data file (optional)

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Wigner-Ville Decomposition". It contains several input fields and a checkbox. The checkbox "Process times referenced to horizon file" is unchecked. Below it are six input fields: "Processing start time (ms)" with value 0.0, "Processing end time (ms)" with value 4000.0, "Output start time (ms)" with value 0.0, "Output end time (ms)" with value 4000.0, "First output frequency (Hz)" with value 5, and "Last output frequency (Hz)" with value 80. Below these is "Output frequency increment (Hz)" with value 1. At the bottom is a dropdown menu for "Output type" set to "Magnitude". At the very bottom are three buttons: "OK", "Help", and "Cancel".

Parameter	Value
Process times referenced to horizon file	☐
Processing start time (ms)	0.0
Processing end time (ms)	4000.0
Output start time (ms)	0.0
Output end time (ms)	4000.0
First output frequency (Hz)	5
Last output frequency (Hz)	80
Output frequency increment (Hz)	1
Output type	Magnitude

Parameter Description:

Process times referenced to horizon file — If checked, uses a horizon card data file to reference times.

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

First output frequency (Hz) — Enter the first output frequency to be considered in the output.

Last output frequency (Hz) — Enter the last output frequency to be considered in the output.

Output frequency increment (Hz) — Enter the frequency increment to be considered in the output.

Output type — Select the output type to be used from the list: Magnitude; Phase; Phase and Magnitude.

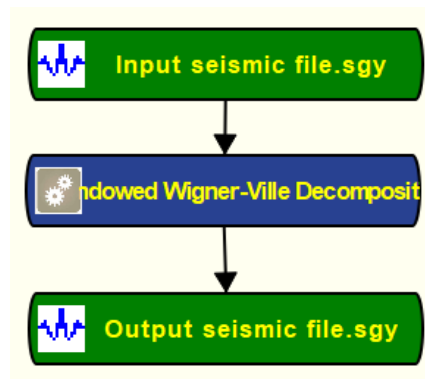
Windowed Wigner-Ville Decomposition

Usage: The Windowed Wigner-Ville Decomposition step apply the Wigner-Ville distribution (WVD) to analyze seismic signals in the joint time-frequency domain with high resolution considering multiple time widows of fixed size.

Input Links: 1) Seismic data in any order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled 'Windowed Wigner-Ville Decom...'. It features several input fields for configuring the analysis: 'Processing start time (ms)' set to 0.0, 'Processing end time (ms)' set to 2000.0, 'First output frequency (Hz)' set to 5, 'Last output frequency (Hz)' set to 80, 'Output frequency increment (Hz)' set to 1, and 'Window length (ms)' set to 200. At the bottom, there is a dropdown menu for 'Output type' currently showing 'Magnitude'. The dialog is closed with 'OK', 'Help', or 'Cancel' buttons.

Parameter	Value
Processing start time (ms)	0.0
Processing end time (ms)	2000.0
First output frequency (Hz)	5
Last output frequency (Hz)	80
Output frequency increment (Hz)	1
Window length (ms)	200
Output type	Magnitude

Parameter Description:

Process times referenced to horizon file — If checked, uses a horizon card data file to reference times.

Processing start time (ms) — Enter the start time (upper boundary) of the analysis in milliseconds.

Processing end time (ms) — Enter the end time (lower boundary) of the analysis in milliseconds.

First output frequency (Hz) — Enter the first output frequency to be considered in the output.

Last output frequency (Hz) — Enter the last output frequency to be considered in the output.

Output frequency increment (Hz) — Enter the frequency increment to be considered in the output.

Window length (ms) — Enter the window length for the analysis in milliseconds.

Output type — Select the output type to be used from the list: Magnitude; Phase; Phase and Magnitude.

Stacking Summing Steps

This section documents the processing steps available in the Stacking and Summing Steps category.

Processing steps currently available are:

 Processing Categories
CMP Stack
Horizontal Trace Sum
Median Stack
Real Time 2D CMP Stack
Real Time 3D CMP Stack
Receiver Order Stack
Source Order Stack
Trace Mixing

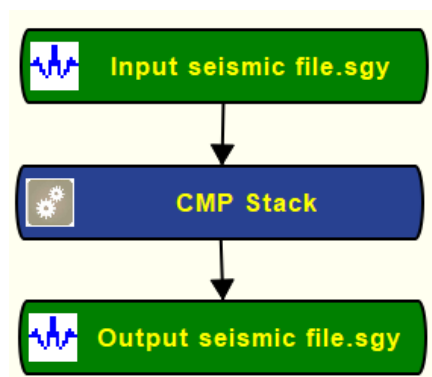
CMP Stack

Usage: The CMP Stack step generates a CMP stack seismic file from CMP sorted input data. The user may choose among stacking all offsets, the near 1/3 offsets, or the mid 1/3 offsets, the far 1/3 offsets. The user may also choose to stack signed (positive and negative) or unsigned (absolute value of positive and negative) offsets. For the signed or unsigned offset cases, the step allows to specify the minimum and maximum offsets to stack. The user may apply a scaling exponent for scaling of the seismic traces. Traces are scaled by the fold of the seismic data raised to the power of the chosen exponent (i.e. fold^{EXP}). The user also specifies whether to sum relative or absolute amplitude traces.

Input Links: 1) Seismic data in any CMP order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

CMP Stack

Normalization exponent

Offset range definition

☒ All offsets
 ☐ Near offsets
☐ Mid offsets
 ☐ Far offsets
☐ Signed offsets
 ☐ Unsigned offsets

Minimum offset

Maximum offset

Trace amplitude definition

☒ Use true amplitude traces
☐ Use relative amplitude traces

☒ Reapply early mute
☐ Remove sample mean after stack
☐ Override: Write 3D output to 2D format

Parameter Description:

Normalization exponent — Enter the scaling exponent. Traces are scaled by $(fold^{exp})$.

The **Offset range definition** specifies the offset range for the stack.

All offsets — If selected, all offsets will be stacked.

Near offsets — If selected, the near 1/3rd offsets will be stacked.

Mid-range — If selected, the mid 1/3rd offsets will be stacked.

Far offsets — If selected, the far 1/3rd offsets will be stacked.

Signed offset — If selected, offsets in the signed (both positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Unsigned offset — If selected, offsets in the unsigned (absolute value of positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Minimum — Enter the minimum offset range to stack.

Maximum — Enter the maximum offset range to stack.

The **Trace amplitude definition** specifies the type of amplitudes to be used for the stack.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Reapply early mute — If checked, reapplies an early mute after stacking the data

Remove sample mean after stack — If checked, removes the average DC bias from each stacked trace.

Override: Write 3D output to 2D format — If checked, writes the output as a 2D seismic file.

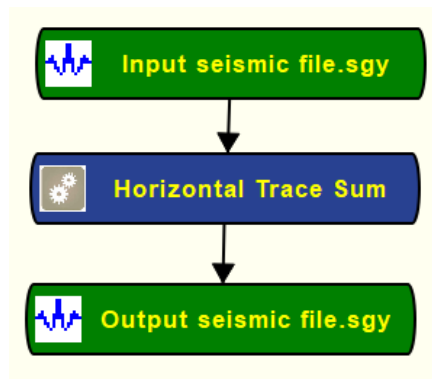
Horizontal Trace Sum

Usage: The Horizontal Trace Sum step is used to perform a horizontal sum of multiple input traces into a single output trace based on either the sequential or the offset order of the input traces.

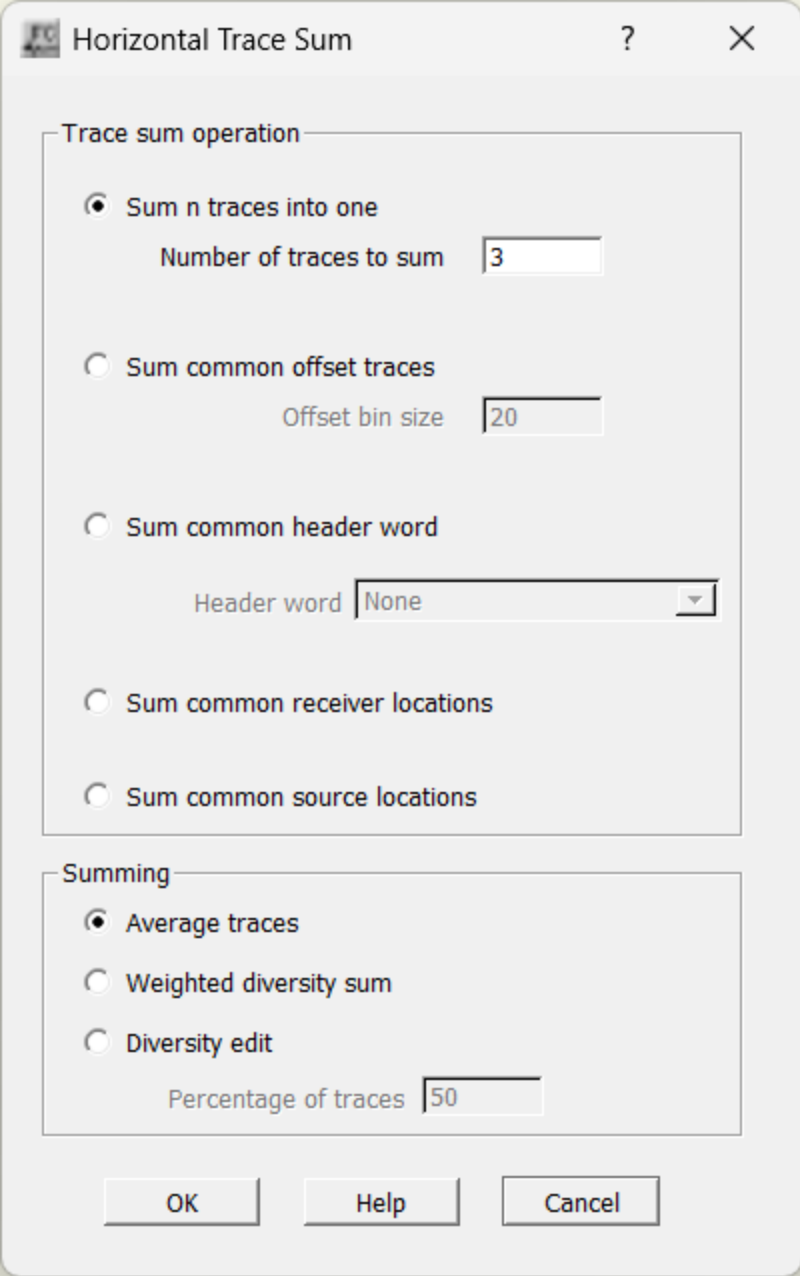
Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Horizontal Trace Sum". It contains two main sections: "Trace sum operation" and "Summing".

Trace sum operation

- ☒ Sum n traces into one
Number of traces to sum:
- ☐ Sum common offset traces
Offset bin size:
- ☐ Sum common header word
Header word:
- ☐ Sum common receiver locations
- ☐ Sum common source locations

Summing

- ☒ Average traces
- ☐ Weighted diversity sum
- ☐ Diversity edit
Percentage of traces:

At the bottom are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **Trace Sum Operation** specifies whether to sum traces sequentially or by common offset bin.

Sum n traces into one — If selected, sum n consecutive seismic traces into a single output trace.

Number of traces to sum — Enter the number of sequential input traces to sum into a single output trace.

Sum common offset traces — If selected, sum seismic traces within a specified offset bin size.

Offset bin size — Enter the offset bin size over which input traces will be summed into a single output trace. All input trace offsets falling between $(n) * \text{offset bin size}$ and $(n+1) * \text{offset bin size}$ will be summed into a single output trace.

Sum common header word — If selected, sum traces with a common header work as defined in Header word

Header word — Selected the header word location to be used to sum traces.

Sum common receiver locations — If selected, sum traces with common receiver locations into a single output trace.

Sum common source locations — If selected, sum traces with common source locations into a single output trace.

The **Summing** specifies how selected traces are summed.

Average traces — If selected, average horizontally all traces selected with equal weights for all traces.

Weighted diversity sum — If selected, each trace is scaled by the inverse of its average power prior to stacking. The composite trace is then renormalized by dividing by the sum of the scalers used.

Diversity edit — If selected, only a percentage of traces as defined in the Percentage of traces is summed.

Percentage of traces — Enter the percentage of traces from the selected range to be summed.

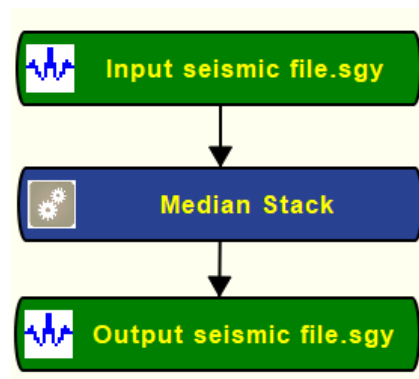
Median Stack

Usage: The Median Stack step performs a sample by sample horizontal stack using a specified percent of the samples centered on the median sample.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

Median Stack

Percent of traces to stack

Normalization exponent

Offset range definition

☒ All offsets ☐ Near offsets

☐ Mid offsets ☐ Far offsets

☐ Signed offsets ☐ Unsigned offsets

Minimum offset

Maximum offset

Trace amplitude definition

☒ Use true amplitude traces

☐ Use relative amplitude traces

☒ Reapply early mute

☐ Remove sample mean after stack

Parameter Description:

Percent of traces to stack — Enter the percentage of traces to sum into each resulting output trace. A number such as 50 indicates that 50% of the samples centered on the median sample value will contribute to the summed output sample.

Normalization exponent — Enter the scaling exponent. Traces are scaled by $(fold^{exp})$.

The **Offset range definition** specifies the offset range for the stack.

All offsets — If selected, all offsets will be stacked.

Near offsets — If selected, the near 1/3rd offsets will be stacked.

Mid offsets — If selected, the mid 1/3rd offsets will be stacked.

Far offsets — If selected, the far 1/3rd offsets will be stacked.

Signed offset — If selected, offsets in the signed (both positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Unsigned offset — If selected, offsets in the unsigned (absolute value of positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Minimum offset — Enter the minimum offset range to stack.

Maximum offset — Enter the maximum offset range to stack.

The **Trace amplitude definition** specify type of amplitudes to be used for the stack.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Reapply early mute — If checked, reapplies an early mute after stacking the data

Remove sample mean after stack — If checked, removes the average DC bias from each stacked trace.

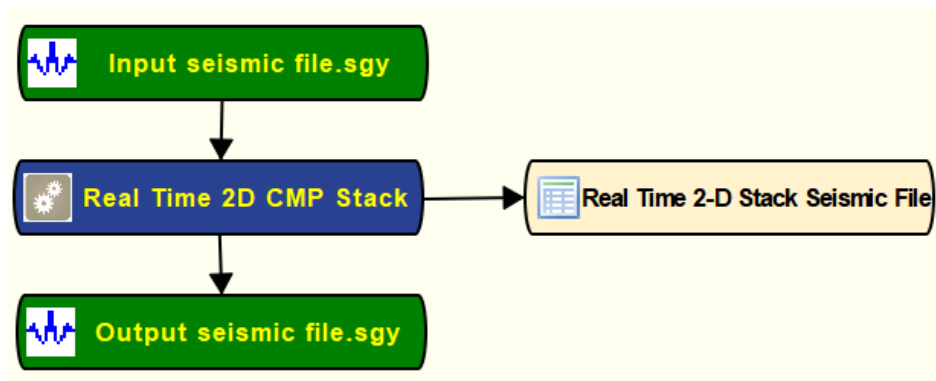
Real Time 2D CMP Stack

Usage: The Real Time CMP Stack step generates a CMP fullstack seismic file from CMP sorted input data with a real time input. This step allows to display the resulting stack in real time using a Real Time Stack Display. The output stack is stored in an output seismic file.

Input Links: 1) Seismic data in any CMP order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time 2D CMP Stack ? X

☒ **Apply frequency bandpass**

Initial freq. (Hz.)	250	dB/octave attenuation	6
Final freq. (Hz.)	3000	dB/octave attenuation	36

☒ **Remove Sample Mean**

Trace amplitude definition

☒ Use true amplitude traces Stack Normalization exponent: 1.0

☐ Use relative amplitude traces Minimum Stack Fold: 20

☒ **Apply NMO correction**

☐ Use velocity from card data file ☒ Use constant velocity: 1500

☐ **Apply receiver depth static corrections** Seawater velocity: 1500

☒ **Apply front end mute** Apparent velocity: 1500

☐ **Apply stretch mute** % stretch: 30 Taper length (samples): 15

☐ **Limit trace offsets:** Min offset: 0.00 Max offset: 0.00

Maximum offset for locations: 20.00

CMP stack output

☒ Use auto-generated file name(s) ☐ Display in real time

☐ Use the specified file name ☐ Output ASCII Path file

File name suffix: ☐ O/p stack images

Parameter Description:

Apply frequency bandpass — If checked, applies a frequency bandpass filter before visualization.

Use Butterworth — If selected, applies a Butterworth filter.

Use frequencies — If selected, applies a frequency filter.

Initial freq. (Hz) — Enter the low pass frequency of the frequency bandpass filter in Hertz.

Final freq. (Hz) — Enter the high pass frequency of the frequency bandpass filter in Hertz.

dB/octave decay — Enter the low pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

dB/octave decay — Enter the high pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

Remove sample mean after stack — If checked, removes the average DC bias from each stacked trace.

The **Trace amplitude definition** specifies the type of amplitudes to be used for the stack.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Stack Normalization exponent — Enter the exponential weighting to apply to the input traces when summing them. This number will generally be close to and not exceeding 1.

Minimum Stack Fold — Enter the minimum number of traces (i.e., fold) to be considered for stacking.

Apply NMO correct — If checked, corrects for normal moveout correct before stack.

Use constant velocity — Enter the stacking velocity to be used in the normal moveout correction.

Apply receiver depth statis corrections — not yet implemented.

Apply front end mute — If checked, applies a front end mute given an apparent velocity.

Apparent velocity — Enter the apparent velocity for the front end mute.

Apply stretch mute — If checked, a stretch mute will be applied to the NMO corrected data. Stretch muting removes the stretching of the data due to the NMO correction.

Percentage — Enter the stretch mute percentage. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

Limit traces offsets — If checked, limits the number of traces considered by offset.

Min offset — Enter the minimum offset to be considered in project units.

Max offset — Enter the maximum offset to be considered in project units.

Maximum offset for locations — Enter the maximum offset of the traces to be used to average the CMP location output to trace headers. This location will be used if an ASCII Path file is output.

The **CMP stack output** specifies the output stack parameters and the automatic generation of figures with the stack.

Use auto-generated file name(s) — If selected, set to output the stack data to files whose names are date stamped and based on the line number.

Use the specified file name — If selected, set to output the stack data to the specified file.

Display in real time — If checked, a real time seismic display will show a portion of the data as it is being stacked.

Output ASCII Path file — If selected, outputs the determined CMP locations into an ASCII file.

O/p stack images — Check to output stack image files, one per output line.

Set images parameters — Click to set the parameters to be used in displaying the seismic data.

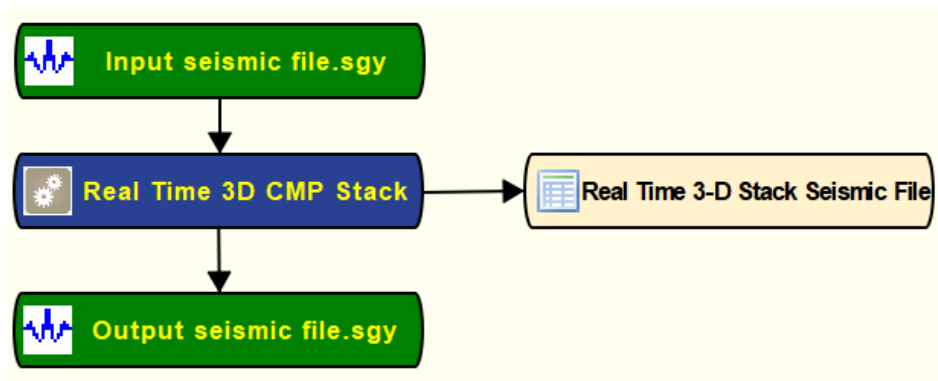
Real Time 3D CMP Stack

Usage: The Real Time CMP Stack step generates a CMP fullstack seismic file from CMP sorted input data with a real time input. This step allows to display the resulting stack in real time using a Real Time Stack Display. The output stack is stored in an output seismic file.

Input Links: 1) Seismic data in any CMP order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time 3D CMP Stack

☒ **Apply frequency bandpass**

☒ Use Butterworth Initial freq. (Hz.) dB/octave decay
☐ Use frequencies Final freq. (Hz.) dB/octave decay

☒ **Remove Sample Mean**

Trace amplitude definition

☒ Use true amplitude traces Stack Normalization exponent
☐ Use relative amplitude traces Stacking buffer factor

☒ Check stack trace positions

☒ **NMO correct** Stacking velocity

☐ **Apply receiver depth static corrections**

☒ **Apply front end mute** Apparent velocity

☐ **Limit trace offsets**

Minimum Offset Maximum Offset
☐ Stack 1 trace / offset Offset interval
☐ Include flex traces

☐ **Display in real time**

☒ Display in-line shooting
☐ Display any-direction shooting Use New Version ☐

☐ **Remove data from stack!**

OK Help Cancel

Parameter Description:

Apply frequency bandpass — If checked, applies a frequency bandpass filter before visualization.

Use Butterworth — If selected, applies a Butterworth filter.

Use frequencies — If selected, applies a frequency filter.

Initial freq. (Hz) — Enter the low pass frequency of the frequency bandpass filter in Hertz.

Final freq. (Hz) — Enter the high pass frequency of the frequency bandpass filter in Hertz.

dB/octave decay — Enter the low pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

dB/octave decay — Enter the high pass rolloff rate in dB/Octave. Higher numbers give a steeper filter rolloff.

Remove sample mean after stack — If checked, removes the average DC bias from each stacked trace.

The **Trace amplitude definition** specifies the type of amplitudes to be used for the stack.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Stack Normalization exponent — Enter the exponential weighting to apply to the input traces when summing them. This number will generally be close to and not exceeding 1.

Stacking buffer factor — Enter a stacking buffer during the input seismic file reading. Specify this as at least the swath width divided by the number of streamers. This factor determines the simultaneous number of bins used for stacking, and is important for the efficient running of the step.

Check stack traces positions — If checked, each stacked trace is being written to its correct place on disk. This may increase run time a little and is not normally required.

NMO correct — If checked, corrects for normal moveout correct before stack.

Stacking velocity — Enter the stacking velocity to be used in the normal moveout correction.

Apply receiver depth static corrections — not yet implemented.

Apply front end mute — If checked, applies a front end mute given an apparent velocity.

Apparent velocity — Enter the apparent velocity for the front end mute.

Limit traces offsets — If checked, limits the number of traces considered by offset.

Minimum offset — Enter the minimum offset to be considered in project units.

Maximum offset — Enter the maximum offset to be considered in project units.

Stack 1 trace / offset — If checked, stack one trace per offset.

Include flex traces — If checked, include flex binned traces in the stack.

Offset interval — Enter the offset interval to be considered.

Display in real time — If checked, display in 3D stack in real-time.

Display in-line shooting — If selected, display the stack in the in-line shooting direction.

Display any-direction shooting — If selected, the stack does not consider any direction.

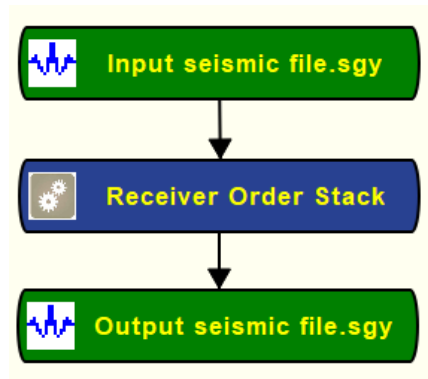
Receiver Order Stack

Usage: The Receiver Order Stack step allows to input data sorted in common receiver order and output a common receiver stack seismic file. The user may apply a scaling exponent for scaling of your traces. Traces are scaled by the fold of the seismic data raised to the power of the chosen exponent (i.e. $fold^{exp}$). The user also specifies whether to sum relative or absolute amplitude traces.

Input Links: 1) Seismic data in common receiver sort order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

Receiver Order Stack

Normalization exponent

Offset range definition

☒ All offsets
 ☐ Near offsets
☐ Mid offsets
 ☐ Far offsets
☐ Signed offsets
 ☐ Unsigned offsets

Minimum offset

Maximum offset

Trace amplitude definition

☒ Use true amplitude traces
☐ Use relative amplitude traces

☒ Reapply early mute
☐ Remove sample mean after stack
☐ Override: Write 3D output to 2D format

OK Help Cancel

Parameter Description:

Normalization exponent — Enter the scaling exponent. Traces are scaled by $(fold^{exp})$.

The **Offset range definition** specifies the offset range for the stack.

All offsets — If selected, all offsets will be stacked.

Near offsets — If selected, the near 1/3rd offsets will be stacked.

Mid offsets — If selected, the mid 1/3rd offsets will be stacked.

Far offsets — If selected, the far 1/3rd offsets will be stacked.

Signed offsets — If selected, offsets in the signed (both positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Unsigned offsets — If selected, offsets in the unsigned (absolute value of positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Minimum offset — Enter the minimum offset range to stack.

Maximum offset — Enter the maximum offset range to stack.

The **Trace amplitude definition** specifies the type of amplitudes to be used for the stack.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Reapply early mute — If checked, reapplies an early mute after stacking the data

Remove sample mean after stack — If checked, removes the average DC bias from each stacked trace.

Override: Write 3D output to 2D format — If checked, writes the output as a 2D seismic file.

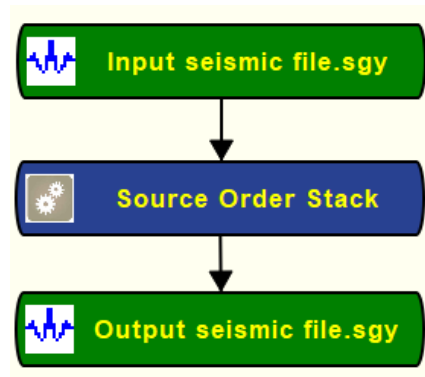
Source Order Stack

Usage: The Source Order Stack step allows to input data sorted in common source order and output a common source stack seismic file. The user may apply a scaling exponent for scaling of the seismic traces. Traces are scaled by the fold of the seismic data raised to the power of the chosen exponent (i.e. $fold^{exp}$). The user also specifies to sum relative or absolute amplitude traces.

Input Links: 1) Seismic data in common source sort order (mandatory).

Output Links: 1) Seismic data as a stack (mandatory).

Example Flowchart:



Step Parameter Dialog:

Source Order Stack

Normalization exponent

Offset range definition

☒ All offsets
 ☐ Near offsets
 ☐ Mid offsets
 ☐ Far offsets
 ☐ Signed offsets
 ☐ Unsigned offsets

Minimum offset

Maximum offset

Trace amplitude definition

☒ Use true amplitude traces
 ☐ Use relative amplitude traces

☒ Reapply early mute
 ☐ Remove sample mean after stack
 ☐ Override: Write 3D output to 2D format

Parameter Description:

Normalization exponent — Enter the scaling exponent. Traces are scaled by $(fold^{exp})$.

The **Offset range definition** specifies the offset range for the stack.

All offsets — If selected, all offsets will be stacked.

Near offsets — If selected, the near 1/3rd offsets will be stacked.

Mid offsets — If selected, the mid 1/3rd offsets will be stacked.

Far offsets — If selected, the far 1/3rd offsets will be stacked.

Signed offsets — If selected, offsets in the signed (both positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Unsigned offsets — If selected, offsets in the unsigned (absolute value of positive and negative offsets) range will be stacked. Specify the minimum and maximum offsets to be used.

Minimum offset — Enter the minimum offset range to stack.

Maximum offset — Enter the maximum offset range to stack.

The **Trace amplitude definition** specifies the type of amplitudes to be used for the stack.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, relative amplitude will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Reapply early mute — If checked, reapplies an early mute after stacking the data

Remove sample mean after stack — If checked, removes the average DC bias from each stacked trace.

Override: Write 3D output to 2D format — If checked, writes the output as a 2D seismic file.

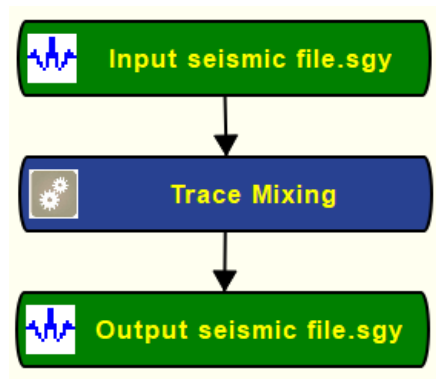
Trace Mixing

Usage: The Trace Mixing step is used to perform a weighted horizontal sum of up to fifteen (15) sequential input traces into a single output trace.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Trace Mixing' dialog box has a title bar with a question mark and a close button. It contains a 'Number of traces to mix' field with a spinner set to 3. Below this is a table with two columns: 'Trace' and 'Weight'. The table has two rows, both with '1' in the 'Trace' column and '1.0000' in the 'Weight' column. There are scroll bars on the right and bottom of the table. At the bottom of the dialog is a checkbox labeled 'Normalize weights prior to application' which is unchecked. Below the checkbox are three buttons: 'OK', 'Help', and 'Cancel'.

Trace	Weight
1	1.0000
2	1.0000

☐ Normalize weights prior to application

OK Help Cancel

Parameter Description:

Number of traces to mix — Enter the number of traces to mix (blend) into each output trace.

Weight — The relative value of the weight for each trace in the mix.

Statics Steps

Statics
 Processing Categories
Apply Static Shifts
Datum Statics
Estimate Receiver Depth
First Arrival Picking
First Break Auto-Picking
Flat Datum Statics
Real Time Direct Arrival Picking
Real Time Seabed Picking
Real Time Tide Correction
Stack-Power Optimization Statics
Surface Consistent Residual Statics
Swell Static Real Time Filter
Trim Statics

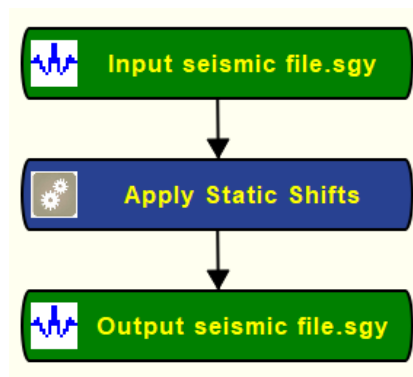
Apply Static Shifts

Usage: The Apply Static Shifts step allows to apply source, receiver, CMP, and trace statics calculated by the various statics processing steps. The static shift values can be applied in either a coarse grain mode or fine grain mode. The coarse grain mode applies static shifts by shifting the trace to the nearest sample in the time domain. The fine grain mode uses a phase shift in the frequency domain to apply the shift, allowing an efficient method of shifting the seismic data in increments less than the sample interval.

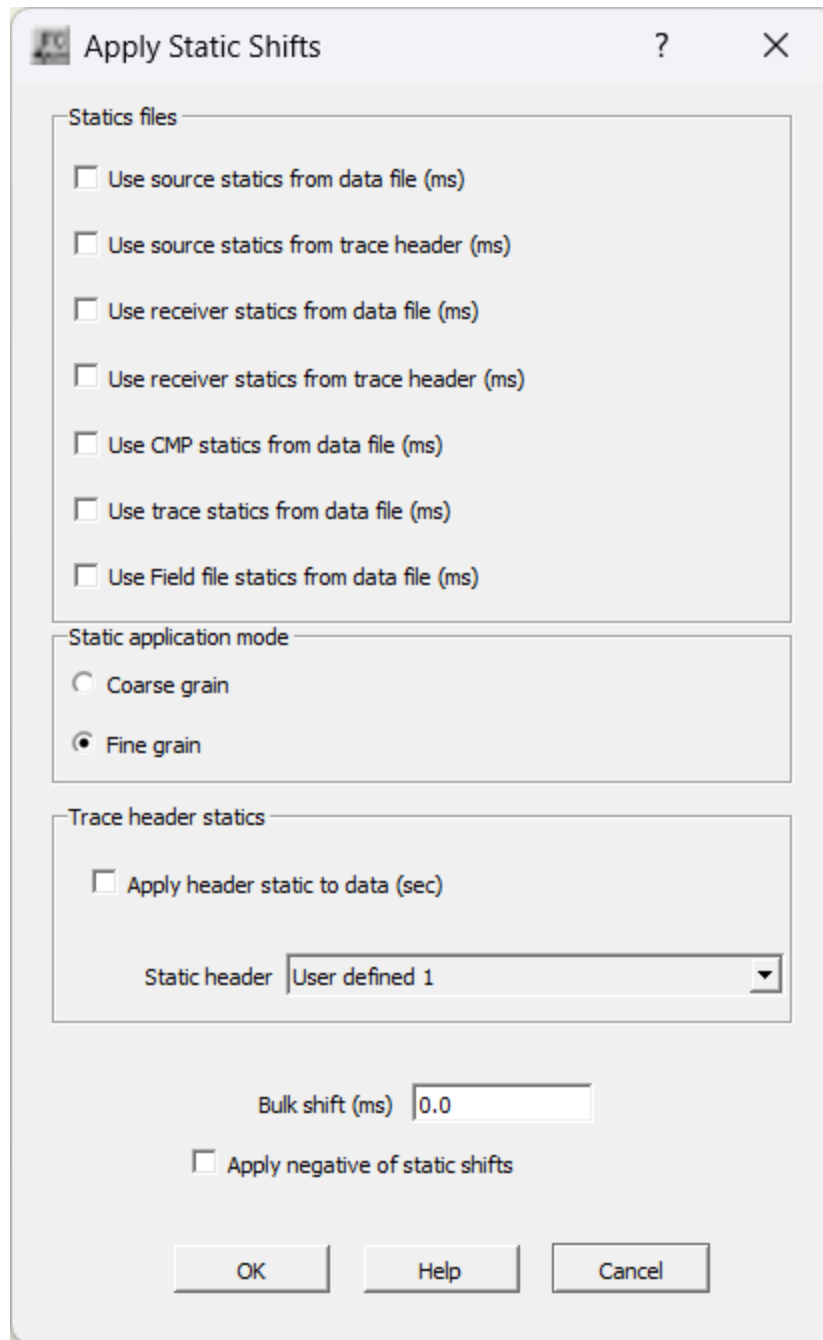
Input Links: 1) Seismic data in any sort order (mandatory); 2) CMP Statics cards (optional); 3) Receiver Statics cards (optional); 4) Source Statics cards (optional); 5) Trace Statics cards (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The dialog box is titled "Apply Static Shifts" and contains three main sections. The "Statics files" section has seven unchecked checkboxes. The "Static application mode" section has two radio buttons, with "Fine grain" selected. The "Trace header statics" section has one unchecked checkbox and a dropdown menu set to "User defined 1". At the bottom, there is a text input for "Bulk shift (ms)" with the value "0.0", an unchecked checkbox for "Apply negative of static shifts", and three buttons: "OK", "Help", and "Cancel".

Statics files

- ☐ Use source statics from data file (ms)
- ☐ Use source statics from trace header (ms)
- ☐ Use receiver statics from data file (ms)
- ☐ Use receiver statics from trace header (ms)
- ☐ Use CMP statics from data file (ms)
- ☐ Use trace statics from data file (ms)
- ☐ Use Field file statics from data file (ms)

Static application mode

☐ Coarse grain

☒ Fine grain

Trace header statics

☐ Apply header static to data (sec)

Static header User defined 1

Bulk shift (ms) 0.0

☐ Apply negative of static shifts

OK Help Cancel

Parameter Description:

The **Statics files** specifies the static shifts that will be applied.

Use source statics from data file (ms) — If checked, source statics shifts in milliseconds will be applied from a data file.

Use source statics from trace header (sec) — If checked, source statics shifts in seconds will be applied from a trace header.

Use receiver statics from data file (ms) — If checked, receiver statics shifts in milliseconds will be applied from a data file.

Use receiver statics from trace header (sec) — If checked, receiver statics shifts in seconds will be applied from a trace header.

Use CMP statics from data file (ms) — If checked, CMP statics shifts in milliseconds will be applied from a data file.

Use trace statics from data file (ms) — If checked, trace statics shifts in milliseconds will be applied from a data file.

Use Field file statics from data file (ms) — If checked, field file statics shifts in milliseconds will be applied from a data file.

The **Static application mode** specifies the mode of statics application.

Coarse grain — If selected, statics shifts are applied to the nearest discrete sample position.

Fine grain — If selected, statics shifts are applied as a precise phase shift operator in the Fourier domain.

The **Trace header statics** specifies the header location with statics to be applied to the seismic data.

Apply header static to data (sec) — If checked, the value in the user selected trace header field will be applied to the seismic trace as a static shift.

Static header — Use the drop down menu to select the trace header field that will be applied to the trace as a static shift.

Bulk shift (ms) — Enter a constant statics shift in milliseconds to apply to all the seismic data traces.

Apply negative of static shifts — If checked, the negative of the static values will be applied.

Datum Statics

Usage: The Datum Statics step inputs the trace headers from a Seismic Data file and outputs a set of Source and Receiver static files that adjust the data to a floating datum, and CMP static file that adjusts the data from the floating datum to a flat datum. Alternatively, the Source and Receiver statics can be computed that adjust the surface data directly to a flat datum. In both cases, the statics are applied using the Apply Statics step.

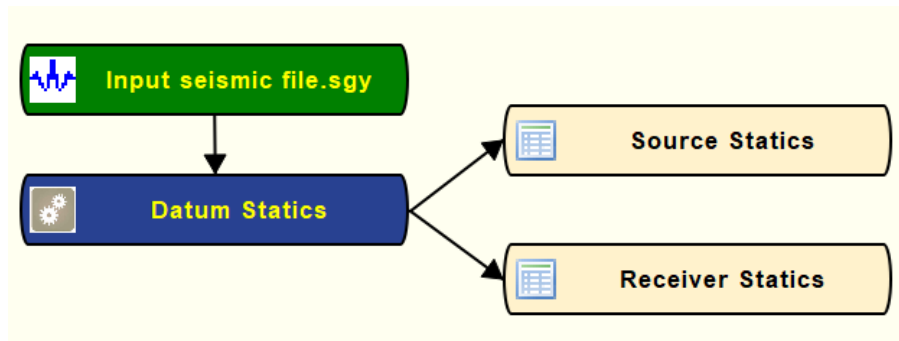
Input Links: 1) Seismic data file in any sort order (mandatory).

Output Links: 1) Source Statics cards (mandatory).

2) Receiver Statics cards (mandatory).

3) CMP Statics cards (optional, in the case of correction to a Floating Datum).

Example Flowchart:



Step Parameter Dialog:

Datum Statics

Reference datum

- ☒ Final datum
- ☐ Floating datum

Datum definition

Final datum elevation

Floating datum

- ☒ Mean datum static
- ☐ Median datum static
- ☐ Offset weighted datum static
 - Multiplier
 - Exponent

☐ Apply spatial smoothing

Radius of smoothing

Weathering correction

Elevation correction

Replacement velocity (Vp)

Replacement velocity (Vs)

Upholes

☐ Apply uphole time

Static output

- ☒ Output source statics file
- ☒ Output receiver statics file
- ☐ Output midpoint statics file

OK Help Cancel

Parameter Description:

The **Reference datum** specifies the datum preference.

Final datum — If selected final datum is considered.

Floating datum — If selected, a floating datum is considered.

The **Datum definition** specifies the parameters that define the datum preference.

Final datum elevation — Enter a constant value for the elevation of the flat datum.

The **Floating datum** specifies the parameters for a floating datum function, if Floating datum is selected.

Mean datum static — If selected, an average operator for calculating the datum static will be used to define the datum.

Median datum static — If selected, a median smoothing operator for calculating the datum static will be used to define the datum.

Offset weighted datum static — If selected, a weighted CMP elevation function of the form $\text{weight} = \text{multiplier} * (\text{offset}^{\text{exponent}})$ will be used to define the datum.

Multiplier — Enter the multiplier of the weighting function.

Exponent — Enter the exponent of the weighting function.

Apply spatial smoothing — If checked, apply spatial smoothing to the floating datum.

Radius of smoothing — Enter the radius of smoothing.

The **Elevation correction** specifies the replacement velocities to correct the elevation.

Replacement velocity (Vp) — Enter a constant value to correct the traces to the final datum using the consolidated p-wave velocity.

Replacement velocity (Vs) — Enter a constant value to correct the traces to the final datum using the consolidated s-wave velocity.

The **Upholes** specify whether to apply the uphole time.

Apply uphole time — If checked, the uphole static will be applied.

The **Static output** specifies how to output flat datum statics.

Output source statics file — If checked, source statics will be output as calculated from the surface to the flat datum.

Output receiver statics file — If checked, receiver statics will be output as calculated from the surface to the flat datum.

Output midpoint statics file — If checked, CMP statics will be output as zero.

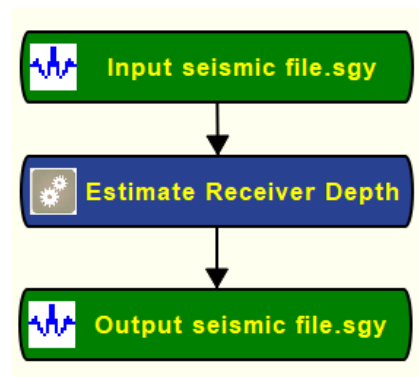
Estimate Receiver Depth

Usage: The Estimate Receiver Depth step estimate the receivers' depths using a streamer and acquisition configuration and the direct arrivals detected automatically from the field records. The estimate can use neighbor shots in space of previous shots in times.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

Set streamer configuration — If selected, set the number of sources, number of streamers, number of channels per streamer and the trace header word used to specify the source ID. If using the database, these parameters will be preset, and changing the values will not be enabled.

Set marine configuration — If selected, set the data marine parameters to be used.

If using the database, most of these parameters will be preset, and changing the values will not be enabled.

Direct arrival time: i/p header — Specify the trace header word containing the direct arrival time.

The **Direct arrival wavelet window** specifies the direct arrival wavelet window parameters.

Start time before direct arrival — Enter the start time in milliseconds before the seabed pick of the wavelet from each channel to be displayed.

Window length (ms) — Enter the window length in millisecond of the wavelet from each channel to be displayed.

Dispersion factor — Specify the dispersion factor.

Use surrounding shots — If selected, make the current shot pick in the center of the adjacent shots' picks. This option, which requires buffering and delayed output of the shots, generally gives the best results.

Use previous shots — If selected, make the line-search shots to be those of the same source immediately previous to the current shot. This option does not require buffering or delayed output of the data.

Average over 'n' shots — Specify the number of shots to be used in the smoothing of each of the streamer channels.

Linear streamer depths — If selected, make the current shot pick in the center of the adjacent shots' picks. This option, which requires buffering and delayed output of the shots, generally gives the best results.

Variable receiver depths — If selected, make the line-search shots to be those of the same source immediately previous to the current shot. This option does not require buffering or delayed output of the data.

Lead in shots — Specify the number of shots to be used as lead in (i.e., not considered in the smoothing).

Smoothness — Specify the number of channels to be used in the smoothing of each of the streamer channels.

O/p receiver depths (m) — If checked, write the calculated receiver depths to a specified trace header. If there are multiple sources, this depth will be averaged from the depths determined from the separate sources.

O/p header — Select the trace header to be used for output of the receiver depths determined from the current source.

O/p depths std dev — If checked, calculate and write to the chosen trace header, the standard deviation in the receiver depths calculated from each source independently. This value is intended to give some indication of how well the current data is being analyzed for the receiver depths.

O/p header — Specify the trace header to be used for output of the standard deviation of the receiver depths calculated from each source.

Overwrite receiver depths in database — If checked, the seabed picks in the database will be overwritten based on unique line ID, channel and field file numbers. Check this option for re-runs of line.

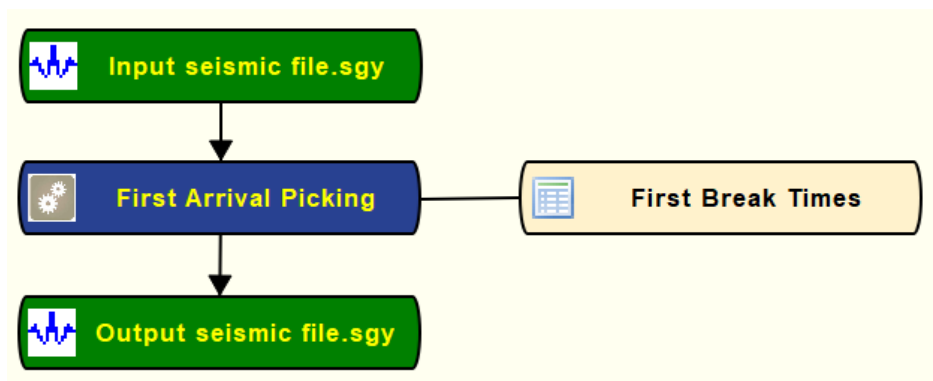
First Arrival Picking

Usage: The First Arrival Picking step automatically picks first arrivals from an input seismic file and writes the picking in a first break times card data.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory); 2) First break times card data (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "First Arrival Picking" and contains the following sections:

- Picking parameters**
 - ☐ First Arrivals search window
 - Starting time (ms): 0.0
 - Ending time (ms): 0.0
 - Energy window length (ms): 40.0
 - Long term window length (ms): 160.0
 - Threshold (%): 2
 - Pick phase: Trough
 - Pick phase search length (ms): 40.00
 - Output first arrival time to: User defined 1
 - ☐ Output pick trace
- Picking method**
 - ☒ Energy ratio
 - ☐ Modified energy ratio
 - ☐ STA/LTA
 - ☐ Array energy ratio
 - ☐ Peak tracking
 - ☐ Gradient normal
- Filtering and DC bias removal**
 - ☐ Median DC bias removal
 - ☐ Apply low-cut filter
 - Low-cut corner frequency (Hz): 9
 - Low-cut rolloff rate (dB/oct): 18
 - ☐ Apply high-cut filter
 - High-cut corner frequency (Hz): 250
 - High-cut rolloff rate (dB/oct): 18
 - ☒ Zero-Phase
 - ☐ Minimum-Phase

Buttons: OK, Help, Cancel

Specify low-c parameters.

Parameter Description:

The **Picking parameters** specify the search and automatic picking parameters of the first arrivals.

First Arrivals search window — If checked, defines a search window where the first arrivals will be picked.

Starting time (ms) — Enter the starting time of the searching window in milliseconds. To use a seismic trace header word with the starting time check the box.

Ending time (ms) — Enter the ending time of the searching window in milliseconds. To use a seismic trace header word with the ending time check the box.

Energy window length (ms) — Enter the length of the searching window in milliseconds for the automatic picking.

Threshold (%) — If checked, enter a percentage of the seismic amplitudes to be considered as first arrival.

Pick phase — Select the phase to be picked; Trough, Peak, +/- or -/+.

Pick phase search length (ms) — Enter the length of the pick phase window in milliseconds.

Output pick trace — If checked, the picked trace is part of the output data set.

The **Picking method** specify the method used for the automatic picking.

Energy ratio — If selected, uses the energy ratio of the signal to identify the first arrival.

Modified energy ratio — If selected, uses the energy ratio of the signal to identify the first arrival.

STA/LTA — If selected, uses the STA/LTA method to identify the first arrival.

The **Filtering and DC bias removal** specify the parameterization of the Butterworth and DC filters applied before the picking.

Median DC bias removal — If checked, applies a DC bias filter.

Apply low-cut filter – If checked, applies a low-filter to the data.

Low-cut corner frequency (Hz) – Enter the low-cut corner frequency of the filter.

Low-cut rolloff rate (dB/oct) – Enter the slope of the low-cut filter.

Apply High-cut filter – If checked, applies a high-filter to the data.

High-cut corner frequency (Hz) – Enter the high-cut corner frequency of the filter.

High-cut rolloff rate (dB/oct) – Enter the slope of the high-cut filter.

High-cut corner frequency (Hz) – Enter the high-cut corner frequency of the filter.

High-cut rolloff rate (dB/oct) – Enter the slope of the high-cut filter.

Zero-phase – If selected, applies a zero-phase Butterworth filter.

Minimum-phase – If selected, applies a minimum-phase Butterworth filter.

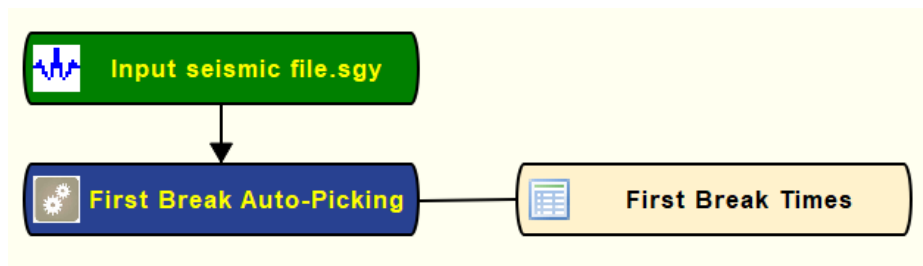
First Break Auto-Picking

Usage: The First Break Auto-picking step automatically picks the first arrivals of a field record based on its energy content. These picks can be used to compute statics.

Input Links: 1) Seismic data file in any sort order (mandatory).

Output Links: 1) First Break Times card file (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'First Break Autopicker' dialog box contains the following settings:

- Energy window length (ms): 40.0
- Energy smoothing length (ms): 60.0
- Pick Correction:
 - ☒ Interpolate missing First Breaks
 - ☐ Set missing First Breaks as dead traces
- ☒ Output picks to a First Breaks File
- ☒ Output picks to trace header: User defined 1 (dropdown menu)
- Diagnostic display:
 - ☐ Add first break picks to output data
 - ☐ Output energy trace

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Energy window length (ms) — Enter the window length to capture the first arrival energy (i.e., the period of the first-arrival waveform).

Energy window length (ms) — Enter the edge-preserving smoothing length. This is used to improve the ability to pick the first arrivals. It is recommended to set this length to between one and one and a half first arrival waveform periods.

Pick Correction — specifies the corrections applied to the picks

Interpolate missing First Breaks — If checked, interpolates in between first break pick.

Set missing First Breaks as dead traces — If checked, set traces where no First Breaks found as Dead traces.

Output picks to a First Break File — If checked creates a First Breaks file containing the pick times found.

Output picks to trace header — If checked, outputs the first arrival picks to the output data trace headers.

Diagnostic display — specifies the diagnostics to examine the first break picking visually. The output data will be suitable for this visual inspection only.

Add first break picks to output data — If checked, the output data will be augmented by an impulse at the time of the calculated first break pick.

Output energy traces — If checked, the data energy trace calculated and used by the picking algorithm will be output for visual inspection.

Flat Datum Statics

Usage: The Flat Datum Statics applies a static shift correction to all the traces in reference to a flat datum as defined by its elevation.

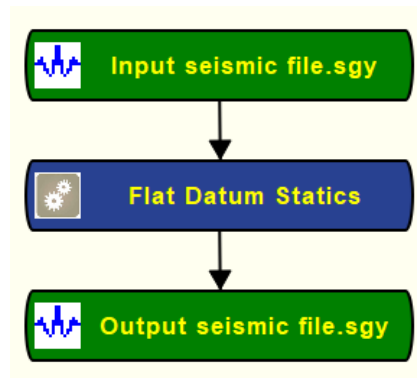
Input Links: 1) Seismic data file in any sort order (mandatory).

Output Links: 1) Seismic data file in any sort order (mandatory).

2) Source Statics cards (optional).

3) Receiver Statics cards (optional).

Example Flowchart:



Step Parameter Dialog:

The 'Flat Datum Statics' dialog box features a title bar with a question mark icon and a close button. It contains three input fields: 'Consolidated P velocity' with a value of 2000, 'Consolidated S velocity' with a value of 500, and 'Flat datum elevation' with a value of 0. Below these fields are three unchecked checkboxes: 'Include uphole time', 'Output source statics file', and 'Output receiver statics file'. At the bottom are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Consolidated P-velocity — Enter a constant value to correct the traces to the final datum using the consolidated P-wave velocity.

Consolidated S-velocity — Enter a constant value to correct the traces to the final datum using the consolidated S-wave velocity.

Final datum elevation — Enter a constant value for the elevation of the flat datum.

Include uphole time — If checked, the uphole static will be applied.

Output source statics file — If checked, source statics will be output as calculated from the surface to the flat datum.

Output receiver statics file — If checked, receiver statics will be output as calculated from the surface to the flat datum.

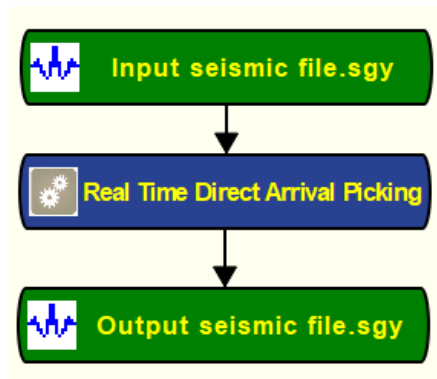
Real Time Direct Arrival Picking

Usage: The Real Time Direct Arrival step pick automatically the direct arrivals from the input seismic file.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time Direct Arrival Picker

☐ Apply spiking decon

☒ Apply frequency bandpass

Set marine configuration

Set decon parameters

Set bandpass parameters

Picking parameters

Picking window length (ms.) 4.0

Min ratio: first arrival/max peak 0.40

Peak polarity Negative

Direct arrival location Peak 0.3

Sea water velocity 1500.00

☐ Use time-varying search window

Max variation (ms) 10.0

☒ Use local pick verification

☐ Use surrounding shots

☒ Use previous shots

Analysis records per source 9

Near channel smoothness 3

Far channel smoothness 3

☒ Output picks to trace header: User defined 8

☐ Display picking windows in real time: Select Display Channels

☐ Overwrite direct arrival picks in database

OK Help Cancel

Parameter Description:

Set marine configuration — Select to set the marine acquisition geometry configuration.

Apply spiking decon — If checked, applies a spiking deconvolution to the data with the Set decon parameters. The spiking deconvolution is applied only for visualization.

Set decon parameters — Select the spiking deconvolution parameters to be applied to the data.

Apply frequency bandpass — If checked, applies a frequency bandpass filter to the data with the Set bandpass parameters. The spiking deconvolution is applied only for visualization.

Set bandpass parameters — Select the frequency bandpass filter parameters to be applied to the data.

The **Picking parameters** specifies the automatic real time direct arrival picking parameters.

Picking window length (ms.) — Enter the searching window length for automatic picking.

Min ratio: first arrival/max peak. — Enter the minimum ratio of first arrival, maximum peak to be considered for the automatic picking.

Peak polarity — Select the peak polarity: Negative or positive.

Direct arrival location — Enter the relative location of the direct arrival pick: Peak, Zero-crossing before peak, Set back from peak (ms.) (enter the time to be considered before the peak).

Sea water velocity — Enter the average, constant, seawater velocity.

Use time-varying search window — If checked, enter a maximum variation time window.

Maximum variation (ms) — Enter the maximum variation of the time-varying search window.

Use local pick verification — If checked, uses a validation of the pick based on the following parameters.

Use surrounding shots — If selected, use surrounding shots for pick validation.

Use previous shots — If selected, use previous shots for pick validation.

Analysis record per sources — Enter the number of records for validation.

Near channel smoothness — Enter a smoothness weight for near channel picks.

Far channel smoothness — Enter the smoothness weight for far channel picks.

Output picks to trace headers — If checked, select the trace header location to store picks.

Display picking windows in real time — If checked, select channels for pick display.

Overwrite direct arrival picks in database — If checked, overwrites database picking information.

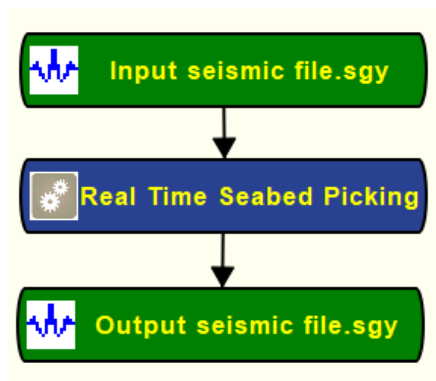
Real Time Seabed Picking

Usage: The Real Time Seabed Picking step automatically pick the seabed reflection from the input data. More than one channel per streamer must be specified.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time Seabed Picker
?
×

☐ Apply spiking decon

Set marine configuration

Set decon parameters

Set bandpass parameters

☒ Apply frequency bandpass

Picking parameters

Picking window length (ms.)

4.0

Min ratio: selected/max peak

0.40

Peak polarity

Negative

Seabed location

Peak

0.3

Mean sea water velocity

1500.00

Seabed depth specification

☒ Use nominal seabed 2-way time (ms.):

0.0

☐ Read seabed depth from trace header (ShotDepth)

☒ Use local pick verification

☐ Use surrounding shots

Analysis records per source

9

☒ Use previous shots

☒ O/p seabed offset time picks to trace header:

User defined 7

☐ Display picking windows in real time:

Select Display Channels

☐ Overwrite seabed picks in database

OK

Help

Cancel

Parameter Description:

Set marine configuration — Select to set the marine acquisition geometry configuration.

Apply spiking decon — If checked, applies a spiking deconvolution to the data with the Set decon parameters. The spiking deconvolution is applied only for visualization.

Set decon parameters — Select the spiking deconvolution parameters to be applied to the data.

Apply frequency bandpass — If checked, applies a frequency bandpass filter to the data with the Set bandpass parameters. The spiking deconvolution is applied only for visualization.

Set bandpass parameters — Select the frequency bandpass filter parameters to be applied to the data.

The **Picking parameters** specifies the automatic real time direct arrival picking parameters.

Picking window length (ms.) — Enter the searching window length for automatic picking.

Min ratio: first arrival/max peak. — Enter the minimum ratio of first arrival, maximum peak to be considered for the automatic picking.

Peak polarity — Select the peak polarity: Negative or positive.

Seabed location — Enter the relative location of the seabed pick: Peak, Zero-crossing before peak, Set back from peak (ms.) (enter the time to be considered before the peak).

Sea water velocity — Enter the average, constant, seawater velocity.

The **Seabed depth specifications** specifies the seabed depth information for automatic real time seabed picking parameters.

Use nominal seabed 2-way time (ms.) — If selected, enter a nominal, constant seabed 2-way time in milliseconds.

Read seabed depth from trace header (ShotDepth) — If selected use trace header information stored in shot depth as seabed depth in milliseconds.

Use local pick verification — If checked, uses a validation of the pick based on the following parameters.

Use surrounding shots — If selected, use surrounding shots for pick validation.

Use previous shots — If selected, use previous shots for pick validation.

Analysis record per sources — Enter the number of records for validation.

O/p seabed offset time picks to trace headers — If checked, select the trace header location to store picks.

Display picking windows in real time — If checked, select channels for pick display.

Overwrite direct arrival picks in database — If checked, overwrites database picking information.

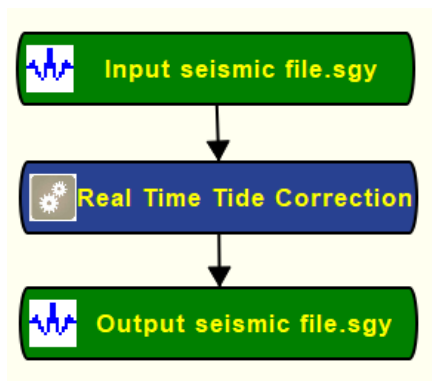
Real Time Tide Correction

Usage: The Real Time Tide Correction step applies a static shift to the data in real-time based on the tide information stored in the database.

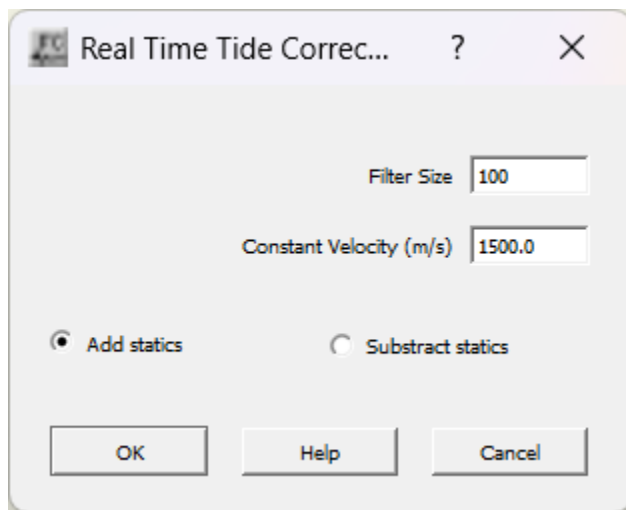
Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Filter size — Enter the filter size for real time tide correction in milliseconds.

Constant Velocity (m/s) — Enter the constant water velocity in m/s.

Add statics — If selected, add tide statics to the traces.

Subtract statics — If selected, remove tide statics to the traces.

Stack-Power Optimization Statics

Usage: The Stack-Power Optimization Statics step calculates surface consistent residual static time corrections by maximizing the power in the stack. Source and receiver super traces are cross-correlated to corresponding CMP super traces to determine a surface consistent static correction.

For 3-D, the input seismic file is required to be a CMP binned seismic volume. For 2-D, the input seismic file can be in any sort order, as long as Geometry Definition has been applied. Binning geometry for 3-D surveys should include all shot and receiver locations. Set the bin origin at the minimum source, receiver or CMP location.

Output stacks may be generated to evaluate the quality of the statics. The stacks show the sorted input file stacked in the analysis window with static corrections applied. The stacks are accumulated in the frequency domain and back transformed for the final stack trace. Numerical round off may cause slight variations when compared with stacks from the CMP Stack processing step. Stack type may be source, receiver or CMP.

Analysis stacks at specified intervals may be created to evaluate optimal convergence. The analysis stacks are a selected subset of source, receiver or CMP lines output to a specified directory. A unique filename suffix is assigned automatically for each iteration. Small subsets are recommended to reduce disk storage requirements. Full volume source, receiver and CMP stacks with user specified filename may be output for the final iteration.

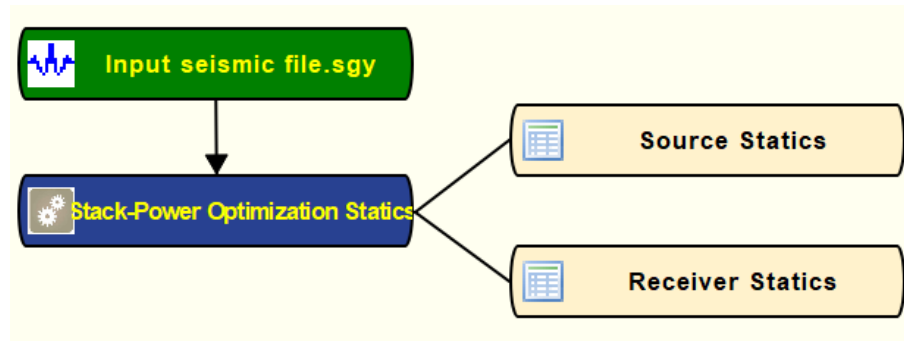
An option exists to output to the console a summary of the static corrections generated at the end of each iteration. The source and receiver statics output by the Stack-Power Optimization Statics Step are applied with the Apply Statics Shift step.

Input Links: 1) Seismic data, 3-D binned or 2-D in any sort order with geometry applied (mandatory).

Output Links: 1) Source statics cards (mandatory); 2) Receiver statics cards (mandatory); 3) Selected stack analysis files (optional); 4) Selected stack volume (optional).

Reference: Ronen J., and Claerbout, J., 1985, Surface-consistent residual statics estimation by stack-power maximization, Geophysics, vol. 50, no. 12, p. 2759-2767.

Example Flowchart:



Step Parameter Dialog:

Stack Power Optimization Statics

Stack power window

☒ Use fixed window

☐ Use window definition file

Start (ms) 1000.0

Stop (ms) 2000.0

Output pilot stack No

Statics calculation

Maximum allowable static (ms) 24.00

Percent stack power change for termination 3.00

Minimum allowable fold 3

Maximum number of iterations 3

☒ Compute Source term

☒ Compute Receiver term

OK Help Cancel

Parameter Description:

The **Stack power window** specifies the pilot traces to be used in the stack power window.

Use fixed window— If checked, pilot traces are built from a constant time gate from the input seismic data.

Correlation window start time (ms) — Enter the start time in milliseconds for the correlation window used to build the pilot.

Correlation window stop time (ms) — Enter the end time in milliseconds for the correlation window used to build the pilot.

Use window definition file— If checked, pilot traces are built from an auxiliary Window definition card data from the input seismic data (not implemented).

Output pilot stacks — Select from the drop-down menu to output the pilot stacks used for the optimization. Stacks can be from the midpoint, source, receiver or any combination of these.

The **Statics calculation** specifies the statics calculation parameters.

Maximum allowable static (ms) — Enter a value in milliseconds for the maximum static shifts for each iteration. The final static is the sum of statics at each iteration. The total static may exceed the maximum allowable static per iteration.

Percent stack power change for termination — Enter the percentage value of the stack power change to terminate the optimization process.

Minimum allowable fold — Enter the maximum allowable fold for the processing step.

Maximum number of iterations — Enter the maximum number of iterations for the processing step.

Compute source term — If checked, select from the drop-down menu to compute the statics for the source component.

Compute receiver term — Select from the drop-down menu to compute the statics for the receiver component.

Surface Consistent Residual Statics

Usage: The Surface Consistent Residual Statics step calculates source and receiver residual statics using a Gauss-Seidel iterative method to solve for the source static, receiver static, structure term, and residual NMO) that provide a best fit to the linear traveltime equations in a least-squares sense. linear inversion routine to decompose traveltime equations into source, receiver, CMP, and offset related terms. The pick times input to the inversion are picked automatically using cross correlation in a specified time window. The user controls the window of data for analysis as well as the maximum allowable static that can be computed. A damping filter can be applied to suppress any long period effects associated with the residual statics solution. Options exist for removing either or both the residual normal moveout (RNMO) term and a linear trend from the statics solution. The source and receiver statics output by the Surface Consistent Residual Statics Step are applied with the Apply Statics step.

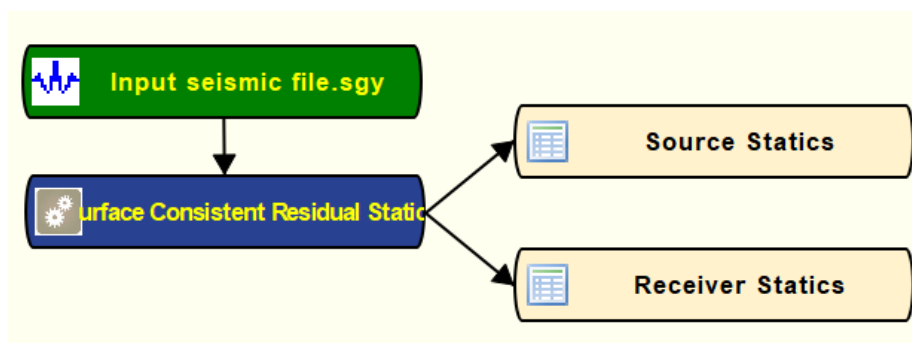
Input Links: 1) Seismic data - NMO corrected CMP gathers (mandatory).

Output Links: 1) Source Statics cards (mandatory); 2) Receiver Statics cards (mandatory).

Reference: Wiggins, R. A., et al., 1976, Residual statics analysis as a general linear inverse problem: Geophysics, vol. 50, no. 11, p. 2172ff.

See Technical Note TN-ResSt.doc

Example Flowchart:



Step Parameter Dialog:

Surface Consistent Residual Statics ? X

Pilot

Pilot traces source

☒ Use stacked input records

☐ Use auxiliary seismic stack

Pilot options

Build refined pilot

Output pilot

Pilot window definition

☒ Use fixed window

☐ Use window definition file

Fixed window

Start (ms)

Stop (ms)

Offset bins

☒ Specify offset bin size:

Statics calculation

Maximum allowable static (ms)

RMS error change for termination (ms)

Minimum allowable fold

Source term

☒ Compute ☐ Smooth Radius (bins)

Receiver term

☒ Compute ☐ Smooth Radius (bins)

Structure (CMP) term

☒ Compute ☐ Smooth Radius (bins)

Residual moveout (RNMO) term

☐ Compute ☐ Smooth Radius (offset bins)

OK Help Cancel

Parameter Description:

The **Pilot** specifies parameters related to the pilot data.

The **Pilot traces source** specifies the pilot traces source.

Use stacked input records — If selected, use stacked input records.

Use auxiliary seismic stack — If selected, use auxiliary stack as input records.

The **Pilot options** specifies the pilot parameters.

Build refined pilot — Select if pilot is refined.

Output pilot — Select if pilot is output.

The **Pilot window definition** specifies the pilot traces source.

Use fixed window — If selected, use a fixed window for pilot.

Use window definition file — If selected, use an auxiliary file for window definition (not implemented).

The **fixed window** specifies the fixed window parameterization.

Start (ms) — Enter the start window time in milliseconds.

Stop (ms) — Enter the end window time in milliseconds.

The **Offset bins** specifies offset binning parameterization.

Specify offset bin size — If selected, use offset binning and enter offset bin size.

The **Statics calculation** specifies parameters related to the statics calculation.

Maximum allowable static (ms) — Enter the maximum allowable static shift in milliseconds.

RMS error change for termination (ms) — Error the minimum RMS error change from iteration to iteration for the optimization to be considered finished.

Minimum allowable fold — Enter the minimum fold allowable for the optimization.

The **Source term** specifies source parameterization

Compute source term — If checked, computes the statics for the source term.

Smooth— If selected, smooths the source term.

Smooth source term — If filtering the source term, enter the filter radius.

The **Receiver term** specifies receiver parameterization.

Compute receiver term — Select from the drop-down menu to compute the statics for the receiver term.

Smooth receiver term — If selected, smooths the source term.

Receiver term smoothing radius — If filtering the receiver term, enter the filter radius.

The **Structure (CMP) term** specifies CMP parameterization.

Compute structure term — Select from the drop-down menu to compute the statics for the receiver component.

Smooth structure term — If selected, smooths the CMP term.

Structure term smoothing radius — If filtering the structure term, enter the filter radius.

The **Residual moveout (RNMO) term** specifies residual parameterization.

Compute residual moveout (RNMO) term — If checked, a least squares linear fit will be removed from the final statics solution.

Smooth RNMO term — If selected, filter the RNMO term component.

RNMO smoothing radius — If filtering the RNMO term, enter the filter radius

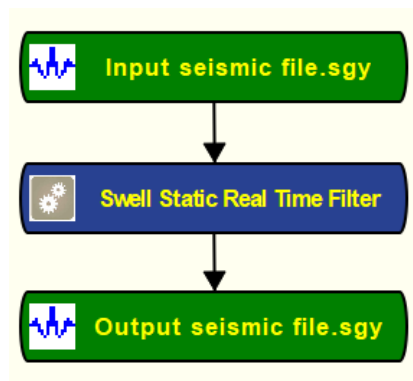
Swell Static Real Time Filter

Usage: The Swell Static Real Time Filter step apply a swell filter in real time to the input seismic data.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Swell Static Real Time Filter

Seabed time: i/p header: User defined 7

☐ **Apply coherency trim static**

Coherency filter

Coherency filter length (Field files) 11 % Alpha trim 25

☐ **Apply a minimum wavelength filter**

Minimum wavelength filter

Swell filter length (Field files) 25 % Alpha trim 15

☐ **Apply a maximum wavelength filter**

Maximum wavelength filter

Swell filter length (Field files) 55 % Alpha trim 15

Corrected seabed: o/p header: None

OK Help Cancel

Parameter Description:

Seabed time: i/p header — Select seismic trace header location with the input seabed time.

Apply coherency trim statics — If checked, applies a coherency trim statics filter.

The **Coherency filter** specifies the coherency filter parameterization.

Coherency filter length (Field Files) — Enter the filter length in field files number.

% Alpha trim — Enter the percentage trim of the smallest and of the largest pick times before averaging the remainder.

Apply a minimum wavelength filter — If checked, applies a minimum wavelength (swell) filter.

The **Minimum wavelength filter** specifies the minimum wavelength filter parameterization.

Swell filter length (Field Files) — Enter the filter length in field files number.

% Alpha trim — Enter the percentage trim of the smallest and of the largest pick times before averaging the remainder .

Apply a maximum wavelength filter — If checked, applies a maximum wavelength (swell) filter.

The **maximum wavelength filter** specifies the maximum wavelength filter parameterization.

Swell filter length (Field Files) — Enter the filter length in field files number.

% Alpha trim — Enter the percentage trim of the smallest and of the largest pick times before averaging the remainder.

Corrected seabed: o/p header — Select seismic trace header location to store the corrected seabed time.

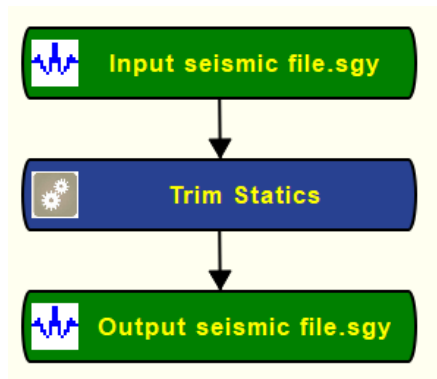
Trim Statics

Usage: The Trim Statics step calculates small CMP statics shifts for the data based on alignment of events within the specified window. The user specifies the start time and the length of the analysis window for calculation and the maximum allowed static shift. The step finds the static shift within these limits using automatic picking of the peak of the cross-correlation amplitude between the trace and the stacked trace for the gather.

Input Links: 1) Seismic data in CMP sort order (mandatory).

Output Links: 1) Seismic data in CMP sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The 'Trim Statics' dialog box contains the following parameters:

- Window start time (ms): 500.00
- Window length (ms): 100.00
- Max static shift +/- (ms): 4.00
- ☐ Use auxiliary stack trace as pilot

Buttons at the bottom: OK, Help, Cancel.

Parameter Description:

Window start time (ms) — Enter the window start time in milliseconds for trim statics analysis.

Window length (ms) — Enter the length of the window in milliseconds for trim statics analysis.

Max static shift +/- (ms) — Enter the largest allowable static shift in milliseconds for trim statics analysis.

Use auxiliary stack trace as pilot — Not yet implemented.

Trace Attributes Steps

This section documents the processing steps available in the Trace Attributes Steps category. The types of Trace Attributes Steps currently available are:

Trace Attributes	
↑	Processing Categories
Instantaneous Amplitude	
Instantaneous Frequency	
Instantaneous Phase	

Instantaneous Amplitude

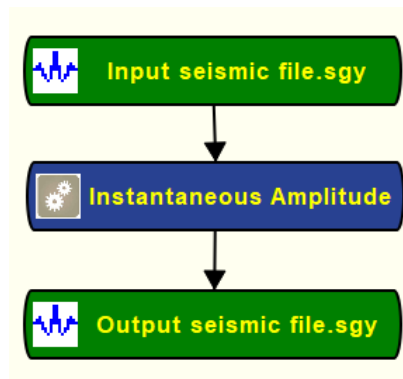
Usage: The Instantaneous Amplitude step calculates instantaneous amplitude attributes for each trace and outputs the instantaneous amplitude as a seismic trace in the output seismic file. Instantaneous amplitude is a measure of reflectivity strength of events on a seismic section.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic attribute data in any sort order (mandatory).

Reference: Taner, M.T., Koehler, F., Sheriff, R.E., 1979, Complex Seismic Trace Analysis: Geophysics, v. 44, no. 6, p. 1041-1063.

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled 'Instantaneous Amplitude'. It features two input fields: 'Processing start time (ms)' with the value '0' and 'Processing end time (ms)' with the value '2000'. At the bottom, there are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) in milliseconds of the time gate where the calculation will start.

Processing end time (ms) — Enter the end time (lower boundary) in milliseconds of the time gate where the calculation will end.

Instantaneous Frequency

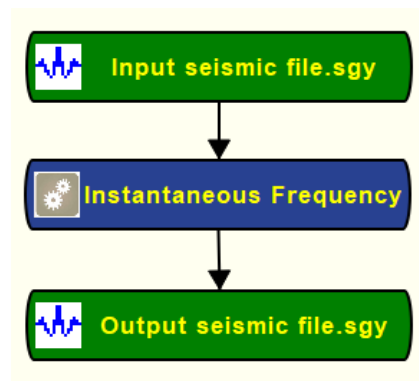
Usage: The Instantaneous Frequency step calculates instantaneous frequency attribute for each trace and outputs instantaneous frequency as a seismic trace in the output seismic file. This attribute is a measure of the frequency of events on a seismic section.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic attribute data in any sort order (mandatory).

Reference: Taner, M.T., Koehler, F., Sheriff, R.E., 1979, Complex Seismic Trace Analysis: Geophysics, v. 44, no. 6, p. 1041-1063.

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a software dialog box titled 'Instantaneous Frequency'. It features three input fields for parameter configuration: 'Processing start time (ms)' with a value of '0', 'Processing end time (ms)' with a value of '2000', and 'Number of samples to average' with a value of '5'. At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) in milliseconds of the time gate where the calculation will start.

Processing end time (ms) — Enter the end time (lower boundary) in milliseconds of the time gate where the calculation will end.

Number of samples to average — Enter the number of seismic samples to be averaged during the calculation of the Instantaneous Frequency step.

Instantaneous Phase

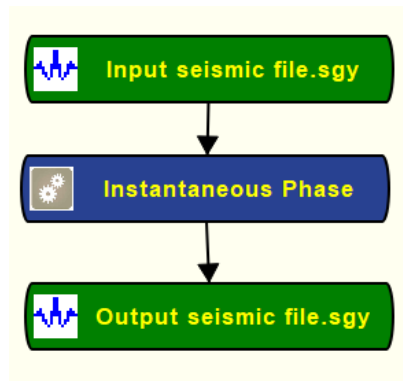
Usage: The Instantaneous Phase step calculates instantaneous phase attribute for each trace and outputs the instantaneous phase as a seismic trace in the output seismic file. This attribute is a measure of the continuity of events on a seismic section.

Input Links: 1) Seismic data in any sort order (mandatory).

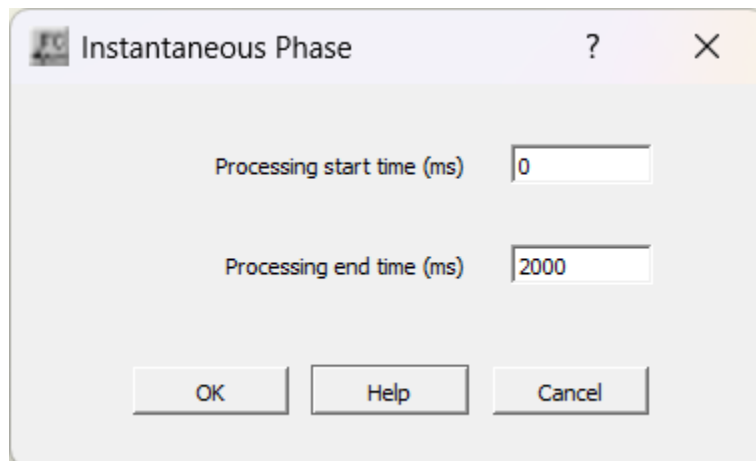
Output Links: 1) Seismic attribute data in any sort order (mandatory).

Reference: Taner, M.T., Koehler, F., Sheriff, R.E., 1979, Complex Seismic Trace Analysis: Geophysics, v. 44, no. 6, p. 1041-1063.

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

Processing start time (ms) — Enter the start time (upper boundary) in milliseconds of the time gate where the calculation will start.

Processing end time (ms) — Enter the end time (lower boundary) in milliseconds of the time gate where the calculation will end.

VSP Steps

This section documents the processing steps available in the VSP Steps category.

Processing steps currently available are:

VSP
 Processing Categories
3D VSP-CMP Add Transform
Apply VSP Traveltimes
Calculate VSP Traveltimes
VSP CMP Transform
VSP Corridor Stack
VSP Deconvolution
VSP Downhole Locations
VSP Extract Corridor
VSP First Arrival Time Picks
VSP Geometry Definition
VSP SPS Relation Records
VSP Surface Locations
VSP Wavefield Separation

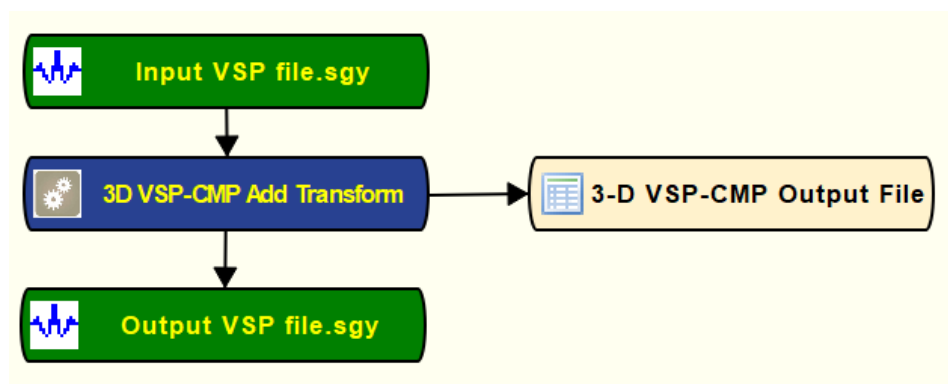
3D VSP-CMP Add Transform

Usage: The 3D VSP-CMP Add Transform step adds a VSP to CDP 2D line transform or to a 3D transform. The step integrates Vertical Seismic Profile (VSP) data into a Common Midpoint (CMP) framework within a seismic data set.

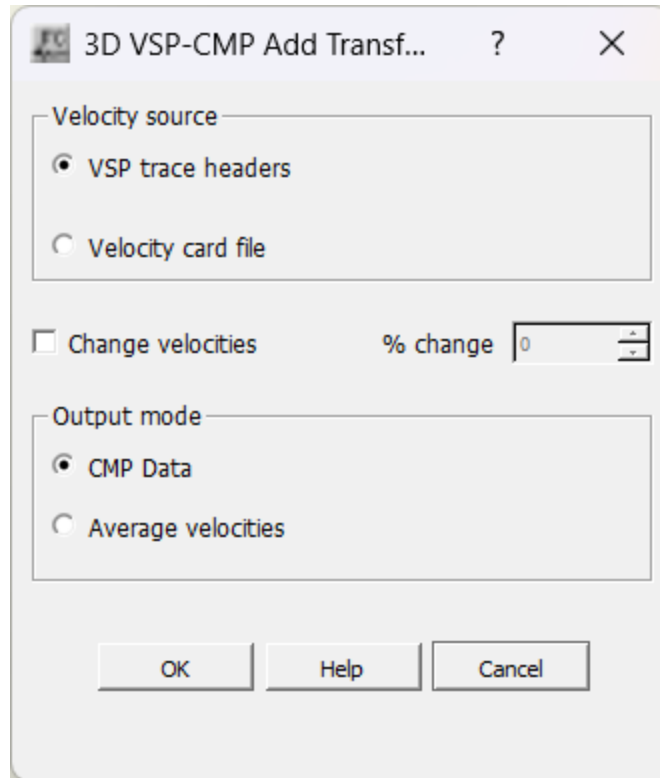
Input Links: 1) Seismic data in any sort order (mandatory); 2) Velocity card file (optional).

Output Links: 1) Seismic data in any sort order (mandatory); 2) 3-D VSP-CMP Output File (mandatory)

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Velocity source** specifies the type of input velocity.

VSP trace headers — If selected, uses as velocity the value store in the trace header.

Velocity card file – If selected, uses an auxiliary velocity card file to define the velocities.

Change velocities — If selected allow scaling the input velocities by a given percentage.

% change – Enter the percentage of change of the input velocity.

The **Output mode** specifies the type of output.

CMP Data — If selected, output data as a CMP Data.

Average velocities – If selected, output average velocities.

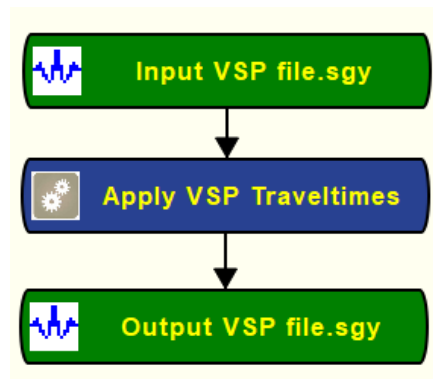
Apply VSP Traveltimes

Usage: The Apply VSP Traveltimes step applies the traveltimes corrections stored in the trace headers of the seismic file, as computed from Calculate VSP Traveltimes, so the gather can be flattened according to these corrections.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Apply VSP Traveltimes

Correct first arrival traveltimes to...

- ☒ Constant time
- ☐ One-way direct arrival time
- ☐ One-way vertical time from Ground level
- ☐ One-way vertical time from Seismic datum
- ☐ Two-way vertical time from Ground level
- ☐ Two-way vertical time from Seismic datum

Application mode

- ☐ Coarse grain
- ☒ Fine grain

☐ Apply negative of static shifts

Constant Time (ms)

OK Help Cancel

Parameter Description:

The **Correct first arrival traveltimes to...** specifies where the VSP first arrival traveltimes will be corrected to.

Constant time — If selected, VSP first arrival traveltimes will be correct to a constant two-way time as defined in Constant Time (ms).

One-way direct arrival time — If selected, VSP first arrival traveltimes will be correct to the one-way direct arrival time as defined in the picking file.

One-way vertical time from Ground level — If selected, VSP first arrival traveltimes will be corrected vertically to the one-way time corresponding to the ground level location.

One-way vertical time from Seismic datum — If selected, VSP first arrival traveltimes will be corrected vertically to the one-way time corresponding to the ground seismic reference datum.

Two-way vertical time from Ground level — If selected, VSP first arrival traveltimes will be corrected vertically to the two-way time corresponding to the ground level location.

Two-way vertical time from Seismic datum — If selected, VSP first arrival traveltimes will be corrected vertically to the two-way time corresponding to the seismic reference datum.

The **Application mode** specifies the mode of statics application.

Coarse grain — If selected, statics shifts are applied to the nearest discrete sample position.

Fine grain — If selected, statics shifts are applied as a precise phase shift operator in the Fourier domain.

Apply negative static shifts — If, checked apply a negative of the static shifts.

Constant time (ms) — Enter the constant time in millisecond to be used as reference if Constant time is selected. Enter a bulk shift value in milliseconds to shift all the data simultaneously with this value.

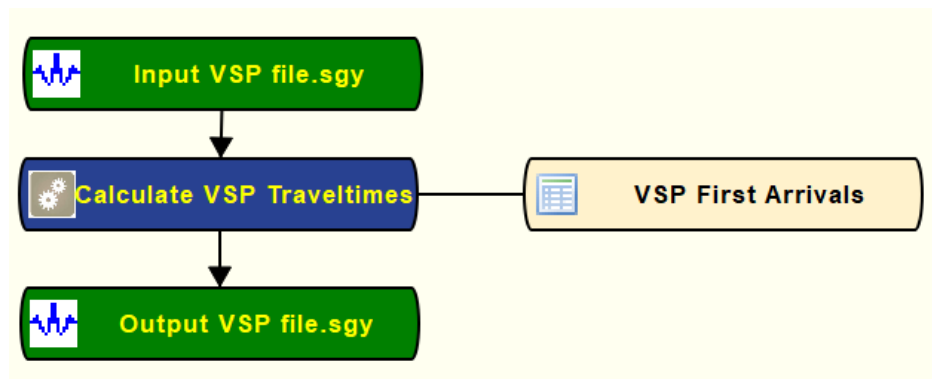
Calculate VSP Traveltimes

Usage: The Calculate VSP Traveltimes step computes corrections for the travel times based on the picking of the first arrivals (auxiliary VSP First Arrivals card data). The output seismic file has the trace headers corresponding to VSP depths, times and velocities update accordingly. This file can then be used as input for the Apply VSP Traveltimes step to flatten the record.

Input Links: 1) Seismic data in any sort order (mandatory); 2) VSP First arrivals card data (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Calculate VSP Traveltimes

Well location

Kelly bushing Seismic reference datum

Ground elevation Mean sea level

Project updates

 Update from project  Update project

Near surface model

Weathering depth ☐ Marine VSP

Weathering velocity Fluid velocity

Replacement velocity

OK Help Cancel

Parameter Description:

The **Well location** specifies general parameter related to the well corresponding to the VSP.

Kelly bushing — Enter a value for the Kelly bushing (KB) of the well corresponding to the VSP. KB is defined in project units (m or ft).

Seismic reference datum — Enter a value for the seismic reference datum (SRD). SRD is defined in project units (m or ft).

Ground elevation — Enter a value for the ground elevation/level (GL). GL is defined in project units (m or ft).

Mean sea level — Enter a value for the mean sea level (MSL). MSL is defined in project units (m or ft).

The **Project updates** specify either if the geometry is updated from the project or if the project settings will be updated with current parameterization.

Update from project — Use this to update the corner points from the SPS data that has been associated with the project using the Survey > SPS Database menu.

Update project — Use this to broadcast the corner points so that they can be used by to set the Easting and Northing ranges of plotting functions, such as the Attribute Map used later in this flow.

The **Near surface model** specifies the parameters related to the near surface model.

Weathering depth — Enter a value for the total depth of the weathering layer. Depth defined in project units (m or ft).

Weathering velocity — Enter a value for the velocity of the weathering layer.

Replacement velocity — Enter a value for the replacement velocity to be used to compute the VSP traveltimes corrections.

Marine VSP — If checked, VSP is assumed to be acquired in marine environment.

Fluid velocity — Enter the fluid velocity if VSP was acquired in marine environment.

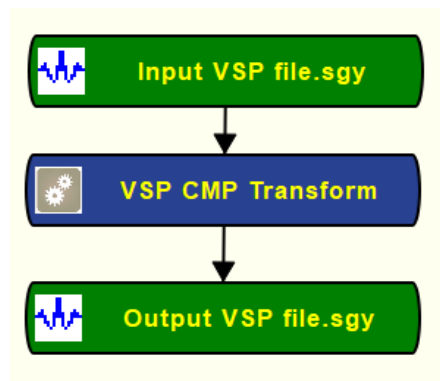
VSP CMP Transform

Usage: The VSP CMP Transform step moves offset VSP data to the reflecting point location (approximately half the distance for the largest offset) assuming that there is no dip.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Velocity card file (optional); 3) VSP first arrivals card file (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

VSP CMP Transform ? X

CMP specification

CMP line number

CMP location no. nearest well

CMP bin size

Output sample interval (ms)

☒ CMPs increasing along line direction
☐ CMPs decreasing along line direction

Velocity source

☒ VSP trace headers
☐ VSP first arrivals card file
☐ Velocity card file

☐ Change velocities % change

Output mode

☒ CMP Data
☐ Average velocity profile

OK Help Cancel

Parameter Description:

The **CMP specification** specifies which CMP location is closer to the well head.

CMP line number — Enter the CMP line number.

CMP location no. nearest well — Enter the CMP location nearest well.

CMP bin size — Enter CMP bin size.

Output sample interval (ms) — Enter the sample interval of the output VSP data.

CMPs increasing along the line direction — If selected, considers CMPs increasing along the line direction.

CMPs decreasing along the line direction — If selected, considers CMPs decreasing along the line direction.

The **Velocity source** specifies type of input velocity.

VSP trace headers — If selected, uses as velocity the value store in the trace header.

VSP first arrivals card file — If selected, velocities are estimated from VSP first arrival picks.

Velocity card file — If selected, uses an auxiliary velocity card file to define the velocities.

Change velocities — If checked, allow scaling the input velocities by a given percentage.

% change – Enter the percentage of change of the input velocity.

The **Output mode** specifies the type of output.

CMP Data — If selected, output data as a CMP Data.

Average velocity profile — If selected, output average velocities.

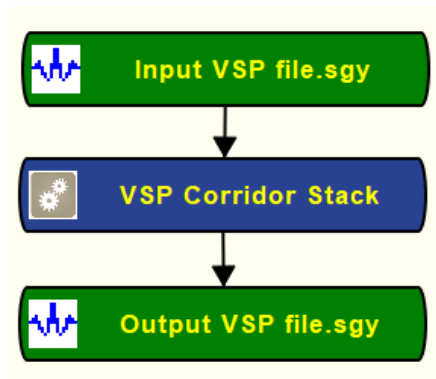
VSP Corridor Stack

Usage: The VSP Corridor Stack stacks a VSP record after a corridor being extracted. The resulting VSP seismic file has the number of traces as defined in Number of duplicate traces parameter.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'VSP Corridor Stack' with a question mark icon and a close button (X). The dialog contains five input fields with labels to their left:

- Corridor length (ms) with a value of 100.0
- Number of duplicate traces with a value of 10
- Number of full length traces with a value of 10
- CMP line number with a value of 1
- CMP location number with a value of 1000

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Corridor length (ms) — Enter the length of the corridor of data to be extracted in milliseconds.

Number of duplicate traces — Enter the number of duplicated traces in the corridor stack.

Number of full length traces — Enter the number of full length traces to be extracted.

CMP line number — Enter the CMP line number corresponding to the VSP location.

CMP location number — Enter the CMP location number corresponding to the VSP location.

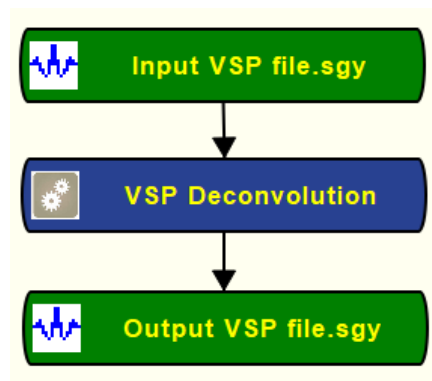
VSP Deconvolution

Usage: The VSP Deconvolution step applies deconvolution operators using Wiener-Levinson algorithm to the VSP data. VSP Deconvolution is normally applied to records representing the downgoing or upgoing wavefields.

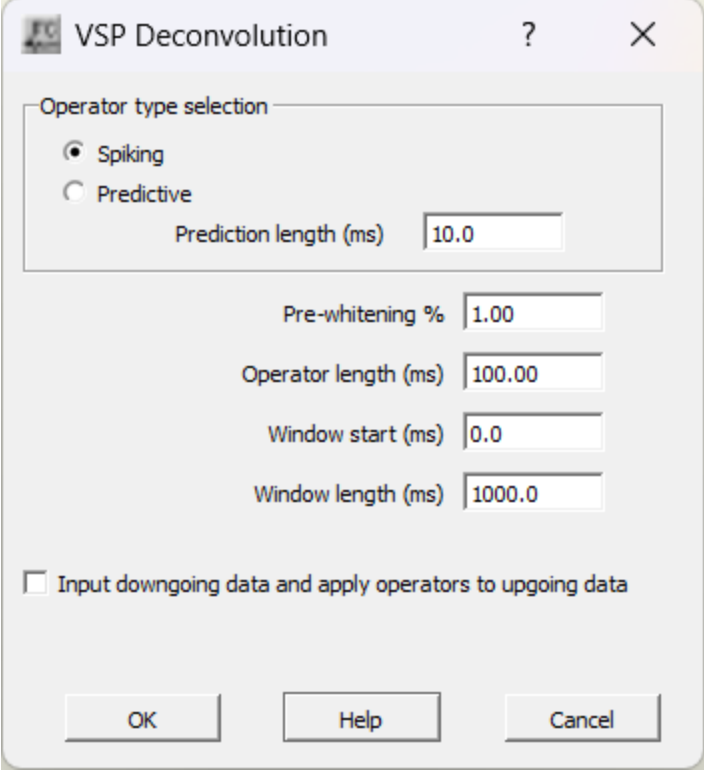
Input Links: 1) Seismic data in any sort order (mandatory); 2) Seismic data with downgoing wavefield (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The image shows a software dialog box titled "VSP Deconvolution". It has a standard Windows-style title bar with a question mark icon and a close button (X). The dialog is divided into several sections. The first section, "Operator type selection", contains two radio buttons: "Spiking" (which is selected) and "Predictive". Below these is a text input field for "Prediction length (ms)" with the value "10.0". The next section contains four text input fields: "Pre-whitening %" with "1.00", "Operator length (ms)" with "100.00", "Window start (ms)" with "0.0", and "Window length (ms)" with "1000.0". Below these fields is a checkbox labeled "Input downgoing data and apply operators to upgoing data", which is currently unchecked. At the bottom of the dialog are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **Operator type selection** specifies the type of deconvolution operator.

Spiking — If selected, applies a spiking deconvolution to the VSP data.

Predictive — If selected, applies a predictive deconvolution to the data.

Prediction length (ms) — Enter the prediction length of the predictive deconvolution operator.

Pre-whitening % — Enter the amount of white noise to add. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Operator length (ms) — Enter the length of the operator to be calculated and applied in milliseconds.

Window start (ms) — Enter the start time in milliseconds of the deconvolution design window.

Window length (ms) — Enter the length in milliseconds of the deconvolution design window.

Input downgoing data and apply operators — If selected, an auxiliary seismic file with the downgoing field is used as auxiliary data.

VSP Downhole Locations

Usage: The VSP Downhole Locations card data is used to store the positional downhole receiver locations to be used by VSP Geometry Definition step.

Step Parameter Dialog:

VSP Surface Locations

VSP downhole locations

File name: C:/DATA/Documentation/Survey/VSP Downhole locations File Browse...

Spreadsheet | Map

	Record ID	Downhole line	Downhole location	Surface easting	Surface northing	Surface elevation	Measured depth
1	R						
2	R						
3	R						
4	R						
5	R						
6	R						
7	R						
8	R						
9	R						
10	R						

OK Help File icons Analyze format Save changes

Parameter Description:

Downhole line — Enter the downhole line value.

Downhole location — Enter the downhole location.

Surface easting — Enter the surface Easting coordinate corresponding to the downhole location.

Surface northing — Enter the surface Northing coordinate corresponding to the downhole location.

Surface elevation — Enter the surface elevation corresponding to the downhole location.

Measured depth — Enter the measured depth coordinate corresponding to the downhole location.

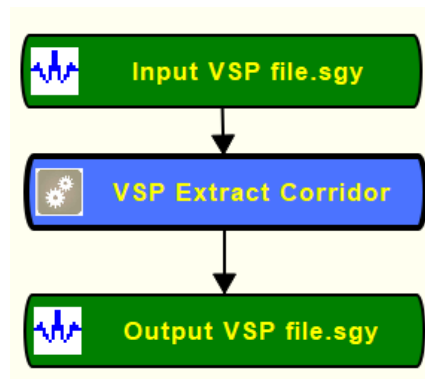
VSP Extract Corridor

Usage: The VSP Extract Corridor step extracts a corridor of data based on the first arrival times. This step allows removing noisy data and focus on reflections close to the well location.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The screenshot shows a dialog box titled 'VSP Extract Corridor' with a question mark icon and a close button (X). It contains four input fields with labels to their left:

- Corridor length (ms) with a value of 100.0
- Number of full length traces with a value of 10
- CMP line number with a value of 1
- CMP location number with a value of 1000

At the bottom of the dialog are three buttons: 'OK', 'Help', and 'Cancel'.

Parameter Description:

Corridor length (ms) — Enter the length of the corridor of data to be extracted in milliseconds.

Number of full length traces — Enter the number of full length traces to be extracted.

CMP line number — Enter the CMP line number corresponding to the VSP location.

CMP location number — Enter the CMP location number corresponding to the VSP location.

VSP First Arrival Time Picks

Usage: The VSP First Arrival Time Picks is an auxiliary card data to store VSP first arrivals.

Step Parameter Dialog:

The screenshot shows a software window titled "VSP First Arrival Times". At the top, there is a tab labeled "First arrival time file". Below this tab is a text field for "File name" containing the path "C:/DATA/Documentation/Auxiliary/VSP First Arrival Times Picks", and a "File Browse..." button to its right. Below the file selection area are two tabs: "VSP first arrival times" (which is active) and "VSP first arrival viewer". The main area of the window is a large, empty rectangular frame. At the bottom of the window, there is a control panel. On the left side of this panel are four buttons: "Save changes", "Help", "Analyze format", and "Close". To the right of these buttons are four dropdown menus for sorting: "Primary sort key" (set to "Source line"), "Secondary sort key" (set to "Source location"), "Tertiary sort key" (set to "Measured depth"), and "Quaternary sort key" (set to "None"). Below these is a "Create record at" dropdown set to "Change in secondary". To the right of the dropdowns are several navigation icons, including arrows, a refresh icon, a calculator icon, and a document icon.

Parameter Description:

File Browse — Select to browse for existing VSP First Break Times file or to define the name of a new file to be saved.

Primary sort key — Select the primary sort key to be used in the navigation from record to record.

Secondary sort key — Select the secondary sort key to be used in the navigation from record to record.

Tertiary sort key — Select the tertiary sort key to be used in the navigation from record to record.

Quaternary sort key — Select the quaternary sort key to be used in the navigation from record to record.

Create record at — Select the sort key used to create records.

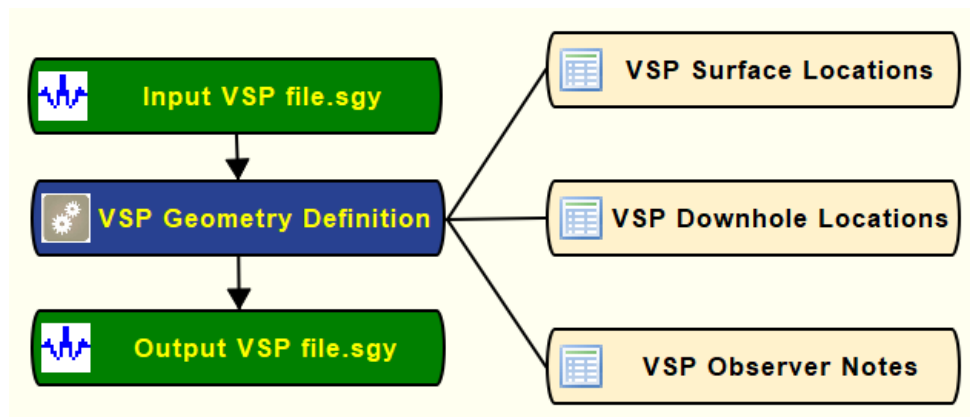
VSP Geometry Definition

Usage: The VSP Geometry Definition step assigns survey information to the VSP trace headers based on the source, receiver, and observer notes SPS files. The VSP Geometry Definition step assigns CMP number based on the source and receiver numbers using the following formula: $\text{CMP Location} = (\text{Source Location} + \text{Receiver Location}) / 2$. Therefore, for 2D lines it is imperative that source and receiver locations as defined in the SPS files share the same coordinate system. This implies that Source location 1 has the same X,Y position as Receiver location 1, and that Source location 2 has the same X,Y position as Receiver location 2, etc....

Input Links: 1) Seismic data in any sort order (mandatory); 2) Observers Notes – SPS Format cards (mandatory); 3) Receiver Locations – SPS Format cards (mandatory); 4) Source Locations – SPS Format cards (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

VSP Geometry Definition ? X

Well description

Well name

Well number

Well easting

Well northing

Project updates

 Update from project

 Update project

Offset definition

☐ Use unsigned offsets

☐ Define survey orientation for signed offsets

Orientation (degrees)

Azimuth definition

☐ Use unsigned azimuths

☐ Zero degrees azimuth = East

☒ Zero degrees azimuth = North

☒ Kill undefined traces and records

☐ Reverse VSP (source in well)

Nominal receiver spacing

OK Help Cancel

Parameter Description:

Well description: Specify general parameters related to the well.

Well name — Enter the name of the well corresponding to the VSP.

Well number — Enter well number corresponding to the VSP. Well number can be defined as the UWI.

Well Easting — Enter Easting coordinates of well head.

Well Northing — Enter Northing coordinates of well head.

The **Project updates** specify either if the geometry is updated from the project or if the project settings will be updated with current parameterization.

Update from project — Updates the corner points from the SPS data that has been associated with the project using the Survey > SPS Database menu.

Update project — Use this to broadcast the corner points so that they can be used by to set the Easting and Northing ranges of plotting functions, such as the Attribute Map used later in this flow. Azimuth definition: Specify the origin of azimuth.

The **Azimuth definition** specify the azimuth sign.

Use unsigned azimuths — If checked, the azimuth sign is ignored.

Zero degrees azimuth = East — If selected, then zero degrees of source-receiver azimuth will be set equal to due East.

Zero degrees azimuth = North — If selected, then zero degrees of source-receiver azimuth will be set equal to due North.

Kill undefined traces and records — If checked, traces undefined after applying the geometry will be flagged as dead.

Reverse VSP (source in Well) — If checked, reverse VSP source location in well.

Nominal receiver spacing — Enter the nominal (in m or ft) distance between receivers within the well.

VSP SPS Relation Records

Usage: The VSP SPS Relation Locations card data is used to store the relationship between surface and downhole receiver locations to be used by VSP Geometry Definition step.

Step Parameter Dialog:

Parameter Description:

Record number — Enter the record number. This value should correspond to the FFID store in the VSP seismic file.

Source line — Enter the source line as defined in VSP Surface Locations.

Source location — Enter the source location as defined in VSP Surface Locations.

From channel — Enter the number of the first active channel.

To channel — Enter the number of the last active channel.

Channel increment — Enter the channel increment.

Receiver line — Enter the receiver line as defined in VSP Downhole Locations.

From receiver — Enter the number of first receiver.

To receiver — Enter the number of last receiver.

Receiver increment — Enter the receiver number increment.

VSP Surface Locations

Usage: The VSP surface Locations card data is used to store the positional surface locations to be used by VSP Geometry Definition step.

Step Parameter Dialog:

VSP Surface Locations

VSP surface locations

File name: C:/DATA/Documentation/Survey/vsp ssurface locations File Browse...

Spreadsheet | Map

	Record ID	Surface line	Surface location	Surface easting	Surface northing	Surface elevation	Point depth	Uphole Time	
1		S							

OK Help File Folder Star Grid Print Copy Paste Analyze format Save changes

Parameter Description:

Surface line — Enter the point line value.

Surface location — Enter the point location.

Surface Easting — Enter the surface Easting coordinate corresponding to the point location.

Surface Northing — Enter the surface Northing coordinate corresponding to the point location.

Surface elevation — Enter the surface elevation corresponding to the point location.

Point depth — Enter the measured depth coordinate corresponding to the point location.

Uphole time — Enter the uphole time.

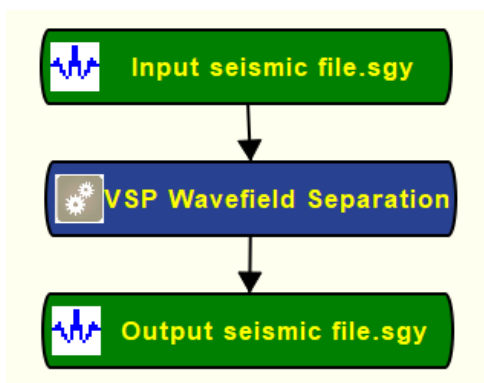
VSP Wavefield Separation

Usage: The VSP Wavefield Separation steps allows filtering the downgoing or the upgoing wavefields by applying a moving average, a median or a F-K filter.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

VSP Wavefield Separation

Filter type

☐ Use moving average filter

☒ Use median filter

Filter length (number of levels)

☐ Use quantile for median application

Quantile value

☐ Use FK velocity filter

Minimum velocity

Maximum velocity

Subtraction

☒ Subtraction ☐ Adaptive subtraction

Output

☒ Downgoing wave field ☐ Upgoing wavefield

OK Help Cancel

Parameter Description:

The **Filter type** specify type of filter to be used for the wavefield separation.

Use moving average filter — If selected, uses a moving average filter to separate wavefields.

Use median filter — If selected, uses a median filter to separate wavefields.

Filter length (number of levels) — Enter the filter length in number of levels.

Use quantile for median application — If checked, uses a quantile as defined in Quantile value to do the filtering.

Quantile value — Enter the quantile value.

Use FK velocity filter — If selected, uses a F-K velocity filter to separate wavefields.

Maximum velocity — Enter the maximum velocity to be considered in the FK velocity filter

Minimum velocity — Enter the minimum velocity to be considered in the FK velocity filter.

The **Subtraction** specify type of subtraction between model and data.

Subtraction — If selected, applies a conventional sample-by-sample subtraction.

Adaptive subtraction — If selected, applies a subtraction as defined in Dataset Math step.

The **Output** specify type of output.

Downgoing wave field — If selected, outputs downgoing wavefield (filter upgoing wavefield).

Upgoing wavefield — If selected, outputs upgoing wavefield (filter downgoing wavefield).

Velocity Steps

Velocities
 Processing Categories
Apply Linear Moveout
Apply Normal Moveout
Apply PP Nonhyperbolic Moveout
Constant Eta Stacks
Constant Velocity Stacks
Create Velocity Field
Eta Semblance
Extract Functions
Interpolate Field
MASW Calculation
Marine Normal Moveout
Offset Dependent Linear Moveout
Real Time 2D Velocity Analysis
Residual Moveout Analysis
Residual Moveout Application
Velocity Semblance

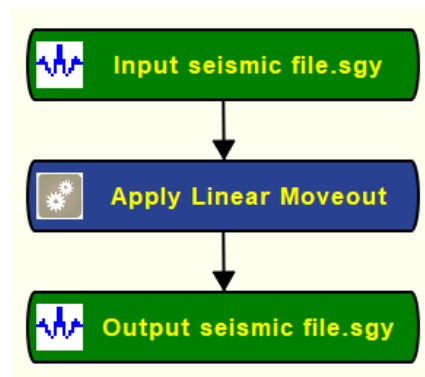
Apply Linear Moveout

Usage: The Apply Linear Moveout step allows to apply a linear moveout function in either the forward or inverse direction. The user specifies the moveout velocity. The user may also apply a constant static shift to the seismic data. The moveout correction may be applied in a coarse or fine-grained application mode. A coarse grained static shift is applied to the nearest sample. Fine-grained static shifts are applied in the frequency domain by phase shifting the seismic data.

Input Links: 1) Seismic data in any sort order (mandatory); Linear velocity card (optional)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Apply Linear Moveout

Input velocities

☐ Use Linear velocity card

☒ Use constant velocity

Correction velocity 2000.0

Static shift

Constant static shift (ms) 0.0

Application mode

☐ Coarse grain

☒ Fine grain

☐ Do inverse linear moveout

OK Help Cancel

Parameter Description:

The **Input velocities** specifies the type of velocities to be used in the linear moveout.

Use Linear velocity card — If selected, use an auxiliary linear velocity card for the linear moveout correction.

Use constant velocity — If selected, use a constant velocity for the linear moveout correction.

Correction velocity — Enter the constant moveout velocity.

The **Static Shift** specifies the constant static shift to apply.

Coarse grain — Specify the constant static shift in milliseconds.

The **Application Mode** specifies the linear moveout application mode.

Coarse grain — If selected, statics shifts are applied to the nearest discrete sample position.

Fine grain — If selected, statics shifts are applied as a precise phase shift operator in the Fourier domain.

Do inverse linear moveout — If checked, inverse linear moveout will be applied to the seismic data.

Apply Normal Moveout

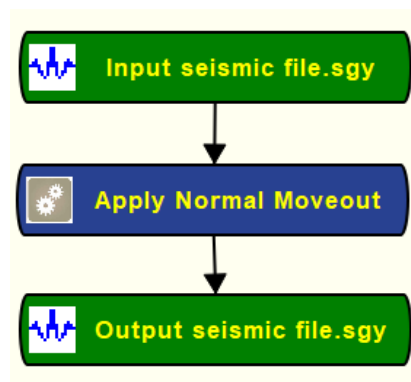
Usage: The Apply Normal Moveout step allows to apply normal moveout corrections to the pre-stack data using a single velocity or a set of velocity function cards. The user chooses between a linear or quadratic interpolation method for interpolating trace sample values back to even sample intervals after applying the moveout. The user may also apply a stretch mute to the NMO corrected seismic data. A constant velocity moveout may be accomplished by inputting a correction velocity in the dialog and not connecting any velocity function cards to the step. The NMO process automatically spatially interpolates the velocity over the entire range of CMPs in the line.

In the case of 3D data, the velocity functions are interpolated using a 2-D Delaunay triangulation weighting of evaluation points. Velocity function CMP locations are triangulated, then barycentric coordinates are used to compute weights between velocity functions. The interpolation is done laterally. No allowance is made for structure.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Velocity Function as a card data file (optional); 3) Velocity Function as a seismic file (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Apply Normal Moveout

Velocity field definition

- ☐ Use velocity from card data file
- ☐ Use velocity from velocity-field file
- ☒ Use constant velocity
 - Constant velocity: 7000.0
 - Scale input velocities by multiplier: 1.00

☐ Use less stretch wavelet transform NMO algorithm (very slow)

Mute control

- ☐ Apply mute from data file
- ☒ Apply stretch mute
 - Percentage: 30.0
 - Taper length (samples): 15.0

Interpolation type selection

- ☒ Linear
- ☐ Quadratic
- ☐ Spline

☐ Do inverse NMO application

☐ Account For Energy Above Zero

OK Help Cancel

Parameter Description:

The **Velocity field definition** specifies the velocity field to be used to correct for hyperbolic moveout.

Use velocity field from data file — If checked, the velocity field from a card data file will be used.

Use velocity field from velocity-field file — If checked, the velocity field from a seismic file will be used.

Use constant velocity — If checked, a constant velocity will be used.

Constant velocity — Enter a constant NMO velocity. This constant velocity will be used if a set of velocity function cards is NOT linked to the NMO correction step.

Scale input velocities by multiplier — Enter the amount by which the input velocities are scaled up or down. A value of 1.0 does not alter the velocity field.

Use less stretch wavelet transform NMO algorithm — If checked, the stretch mute is estimated automatically from wavelet transform.

The **Mute control** specifies the parameters for the stretch mute definition.

Apply mute from data file — If checked, a mute will be applied to the NMO corrected data from a data file.

Apply stretch mute — If checked, a stretch mute will be applied to the NMO corrected data. Stretch muting removes the stretching of the data due to the NMO correction.

Percentage — Enter the stretch mute percentage. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Interpolation type selection** specify the interpolation type (linear or quadratic). The moveout function causes trace data samples to be moved in time to new locations. Since these new time locations of the data sample values are not usually exactly at the sample interval of the data, the data is interpolated to be evenly sampled at the correct sample interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

Spline — If selected, uses a spline approximation to interpolate data values between or beyond existing data.

Do inverse NMO application — If checked, the inverse NMO correction will be applied, instead of the usual forward NMO.

Apply PP Non-hyperbolic Moveout

Usage: The Apply PP Non-hyperbolic Moveout step uses the travel-time equation for transversely isotropic (TI) media described by Alkhalifah and Tsvankin (1997). Non-hyperbolic P-wave moveout may become significant when source-receiver offsets are approximately equal to or greater than the depth of reflection. The resulting deviations from the hyperbolic travelttime equation may be attributed to one or more phenomena: (1) The standard hyperbolic travel-time equation is only a two-term, short-offset approximation of the full travel-time equation for P-wave reflections in layered media; (2) the earth media may be anisotropic. The resulting moveout is a function of the zero-offset time, the source-receiver offset, P-wave short-spread stacking velocity, and η (eta), where eta is an effective anisotropy parameter that measures the ratio of horizontal to vertical P-wave velocity. The Apply PP Non-hyperbolic Moveout step uses the combination of Eta functions and P-wave stacking velocities to correct for non-hyperbolic moveout.

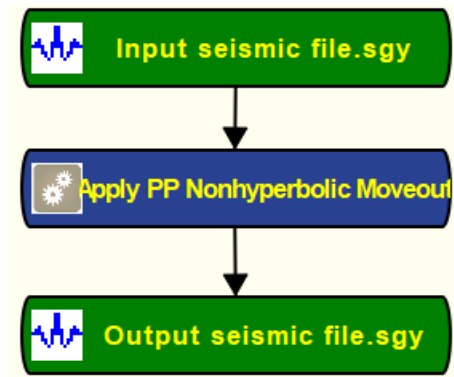
Input Links: 1) Seismic data in any sort order (mandatory); 2) PP Nhmo Eta Function card data file containing eta picks (optional); 3) PP Nhmo Eta Function seismic file containing eta picks (optional); 4) Velocity Function as a card data file (optional); 5) Velocity Function as a seismic file (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Alkhalifah, Tariq, 1997, Velocity analysis using nonhyperbolic moveout in transversely isotropic media: Geophysics, 62, 1839-1854.

Alkhalifah, Tariq, and Tsvankin, Ilya, 1995, Velocity analysis for transversely isotropic media: Geophysics, 60, 1550-1566.

Example Flowchart:



Step Parameter Dialog:

Apply PP Nonhyperbolic NMO ? X

Eta field definition

☐ Use eta functions from data file

☐ Use eta field from seismic file

☒ Use constant eta

Constant eta

Scale input eta values by (%)

P-wave velocity field definition

☐ Use velocity functions from data file

☐ Use velocity field from seismic file

☒ Use constant velocity

Constant velocity

Scale input velocities by (%)

Mute control

☒ Apply stretch mute

Percentage

Taper length (samples)

Interpolation type selection

☐ Linear ☒ Quadratic

☒ Do inverse moveout application

OK Help Cancel

Parameter Description:

The **Eta field definition** specifies how the Eta field will be defined to correct for non-hyperbolic moveout.

Use eta functions from data file — If checked, the eta functions from a data file will be used.

Use eta field from seismic file — If checked, the eta field from a seismic file will be used.

Use constant eta — If checked, a constant eta will be used.

Constant eta — Enter constant eta value.

Scale input eta values by (%) — Enter the amount by which the input eta are scaled up or down. A value of 1.0 does not alter the velocity field.

The **P-wave velocity field definition** specifies how the P-wave velocity field will be defined to correct non-hyperbolic moveout.

Use velocity functions from data file — If checked, the velocity functions from a data file will be used.

Use velocity field from seismic file — If checked, the velocity field from a seismic file will be used.

Use constant velocity — If checked, a constant velocity will be used.

Constant velocity — Enter the short-spread P-wave NMO velocity. This constant velocity will be used if a P-wave stacking velocity function is NOT selected.

Scale input velocities by (%) — Enter the amount by which the input velocities are scaled up or down. A value of 1.0 does not alter the velocity field.

The **Mute control** specifies the parameters for the stretch mute definition.

Apply stretch mute — If checked, a stretch mute will be applied to the NMO corrected data. Stretch muting removes the stretching of the data due to the NMO correction.

Percentage — Enter the stretch mute percentage. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Interpolation type selection** specifies the interpolation type (linear or quadratic). The moveout function causes trace data samples to be moved in time to new locations. Since these new time locations of the data sample values are not usually exactly at the sample interval of the data, the data is interpolated to be evenly sampled at the correct sample interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

Do inverse moveout application — If checked, the inverse NMO correction will be applied, instead of the usual forward NMO (not implemented).

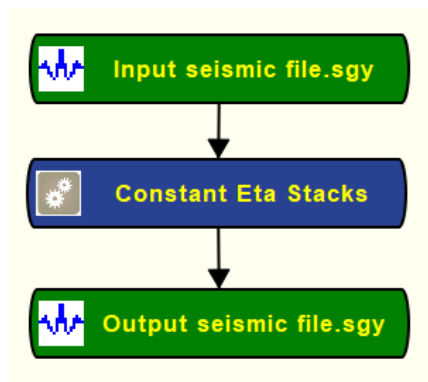
Constant Eta Stacks

Usage: The Constant Eta Stacks step generates a file of constant eta stack traces for anisotropic velocity analysis with different vertical and horizontal velocities. The user chooses the number of eta with which to stack your data, the first eta to apply, and the last eta. The user has the option to apply a stretch mute, if you so desire. With the series of constant eta stack traces, the user may page through these stacked panels using Display and interactively pick eta functions that result in the most coherent stacked sections.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:


Constant eta stacks
?
×

Eta range

First eta

Last eta

Eta increment

Mute control

☐ Apply mute from data file

☒ Apply stretch mute

Percentage

Taper length (samples)

Line range

First line to analyse

Last line to analyse

Line increment

Interpolation type selection

☒ Linear interpolation

☐ Quadratic interpolation

Location range

First location to analyse

Last location to analyse

Location increment

Locations per analysis

Trace amplitude definition

☐ Use relative amplitude traces

☒ Use true amplitude traces

Exponent normalization

P-wave velocity field definition

☐ Use velocity field from data file

☒ Use constant velocity

☐ Use velocity field from seismic file

Constant velocity

Scale input velocities by (%)

OK

Help

Cancel

Parameter Description:

The **Eta range** specifies the first and last eta values along with the eta increment to calculate the number of eta values to use in the analysis. A stacked section is calculated for each eta value linearly interpolated between the starting and ending input eta values. The velocity increment will be:

$$\eta_{\text{inc}} = (\text{last } \eta - \text{first } \eta) / (\text{Number of } \eta - 1)$$

First eta — Enter the starting eta for the analysis. This eta will be used for non-hyperbolic moveout on the first output stack. {>0.0}

Last eta — Enter the ending eta for the analysis. This eta will be used for non-hyperbolic moveout on the last output stack. {>0.0}

Eta increment — Enter the eta increment number. This number will be used to linearly interpolate between the first and last eta.

The **Line range** specifies the first and last lines along with the line increment to calculate the number of lines to use in the analysis.

First line to analyze — Enter the first CMP line number to analyze.

Last line to analyze — Enter the last CMP line number to analyze.

Line increment — Enter the CMP line increment between lines to analyze.

The **Location range** specifies the first and last locations along with the location increment to calculate the number of locations to use in the analysis. At each CMP location a range of constant velocity stacks will be generated from the first velocity to the last velocity in increments of η_{inc} .

First location to analyze — Enter the first CMP location number to analyze.

Last location to analyze — Enter the last CMP location number to analyze.

Location increment — Enter the CMP location increment between groups of CMP locations to analyze.

Locations per analysis — Enter the number of CMP locations in each analysis panel.

The **Mute control** specifies how the mute will be defined.

Apply mute from data file — If checked, a mute will be applied to the non-hyperbolic moveout corrected data.

Apply stretch mute — If checked, a stretch mute will be applied to the non-hyperbolic moveout corrected data. Stretch muting restricts the stretching of the data due to the non-hyperbolic moveout correction.

Percentage — Enter the stretch mute percentage. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Interpolation type selection** specifies the interpolation type (linear or quadratic). The moveout function causes trace data samples to be moved in time to new locations. Since these new time locations of the data sample values are not exactly at the sample interval of the data, the data is interpolated to the correct sample interval.

Linear interpolation — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic interpolation — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

The **Trace amplitude definition** specifies the trace amplitude definition for relative or true amplitude.

Use relative amplitude traces — If selected, relative amplitude traces will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Use true amplitude traces — If selected, uses true amplitude scaled traces in the analysis. True amplitude traces are scaled by one common factor per record.

Exponent normalization — Enter the scaling exponent for normalization. Traces are scaled by (fold^{EXP}).

The **P-wave velocity field definition** specifies how the P-wave velocity field will be defined to correct non-hyperbolic moveout.

Use velocity field from data file — If checked, the velocity field from a data file will be used.

Use velocity field from seismic file — If checked, the velocity field from a seismic file will be used.

Use constant velocity — If checked, a constant velocity will be used.

Constant velocity — Enter the short-spread P-wave NMO velocity. This constant velocity will be used if a P-wave stacking velocity function is NOT selected.

Scale input velocities by (%) — Enter the amount by which the input velocities are scaled up or down. A value of 1.0 does not alter the velocity field.

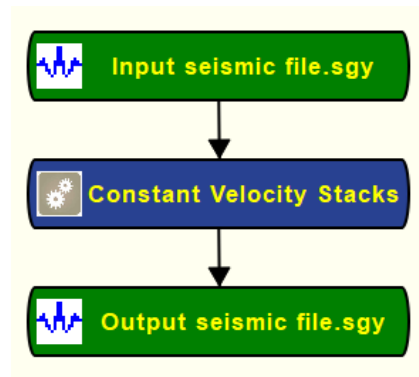
Constant Velocity Stacks

Usage: The Constant Velocity Stacks step generates a file of constant velocity stack traces. The user chooses the number of velocities with which to stack your data, the first velocity to apply, and the last velocity. The user has the option to apply a stretch mute. With the series of constant velocity stack traces, the user may page through these stacked panels using Display and interactively pick velocity functions that result in the most coherent stacked sections.

Input Links: 1) Seismic data pre-stack, in CMP sort order (mandatory)

Output Links: 1) Seismic data pre-stack, in CMP sort order (mandatory)

Example Flowchart:



Step Parameter Dialog:

Constant Velocity Stacks

Velocity range

First velocity: 1500.0

Last velocity: 4500.0

Velocity increment: 100.0

Line range

First line to analyze: 1

Last line to analyze: 1

Line increment: 1

Location range

First location to analyze: 1000.0

Last location to analyze: 2000.0

Location increment: 100.0

Locations per analysis: 21

Mute control

☐ Apply mute from data file

☒ Apply stretch mute

Percentage: 30

Taper length (samples): 15

Interpolation type selection

☐ Linear ☒ Quadratic

Trace amplitude definition

☐ Use relative amplitude traces ☒ Use true amplitude traces

Exponent for normalization: 1.0

OK Help Cancel

Parameter Description:

The **Velocity range** specifies the first and last velocities along with the velocity increment to calculate the number of velocities to use in the analysis. A stacked section is calculated for each velocity linearly interpolated between the starting and ending input velocities. The velocity increment will be:

$$V_{\text{inc}} = (\text{last velocity} - \text{first velocity}) / (\text{Number of velocities} - 1)$$

First velocity — Enter the starting velocity for the analysis. This velocity will be used for NMO on the first output stack. {>0.0}

Last velocity — Enter the ending velocity for the analysis. This velocity will be used for NMO on the last output stack. {>0.0}

Velocity increment — Enter the velocity increment number. This number will be used to linearly interpolate between the first and last velocities.

The **Line range** specify the first and last lines along with the line increment to calculate the number of lines to use in the analysis.

First line to analyze — Enter the first CMP line number to analyze.

Last line to analyze — Enter the last CMP line number to analyze.

Line increment — Enter the CMP line increment between lines to analyze.

The **Location range** specify the first and last locations along with the location increment to calculate the number of locations to use in the analysis. At each CMP location a range of constant velocity stacks will be generated from the first velocity to the last velocity in increments of Vinc.

First location to analyze — Enter the first CMP location number to analyze.

Last location to analyze — Enter the last CMP location number to analyze.

Location increment — Enter the CMP location increment between groups of CMP locations to analyze.

Locations per analysis — Enter the number of CMP locations in each analysis panel.

The **Mute control** specifies how the mute will be defined.

Apply mute from data file — If checked, a mute will be applied to the NMO corrected data.

Apply stretch mute — If checked, a stretch mute will be applied to the NMO corrected data. Stretch muting restricts the stretching of the data due to the NMO correction.

Percentage — Enter the stretch mute percentage. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

Interpolation type selection — Specify the interpolation type (linear or quadratic). The moveout function causes trace data samples to be moved in time to new locations. Since

these new time locations of the data sample values are not exactly at the sample interval of the data, the data is interpolated to the correct sample interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

The **Trace amplitude definition** specifies the trace amplitude definition for relative or true amplitude.

Use relative amplitude traces — If selected, relative amplitude traces will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Use true amplitude traces — If selected, uses true amplitude scaled traces in the analysis. True amplitude traces are scaled by one common factor per record.

Exponent for normalization — Enter the scaling exponent. Traces are scaled by (fold^{EXP}).

Create Velocity Field

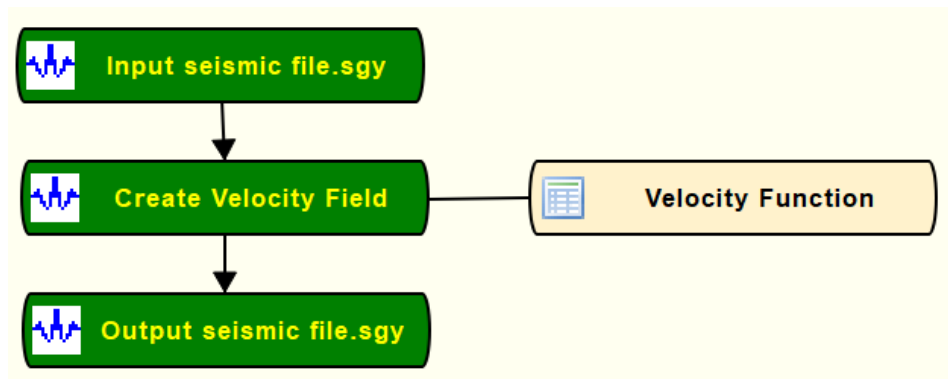
Usage: Create Velocity Field is used to create a velocity-field file from a standard velocity function card, an interval velocity card, or a layer cake model completely from scratch. The constructed model is saved as a SEGY file and can be used either for display or for ray tracing and migration processes.

Input Links: None.

Auxiliary dataset: 1) Velocity function card data file (optional); 2) Pre-Stack seismic data for geometry (optional).

Output Links: Seismic file where the velocity model is going to be saved (mandatory).

Example Flowchart:



Step Parameter Dialog:

Parameter Description:

The **Velocity parameters** specifies the parameters related to input velocity

Interpolate from velocity card file — If checked, connects a standard (RMS) velocity card to the step.

Use a layer cake velocity model — If checked, adds a table allowing the user to build his own layer cake model.

Number of layers — specify the number of layers to be considered.

Lateral smoothing parameter — Enter a lateral smoothing parameter, or else zero (uses the Damped Least Square Filter processing step for the smoothing).

Depth smoothing parameter — specify a depth smoothing parameter, or else zero (uses the damped least square filter for the smoothing).

Scale velocities by factor — enter a scaling factor for the input velocities, or else 1.

The **Output velocities** specify the type of output velocities that will be written in output seismic file. Only available if Input seismic field file is set to Velocity.

Interval velocity — If selected, input velocities are Interval velocities.

RMS (Stacking) velocity — If selected, input velocities are RMS velocities.

Average velocity — If selected, input velocities are average velocities.

Output velocity in Depth — If checked, outputs velocities in the depth domain.

Depth interval (m) — Enter the depth sampling interval of the output velocity model.

Maximum Depth (m) — Enter the maximum depth of the velocity model.

The **Velocity model geometry** specifies the geometry of the output velocity model.

Get geometry from an auxiliary seismic file — If selected, get the geometry of the velocity model from an auxiliary seismic file.

Extend velocity field based on Src/Rec positions — If checked, extends the velocity model to cover all Src/Rec locations instead of just CMP locations.

Extend extra locations — Enter extra locations to extend.

Manually define model geometry — If selected, defines the velocity model geometry manually.

First depth sample — Enter the first depth sample of the model.

Depth interval — Enter the depth interval of the model.

Number of depth samples — Enter the last depth sample of the model.

First lateral sample — Enter the first lateral sample of the model.

Lateral interval — Enter the lateral interval of the model.

Number of lateral samples — Enter the last lateral sample of the model.

The **Headers update** specifies each header of the output velocity model will be updated.

Use CMP Line — If selected, update CMP line header word.

Use CMP Location — If selected, update CMP location header word.

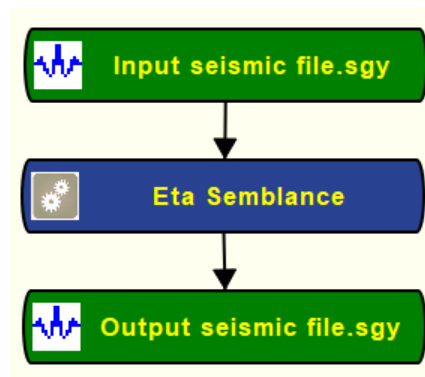
Eta Semblance

Usage: The Eta Semblance step creates eta semblance displays for the input CMP records. For semblance display generation, the user defines the eta range for semblance calculation by choosing the number of eta values, the starting eta value for this range, and the eta increment. The user may generate only one CMP semblance display for each input CMP gather. The user may also control the time gate length around hyperbolic velocity paths for CMP summing in the semblance calculation using the “Semblance length” input parameter. Finally, the output semblance display may be windowed, and a stretch mute may be applied if so desired.

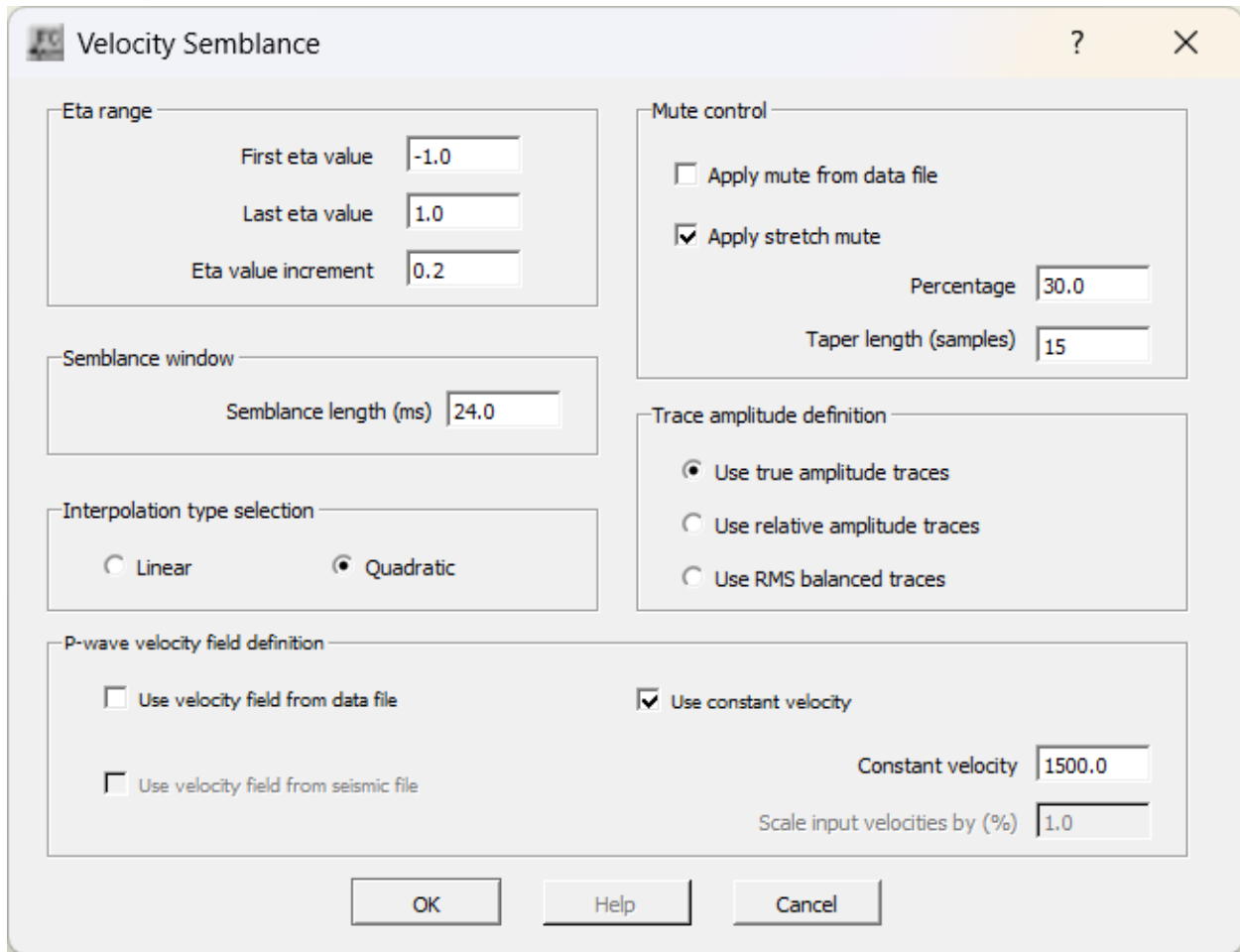
Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The dialog box is titled "Velocity Semblance" and contains several sections for configuring seismic processing parameters. The "Eta range" section has three input fields: "First eta value" (set to -1.0), "Last eta value" (set to 1.0), and "Eta value increment" (set to 0.2). The "Semblance window" section has a single input field: "Semblance length (ms)" (set to 24.0). The "Interpolation type selection" section has two radio buttons: "Linear" and "Quadratic", with "Quadratic" selected. The "Mute control" section has two checkboxes: "Apply mute from data file" (unchecked) and "Apply stretch mute" (checked). Below these are two input fields: "Percentage" (set to 30.0) and "Taper length (samples)" (set to 15). The "Trace amplitude definition" section has three radio buttons: "Use true amplitude traces" (selected), "Use relative amplitude traces", and "Use RMS balanced traces". The "P-wave velocity field definition" section has three checkboxes: "Use velocity field from data file" (unchecked), "Use constant velocity" (checked), and "Use velocity field from seismic file" (unchecked). Below these are two input fields: "Constant velocity" (set to 1500.0) and "Scale input velocities by (%)" (set to 1.0). At the bottom are three buttons: "OK", "Help", and "Cancel".

Parameter Description:

The **Eta range** specifies the eta values range where the semblance will be computed.

First eta — Enter the first eta value to scan.

Last eta — Enter the last eta value to scan.

Eta value increment — Enter the value by which the eta is incremented.

The **Semblance window** specifies the smoothing length of the semblance window.

Semblance length (ms) — Enter the length of the semblance calculation window in milliseconds.

The **Interpolation type selection** specifies the interpolation type (linear or quadratic).

The moveout function causes trace data samples to be moved in time to new locations.

Since these new time locations of the data sample values are not exactly at the sample interval of the data, the data is interpolated to even sampling at the correct interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

The **Mute Control** specifies the stretch mute control parameters.

Apply mute from data file — If checked, a stretch mute card data will be added to the flow and applied to the NMO corrected data

Apply stretch mute — If checked, apply stretch mute as defined below.

Percentage — Enter the percent stretch mute. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Trace amplitude definition** specify amplitude summing selection.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, use of relative amplitude scaled traces in the analysis. Relative amplitude traces are scaled independently of one another.

Use RMS balanced traces — Amplitude traces will be balanced using RMS.

The **P-wave velocity field definition** specifies how the P-wave velocity field will be defined to correct non-hyperbolic moveout.

Use velocity functions from data file — If checked, the velocity functions from a data file will be used.

Use velocity field from seismic file — If checked, the velocity field from a seismic file will be used.

Use constant velocity — If checked, a constant velocity will be used.

Constant velocity — Enter the short-spread P-wave NMO velocity. This constant velocity will be used if a P-wave stacking velocity function is NOT selected.

Scale input velocities by (%) — Enter the amount by which the input velocities are scaled up or down. A value of 1.0 does not alter the velocity field.

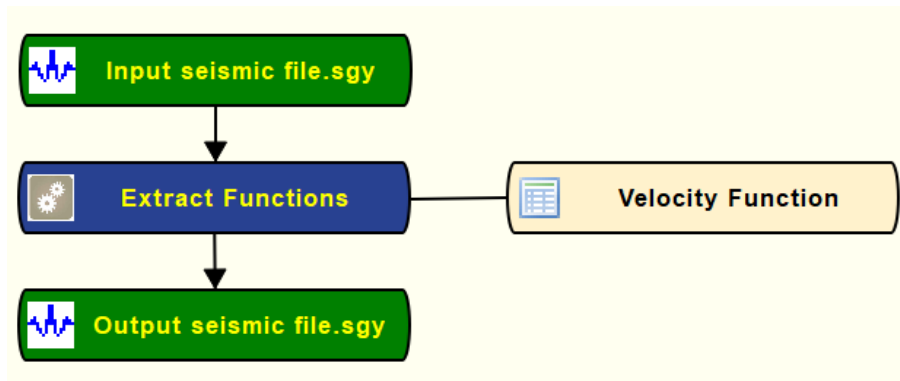
Extract Functions

Usage: The Extract Functions step extracts velocity, Eta or Gamma functions from auxiliary card data files at specific locations as user-defined along an existing seismic data file sorted by CMP.

Input Links: 1) Seismic file in CMP sort order (mandatory); 2) One of the following card data files: Velocity card data file, Eta card data file, Gamma card data file (mandatory).

Output Links: 1) Seismic file with extracted functions (mandatory).

Example Flowchart:



Step Parameter Dialog:

Extract Functions

Input seismic field type

- ☒ Velocity
- ☐ Eta
- ☐ Gamma

Input velocity field type

- ☒ RMS
- ☐ Interval
- ☐ Average

Output auxiliary file velocity type

- ☒ RMS
- ☐ Interval
- ☐ Average

Function selection

- ☐ Regularly spaced locations
- ☒ All trace locations

Line range

First line to extract:

Last line to extract:

Line increment:

Location range

First location to extract:

Last location to extract:

Location increment:

Vertical point selection

- ☒ Interface 'kneepoints'
- ☐ Regular intervals

Interface 'kneepoints'

Average points per function:

Regular intervals

Sampling interval (ms.):

OK Help Cancel

Parameter Description:

The **Input seismic field type** specifies type of auxiliary data type from where functions are going to be extracted.

Velocity — If selected, an auxiliary velocity card data type will be used.

Eta — If selected, an auxiliary Eta card data type will be used.

Gamma — If selected, an auxiliary Gamma card data type will be used.

The **Input velocity field type** specifies the type of input velocities in the auxiliary card data file. Only available if Input seismic field file is set to Velocity.

RMS — If selected, input velocities are RMS velocities.

Interval — If selected, input velocities are Interval velocities.

Average — If selected, input velocities are average velocities.

The **Output auxiliary velocity type** specifies the type of output velocities that will be written in output seismic file. Only available if Input seismic field file is set to Velocity.

RMS — If selected, input velocities are RMS velocities.

Interval — If selected, input velocities are Interval velocities.

Average — If selected, input velocities are average velocities.

The **Function selection** specifies how auxiliary card data files will be sampled.

Regularly spaced locations — If selected, auxiliary field will be sampled at regularly spaced locations as user-defined.

All trace locations — If selected, auxiliary field will be sampled for all the locations available.

The **Line Range** specifies the locations to be extracted in the Line direction. Only available if Function selection is set to Regularly spaced locations.

First line to extract — Enter the value for the first line to be extracted.

Last line to extract — Enter the value for the last line to be extracted.

Line increment — Enter the value for the increment of the sampling in the line direction.

The **Location range** specifies the locations to be extracted in the Location direction. Only available if Function selection is set to Regularly spaced locations.

First location to extract — Enter the value for the first location to be extracted.

Last location to extract — Enter the value for the last location to be extracted.

Location increment — Enter the value for the increment of the sampling in the location direction.

The **Vertical point selection** specifies how auxiliary fields are sampled vertically.

Interface 'kneepoints' — If selected, auxiliary fields will be sampled at the same vertical locations as the picking.

Average points per function — Enter the desired average number of points per function in the vertical direction.

Regular intervals — If selected, auxiliary fields will be sampled vertically at a constant interval

Sampling intervals (ms.) — Enter the sampling interval along the vertical direction.

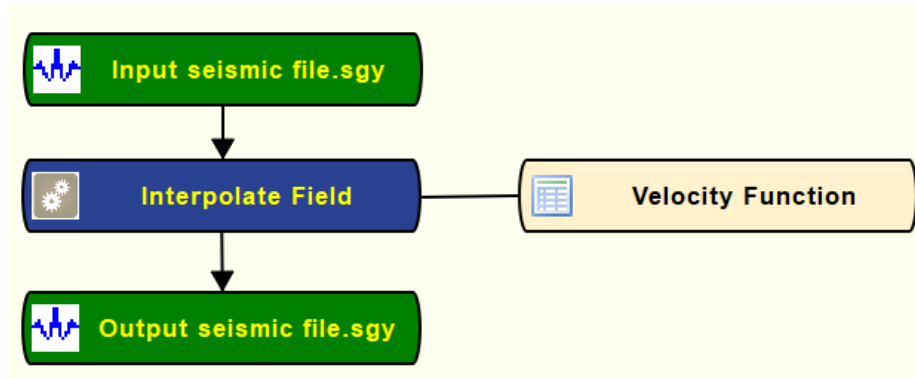
Interpolate Field

Usage: The Interpolate Filed step interpolates velocity, Eta or Gamma fields into a new user-defined geometry

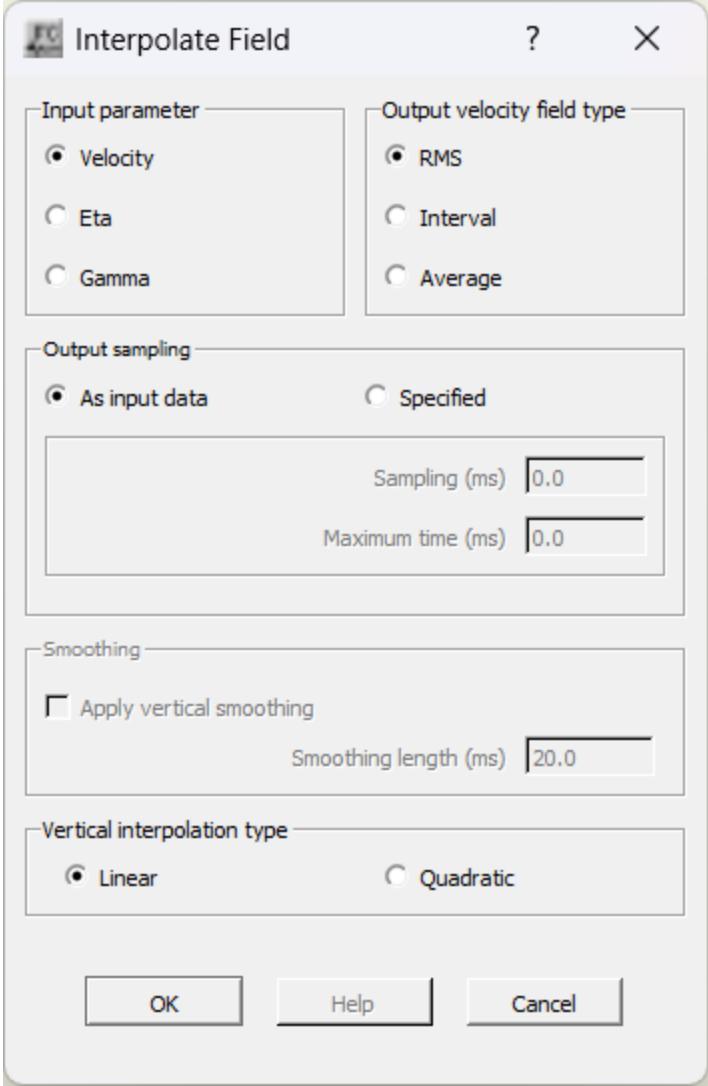
Input Links: 1) Seismic file in CMP sort order (mandatory); 2) One of the following card data files: Velocity card data file, Eta card data file, Gamma card data file (mandatory).

Output Links: 1) Seismic file with extracted functions (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Interpolate Field". It contains several sections for configuring interpolation parameters. The "Input parameter" section has three radio buttons: "Velocity" (selected), "Eta", and "Gamma". The "Output velocity field type" section has three radio buttons: "RMS" (selected), "Interval", and "Average". The "Output sampling" section has two radio buttons: "As input data" (selected) and "Specified". Below these are two input fields: "Sampling (ms)" and "Maximum time (ms)", both set to "0.0". The "Smoothing" section has a checkbox for "Apply vertical smoothing" (unchecked) and a "Smoothing length (ms)" input field set to "20.0". The "Vertical interpolation type" section has two radio buttons: "Linear" (selected) and "Quadratic". At the bottom are "OK", "Help", and "Cancel" buttons.

Parameter Description:

The **Input parameter** specifies type of auxiliary data type from where functions are going to be extracted.

Velocity — If selected, an auxiliary velocity card data type will be used.

Eta — If selected, an auxiliary Eta card data type will be used.

Gamma — If selected, an auxiliary Gamma card data type will be used.

The **Output velocity field type** specify type of output velocities in the auxiliary card data file. Only available if Input parameter is set to Velocity.

RMS — If selected, input velocities are RMS velocities.

Interval — If selected, input velocities are Interval velocities.

Average — If selected, input velocities are average velocities.

The **Output sampling** specifies the sampling rate of output seismic file with interpolated field.

As input data — If selected, output seismic file will have the same sampling rate as input seismic file.

Specified — If selected, output seismic file will have user-defined sampling rate.

Sampling (ms) — Enter output sampling rate in milliseconds.

Maximum time (ms) — Enter maximum time of output in milliseconds.

The **Smoothing** specifies the vertical smoothing of the input field.

Apply vertical smoothing — If checked applies a vertical smoothing to the input field.

Smoothing length (ms) — Enter smoothing length in milliseconds.

The **Vertical interpolation type** specifies the type of vertical interpolation of the input field.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

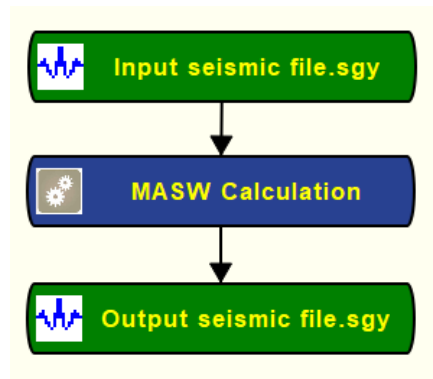
MASW Calculation

Usage: The Multichannel analysis of surface waves (MASW) step creates multi modal dispersion images, which shows a frequency vs. phase velocity space with pattern of energy accumulation that represents the actual dispersion curve. This implementation is designed to run in single thread or in parallel, giving it the possibility to take full advantage of multiple processors at the same time.

Input Links: 1) Multichannel seismic record.

Output Links: 1) Seismic file where the Dispersion images are going to be stored.

Example Flowchart:



Step Parameter Dialog:

Multichannel Analysis of Surface... ? X

Frequency range

Minimum frequency (Hz) 1

Maximum frequency (Hz) 140

Frequency increment

Velocity range

First velocity (m/s) 0

Last velocity (m/s) 1500

Velocity increment (m/s) 1.0

Normalization and Coherency

Coherency factor 6

Normalize by amplitude spectrum ☒

OK Help Cancel

Parameter Description:

The **Frequency range** specifies the frequency range to be considered for the MASW calculation.

Minimum frequency (Hz) — Enter minimum frequency to calculate in Hertz.

Maximum frequency (Hz) — Enter maximum frequency to calculate in Hertz.

Frequency increment — Enter the frequency increment.

The **Velocity range** specifies the velocity range to be considered for the MASW calculation.

First velocity (m/s) — Enter first velocity to calculate in meters per seconds.

Last velocity (m/s) — Enter last velocity to calculate in meters per seconds.

Velocity increment (m/s) — Enter velocity increment in meters per seconds as well.

The **Normalization and Coherency** specify the parameters for MASW calculation.

Coherency factor — Enter enhanced coherency factor, choose 1 for brute image.

Normalize by amplitude spectrum — If checked, normalizes by amplitude spectrum.

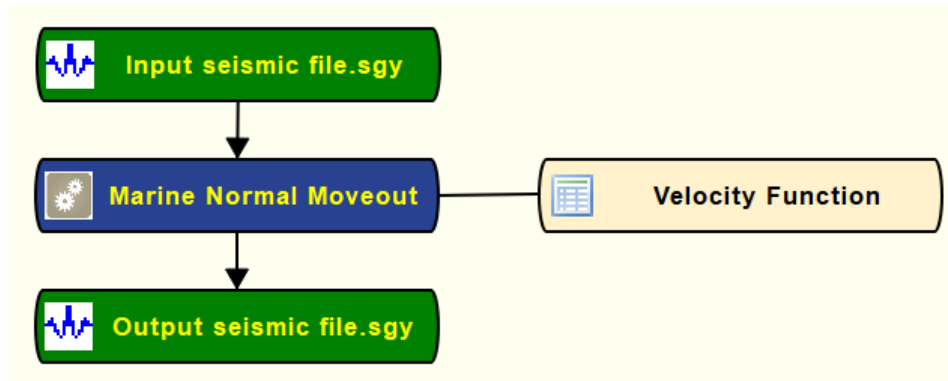
Marine Normal Moveout

Usage: The Marine Normal Moveout step applies a normal moveout to marine data based on seabed offsets times stored in a database or in the seismic trace headers and a user-defined velocity model. A stretch mute can be applied after the normal moveout application.

Input Links: 1) Seismic data in any sort order (mandatory); 2) Velocity Function card data (optional); 3) Early mute card data (optional).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Marine Normal Moveout

Seawater velocity definition

☐ From database ☒ Constant velocity: 1500.0

Seabed offset times definition

☒ From database ☐ Trace header... User defined 7

☐ Apply seabed taper Taper length (samples) 15

Sub-seabed velocity function definition

☐ From database ☒ Card data file

Mute control

☐ Apply mute from data file

☐ Apply stretch mute Percentage 30 Taper length (samples) 15

Data interpolation type

☒ Linear ☐ Cubic

OK Help Cancel

Parameter Description:

The **Seawater velocity definition** specifies seawater velocity parameters.

From database — If selected, uses a velocity value stored in the database (not implemented).

Constant velocity — If selected, uses a sweater constant velocity defined in m/s.

The **Seabed offset times definition** specifies seabed offset times parameters.

From database — If selected, uses a offset times values stored in the database.

Trace header... — If selected, uses the information stored in a trace header location.

Apply seabed taper — If checked, applies a taper to the seabed times.

Taper length (samples) — Enter the taper length in number of samples.

The **Sub-seabed velocity function definition** specifies subsurface velocity parameters.

From database — If selected, uses velocity values stored in the database.

Card data file — If selected, uses velocity values stored in an auxiliary velocity function card data file.

The **Mute control** specifies marine normal moveout mute parameters.

Apply mute from data file — If checked, applies an early mute function defined in auxiliary card data.

Apply stretch mute — If checked, applies a stretch mute.

Percentage — Enter the stretch mute percentage.

Taper length (samples) — Enter the taper length in number of samples.

The **Data interpolation type** specifies the data interpolation parameters.

Linear — If selected, interpolates data linearly.

Quadratic — If selected, uses a cubic function to interpolate the data.

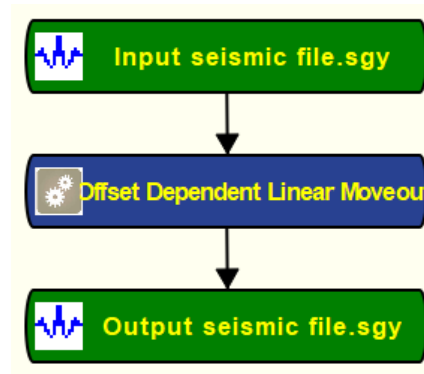
Offset Dependent Linear Moveout

Usage: The Offset Dependent Linear Moveout step applies a linear moveout correction dependent on the offset and a user-defined constant velocity to the input seismic data. The linear moveout may be applied within a user-defined range of offsets in multiple windows with different offsets. Within each offset window the entire length of each seismic trace is corrected accordingly with selected velocity.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

☐ Do inverse linear moveout Bulk shift (ms)

Window	Start offset	Stop offset	Velocity
1	0.00	0.00	0.00

Parameter Description:

Do inverse linear moveout — If checked, applies an inverse linear moveout as defined below in the window table.

Bulk shift (ms) — Enter a value in milliseconds corresponding to a vertical bulk shift of the entire data. If no bulk shift is desired use zero.

Window — Sequential number of the offset window where the offset dependent linear moveout will be applied.

Start offset — Enter the offset from where the linear moveout will be applied for that specific time window.

Stop offset — Enter the last offset where the linear moveout will be applied for that specific time window.

Velocity — Enter the velocity to be used in the offset dependent linear moveout for that specific time window.

Add window — Add a new offset window.

Delete window — Delete the last offset window in the table.

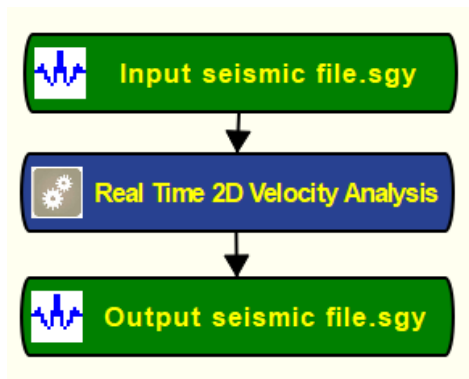
Real Time 2D Velocity Analysis

Usage: The Real Time 2D Velocity Analysis step performs velocity analysis on two-dimensional seismic data in real time without user intervention based on velocity semblance panels. Requires a 2-D Project.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time 2D Velocity Analysis

☐ Apply frequency bandpass

Set bandpass

Minimum Fold 20

☒ Apply stretch mute

Stretch mute control

Percentage 30.0

Taper length (samples) 15

Velocity semblance specification

☒ Use constant stacking velocity functions

Minimum velocity 1500.0

Maximum velocity 4500.0

Velocity increment 100.0

☐ Use guide central velocity function

% velocity variation 50.0

Number of functions 40

Semblance filter length (ms) 8

Analysis every 'n' CMPs: 20

☐ Apply receiver depth static corrections

☒ True amplitude stacking

☐ Relative amplitude stacking

Normalization exponent 1.0

Seawater velocity 1500

☐ Specify final velocity: 5000

Minimum interval velocity 1200

Maximum interval velocity 6000

☐ O/p velocity stack images

☐ O/p velocity semblance images

Set stack image parameters

Set semblance image parameters

☐ Plot automated pick line

Interval for output images (CMPs) 3000

☐ Delete segy files after image output

OK Help Cancel

Parameter Description:

Apply frequency bandpass — If checked, apply a frequency bandpass to the data before stacking.

Set bandpass — Select the bandpass filter parameters to be applied to the data.

Minimum Fold — Enter the minimum stack fold for stacked traces to be output. Stacked traces with fold lower than this will be set as dead traces.

The **Velocity semblance specification** defines the semblance parameters to be used in the velocity analysis

Use constant stacking velocity functions — If checked, generate constant velocity semblance functions.

Minimum velocity — Enter the starting velocity for the analysis. This velocity will be used for NMO on the first output stack. {>0.0}

Maximum velocity — Enter the ending velocity for the analysis. This velocity will be used for NMO on the last output stack. {>0.0}

Velocity increment — Enter the number of velocities to use in the analysis. A stacked section is calculated for each velocity linearly interpolated between the starting and ending input velocities. The velocity increment will be: $V_{inc} = (\text{last velocity} - \text{first velocity}) / (\text{Number of velocities} - 1)$

Use guide central velocity function — If selected, generate a number of velocity functions based around a specified guide velocity function

% velocity variation — Enter the percentage of velocity variation allowed for picking around the central velocity function.

Number of functions — Enter the number of velocity function to be used for the velocity analysis.

Semblance filter length (ms) — Enter the required length of the semblance filter in milliseconds.

Analysis every 'n' CMPs: — Specify the spatial frequency of performing the velocity analysis.

Apply stretch mute — If checked, a stretch mute will be applied to the NMO corrected data before the semblance stacking.

Stretch mute control specifies the mute parameters.

Percentage — Enter the percent stretch mute. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute tape length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

Apply receiver depth static corrections — If checked apply a static correction of the nominal receiver depth to redatum the receivers to the surface. A time shift is applied based on the depth interpolated from the streamer buoy depths, and the specified stacking velocity.

True amplitude stacking — If selected, use of true amplitude scaled traces in the analysis. True amplitude traces are scaled by one common factor per record.

Relative amplitude stacking — If selected, relative amplitude traces will be summed in the stacking process. Relative amplitude traces are scaled independently of one another.

Normalization exponent — Enter the normalization exponent to be applied to the stacked data before the semblance calculation.

Seawater velocity — Enter the (constant) stacking velocity to be used for normal moveout application. Moveout is applied only if this value is greater than zero.

Specify final velocity — If checked, specify the final velocity at the end of the data.

Minimum interval velocity — Enter the starting velocity for the analysis. This velocity will be used for NMO on the first output stack. {>0.0}

Maximum interval velocity — Enter the ending velocity for the analysis. This velocity will be used for NMO on the last output stack. {>0.0}.

O/p velocity stack images — If checked, output stack image files, one per output line.

Set stack image parameters — Select the parameters to be used in displaying the seismic data.

O/p velocity semblance images — If checked, output stack image files, one per output line.

Set semblance image parameters — Select to set the parameters to be used in displaying the seismic data.

Residual Moveout Analysis

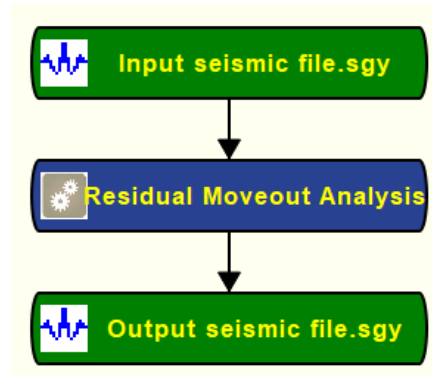
Usage: Residual Moveout Analysis analyses pre-stack 2D or 3D CMP NMO-corrected gathers for errors in the moveout applied. The required residual moveout is parameterized as a CMP-varying 'alpha' function, using either a standard or a long offset moveout assumption. This parameter is determined fully-sampled using a fast semblance analysis and output as a segy file. A velocity field is not required for the analysis. The output parameter field may then be smoothed as required, using for example, 3D Median with a 5-5-1 filter or similar. As a final step use Residual Moveout Application with the derived or the smoothed parameter field as auxiliary input to correct the residual moveout errors.

Input Links: 1) CMP records of offset-sorted moveout-applied seismic data (mandatory).

Output Links: 1) CMP-sorted 'alpha' parameter field (mandatory).

Reference: Castle, R. J. 1994. A theory of normal moveout, Geophysics, Vol 59, No 6, June 1994, pp 983-999.

Example Flowchart:



Step Parameter Dialog:

Residual Moveout Analysis

Moveout correction type

☒ Standard

☐ Long offsets

Reference offsets specification

☐ Shift high offsets only

Minimum Ref. offset: 1000.0

Maximum Ref. offset: 3000.0

Number of Ref. offsets: 5

Correction limits control

Maximum Offset: 0.0

Maximum shift (ms.): 0.0

Advanced

Semblance control

Scan width: 31

Smoothing width (# scans): 3

Max % data stretch: 5.0

Semblance width (samps): 11

Smoothing length (samps): 11

Max initial peaks: 50

☐ Output report file

Report file

Report Offset: 0.0

File Browse... C:/DATA/Documentation/Report/ResidualMoveoutReport.txt

☒ Append to existing file

OK Help Cancel

Parameter Description:

The **Moveout correction type** specifies if the residual moveout correction should consider standard or long-offsets.

Standard — If checked, errors in the standard hyperbolic moveout will be analyzed.

Long offsets — If checked, errors in the long offset quartic moveout equation will be analyzed.

The **Reference offsets specification** is used with Long offsets Moveout correction type only. With long offsets correction there will be an offset where the quartic and quadratic terms in offset balance, known as the 'Reference offset'. The user may select a range of trial reference offsets. The correction parameter will be optimized for each reference offset. The reference offset with best optimization will then be adopted.

To save execution time, the analysis of the best Reference offset could be carried out using a limited number of records, and then this Reference offset used with the entire dataset.

Shift high offsets only — If checked, then only offsets greater than the Reference offset will be shifted by the residual moveout. This can be useful when it is only the high offsets that need correction.

Minimum Ref. offset — Enter the smallest offset to use as a reference offset.

Maximum Ref. offset — Enter the largest offset to use as a reference offset.

Number of Ref. offsets — Enter the number of reference offsets to try.

The **Correction limits control** specifies the maximum offset to be used in the analysis and the maximum vertical shift allowed.

Maximum Offset — Enter the maximum offset to be used to determine the residual moveout to apply.

Maximum shift (ms.) — Enter the maximum trace shift in milliseconds that will be allowed at the specified Maximum offset.

Advanced — If selected, the semblance control parameters may be modified. This is set as an 'advanced' option as the default parameters are usually fine to use

The **Semblance Control** specifies the semblance parameters.

Scan width — Enter the width of the scan for the semblance calculation.

Smoothing width (# scans) — Enter the number of scans to be smoothed together.

Max % data stretch — Enter the maximum percentage of data stretch allowed.

Semblance width (samps) — Enter the semblance width in number of samples.

Smoothing length (samps) — Enter the vertical smoothing length in number of samples.

Max initial peaks — Enter the maximum initial peaks values.

Output report file — If checked, a text report file will be generated giving a few statistics on residual moveout analysis of the specified offset.

The **Report file** specify parameters regarding the report file.

Report Offset — Enter the offset for which statistics will be generated in the report file.

File Browse... — Click to specify a Report file location.

Append to existing file — If checked, the statistics for the specified offset will be tagged on to the end of any text already in the specified file. Otherwise, the contents of the file specified, if already existing, will be overwritten by the current text output.

Residual Moveout Application

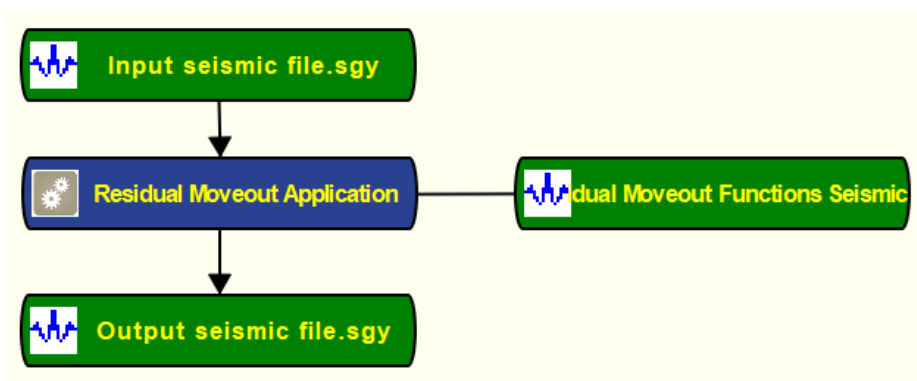
Usage: Residual Moveout Application applies residual moveout to normal moveout-corrected gathers to correct for moveout errors due to use of incorrect velocities or the use of standard hyperbolic moveout when long offset moveout would have been better used. To perform residual moveout, the Residual Moveout Functions file generated by Residual Moveout Analysis is required as auxiliary input. This fully-sampled parameter file with one time trace per CMP should be inspected and smoothed if necessary, before used as auxiliary file to Residual Moveout Application.

Input Links: 1) CMP records of offset-sorted moveout-applied seismic data (mandatory);
2) Auxiliary Residual Moveout Functions file as generated by Residual Moveout Analysis (mandatory).

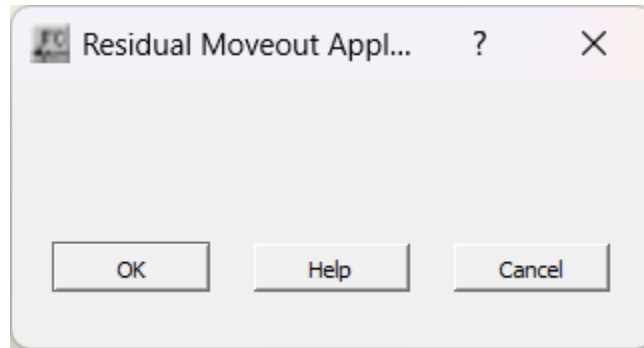
Output Links: 1) CMP-sorted 'alpha' parameter field (mandatory).

Reference: Castle, R. J. 1994. A theory of normal moveout, Geophysics, Vol 59, No 6, June 1994, pp 983-999.

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

No parameters — All parameterization is specified in the prior analysis step Residual Moveout Analysis.

Velocity Semblance

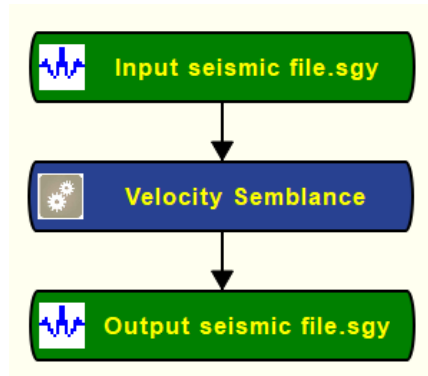
Usage: The Velocity Semblance step creates velocity semblance displays for the input CMP records. For semblance display generation, the user defines the velocity range for semblance calculation by choosing the number of velocities, the starting velocity for this range, and the velocity increment. The user may generate only one CMP semblance display for each input CMP gather. The user may also control the time gate length around hyperbolic velocity paths for CMP summing in the semblance calculation using the “Semblance length” input parameter. Finally, the output semblance display may be windowed, and a stretch mute may be applied if so desired.

Input Links: 1) Seismic data in CMP sort order (mandatory).

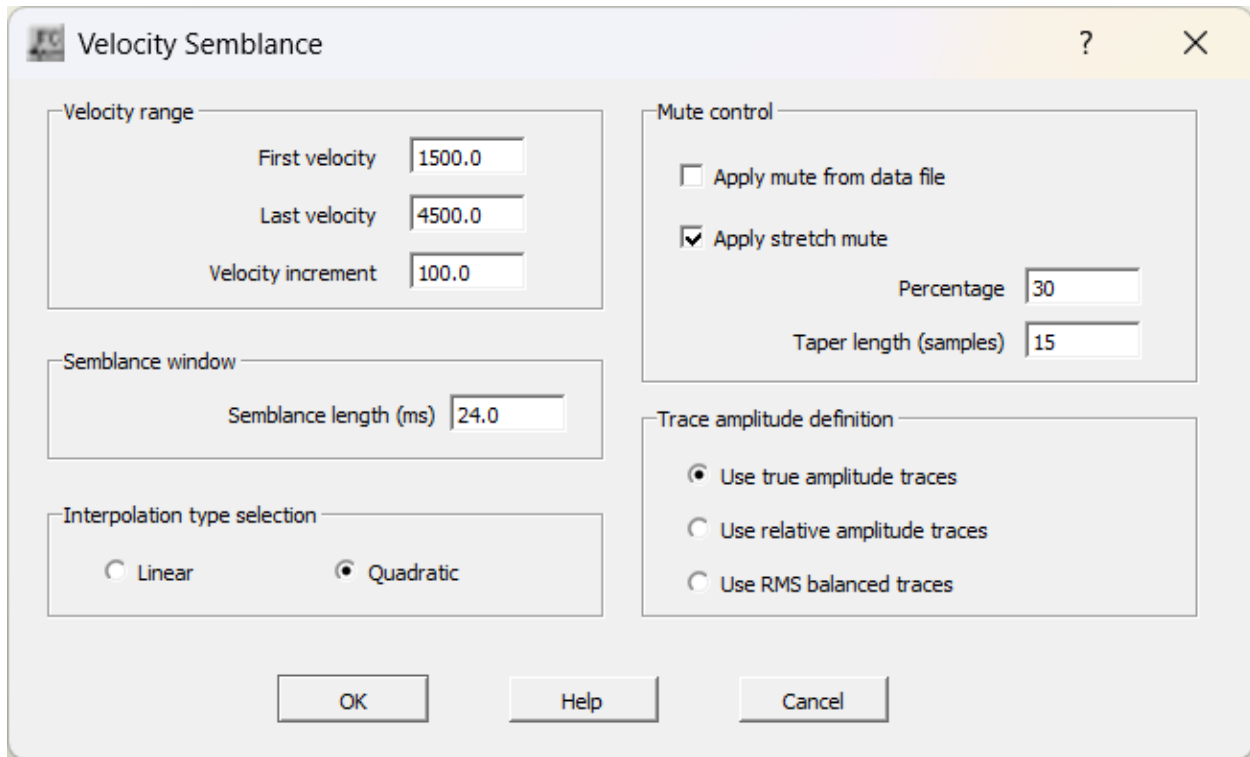
Output Links: 1) Seismic File (mandatory).

Reference: Taner, M. and Kohler, 1969, Velocity spectra — digital computer derivation and applications of velocity functions, Geophysics, v. 34, no. 6, p. 859ff.

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Velocity Semblance". It contains several sections for configuring seismic data processing parameters. The "Velocity range" section has input fields for "First velocity" (1500.0), "Last velocity" (4500.0), and "Velocity increment" (100.0). The "Semblance window" section has a "Semblance length (ms)" field set to 24.0. The "Interpolation type selection" section has two radio buttons: "Linear" and "Quadratic", with "Quadratic" selected. The "Mute control" section has a checkbox for "Apply mute from data file" (unchecked) and a checked checkbox for "Apply stretch mute", which has sub-fields for "Percentage" (30) and "Taper length (samples)" (15). The "Trace amplitude definition" section has three radio buttons: "Use true amplitude traces" (selected), "Use relative amplitude traces", and "Use RMS balanced traces". At the bottom are "OK", "Help", and "Cancel" buttons.

Section	Parameter	Value
Velocity range	First velocity	1500.0
	Last velocity	4500.0
	Velocity increment	100.0
Semblance window	Semblance length (ms)	24.0
Interpolation type selection	Linear	☐
	Quadratic	☒
Mute control	Apply mute from data file	☐
	Apply stretch mute	☒
	Percentage	30
Mute control	Taper length (samples)	15
	Trace amplitude definition	Use true amplitude traces
Use relative amplitude traces		☐
Use RMS balanced traces		☐

Parameter Description:

The **Velocity range** specifies the velocity range where the semblance will be computed.

First velocity — Enter the first velocity to scan.

Last velocity — Enter the first velocity to scan.

Velocity increment — Enter the value by which the velocity is incremented.

The **Semblance window** specifies the smoothing length of the semblance window.

Semblance length (ms) — Enter the length of the semblance calculation window in milliseconds.

The **Interpolation type selection** specifies the interpolation type (linear or quadratic).

The moveout function causes trace data samples to be moved in time to new locations. Since these new time locations of the data sample values are not exactly at the sample interval of the data, the data is interpolated to even sampling at the correct interval.

Linear — If selected, uses a linear interpolation following the equation of a line ($y = mx + b$) to interpolate data values between or beyond existing data.

Quadratic — If selected, uses a quadratic interpolation following the equation of a quadratic ($y = ax^2 + bx + c$) to interpolate data values between or beyond existing data.

The **Mute Control** specifies the stretch mute control parameters.

Apply mute from data file — If checked, a stretch mute card data will be added to the flow and applied to the NMO corrected data

Apply stretch mute — If checked, apply stretch mute as defined below.

Percentage — Enter the percent stretch mute. The smaller the percent the more severe the mute function.

Taper length (samples) — Enter the mute taper length in samples. Longer taper lengths result in a smoother transition from the mute zone to the data zone.

The **Trace amplitude definition** specifies the amplitude summing selection.

Use true amplitude traces — If selected, the absolute amplitude will be summed in the stacking process. True amplitude traces are scaled by one common factor per record.

Use relative amplitude traces — If selected, use of relative amplitude scaled traces in the analysis. Relative amplitude traces are scaled independently of one another.

Use RMS balanced traces — Amplitude traces will be balanced using RMS.

Wavelet Shaping Steps

Wavelet Shaping
Processing Categories
Deghosting
FKK Domain Spectral Shaping
Gabor Deconvolution
Gabor Multichannel Decon
Minimum Phase Compensation
Predictive Deconvolution
Predictive Multichannel Decon
Q Filter
Real Time Deghost
Receiver Deghost
Signature Deconvolution
Spectral Whitening
Spiking Deconvolution
Spiking Multichannel Decon
Surface Consistent Decomposition
Surface Consistent Deconvolution
Surface Consistent Gabor Decomposition
Surface Consistent Gabor Deconvolution

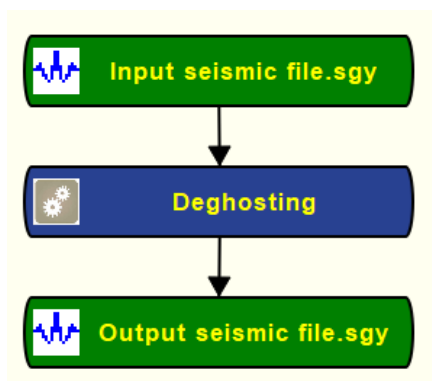
Deghosting

Usage: The Deghosting steps attempts to attenuate the ghost in pre-stack data by local prediction error filtering. The input data is partitioned temporally and spatially into overlapping blocks of data, and each block is minimized independently. A range of prediction filters are calculated using an averaged autocorrelation for each record, using the specified data time range. A reverse operator is optionally calculated and added to the forward operator before the filtering to approximate zero phase filtering. The prediction filters with increasing gap lengths are applied to the data within each block. The o/p is minimized in the L1 sense.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Deghosting

Ghost delay range

Minimum ghost delay (ms) 20

Maximum ghost delay (ms) 80

☐ Allow unfiltered data in output

Filter design

Design window start (ms) 500

Design window length (ms) 500

Filter length (ms) 150

☒ Apply moveout

Moveout velocity 2000

Percentage white noise 0.1

Overlapping deghosting windows

Window length (ms) 70

Window width (traces) 30

Reverse operator

☐ Apply reverse operator

Ghost amplitude 0.85

OK Help Cancel

Parameter Description:

The **Ghost delay range** specifies the range to determine the extent of the predictive gap lengths to include for attenuating the ghost.

Minimum ghost delay (ms) — Enter the smallest ghost delay time to include.

Maximum ghost delay (ms) — Enter the largest ghost delay time to include.

Allow unfiltered data in output — If checked, a possible output from the minimization within a block is the input data. [In data blocks where there is little evidence of the ghost this is a reasonable outcome].

The **Filter design** specifies the parameters from which the predictive gap operators will be calculated are specified here.

Design window start (ms) — Enter the initial data time to be used to extract data used to calculate the predictive gap operators from the data autocorrelation.

Design window length (ms) — Enter the data window length to be used as above.

Filter length (ms) — Enter the lengths of the filters to calculate in milliseconds (not including the predictive gaps).

Apply moveout — If checked, the moveout velocity may be overridden in the adjacent box. A moveout correction corresponding to the trace offset will then be applied before windowing the data according to the parameters above.

Moveout velocity — Enter the moveout velocity.

Percentage white noise — Specify amount of white noise (as a % of the autocorrelation zero lag) to add to stabilize the solution of the Toeplitz matrix in estimation of the filter.

The **Overlapping deghosting windows** specifies the overlap of blocks is set to 50%, using Hanning tapering between the blocks.

Window length (ms) — Enter the length in milliseconds of each deghosting window.

Window width (traces) — Enter the width in traces of each deghosting window.

The **Reverse Operator** specifies if the operation adds in a time-reversed and scaled copy of the operator to act like a zero-phase filter.

Apply reverse operator — If checked, a reverse operator will be added.

Ghost amplitude — Enter the scaling of the reverse operator to approximate the relative amplitude of the ghost.

FKK Domain Spectral Shaping

Usage: The FKK Domain Spectral Shaping step is a spectral shaping filter primarily for application to post-stack and 3D migrated seismic data. The operator is applied in the 3D Fourier transformed FKK domain. The process applies an integration filter to the data with an optional 90 degrees phase shift rotation to simulate acoustic impedance data. Applying such a process to migrated data can cause severe amplitude distortions, excessively amplifying dipping events, signal or noise. Therefore, in replace mode, this process simulates de-migration of the data, application of the integration filter and then re-migration of the data. The result is an FKK filter that is thought to balance the spectrum and preserve low frequencies to be superior to many other FKK filters.

The input data must be in the form of frequency slices – convert the data to frequency slices using Frequency Slices step in a prior job flow.

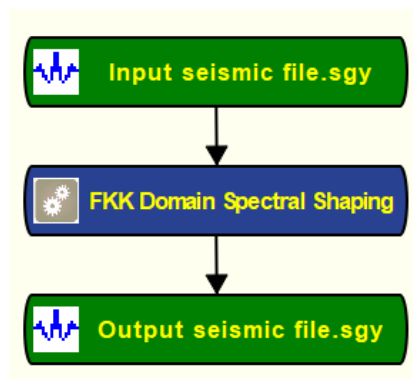
After filtering, convert the frequency slices back to standard time traces in a subsequent job flow with the use of Frequency Slices to Time Traces.

Input Links: 1) Frequency slices sorted by Slice Number and CMP Line (mandatory).

Output Links: 1) Frequency slices sorted by Slice Number and CMP Line (mandatory).

Reference: Lazaratos, S, and David R., 2009, Inversion By Pre-Migration Spectral Shaping, SEG Annual Meeting, 2009.

Example Flowchart:



Step Parameter Dialog:

FKK Domain Spectral Shaping ? X

Integrating filter application mode

☒ Replace ☐ Apply

☐ Apply pre-migration ☐ Remove

Migration velocity

Start frequency

☐ Apply 90 deg phase shift

Override trace spacing

☐ Specify trace spacing

☐ Specify line spacing (3D)

OK Help Cancel

Parameter Description:

The **Integrating filter application mode** specifies the filter application mode.

Replace — If checked, simulates de-migration of the data, application of the integration filter and then re-migration of the data

Apply — If checked, apply the FKK spectral shaping to the data.

Apply pre-migration —If checked, applies the FKK spectral shaping before migration.

Remove — If checked, removes the FKK filter to the data

Migration velocity — Enter constant velocity to be used in the migration step.

Start frequency — Enter the start frequency to be analyzed.

Apply 90 deg. phase shift — If checked, applies a 90 degrees phase shift to the input data to simulate acoustic impedance.

The **Override trace spacing** specify if one wishes to override trace space as defined in input seismic file.

Specify trace spacing — If checked, specify trace spacing entering the corresponding value.

Specify line spacing (3D) — If checked, specify line spacing entering the corresponding value. This option is only valid for three-dimensional dataset.

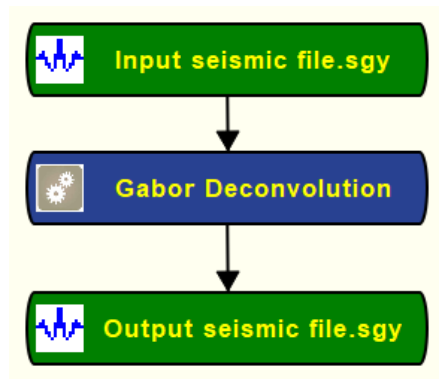
Gabor Deconvolution

Usage: The Gabor Deconvolution step applies a spiking Gabor deconvolution on a trace-by-trace basis. Each trace is transformed into the frequency domain. For each frequency, Wiener filtering, with unity prediction in space, is used to predict the next sample. At the end of the process, data is mapped back to t-x domain.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Gabor Deconvolution

☒ Deconvolve and apply Q compensation
☐ Deconvolve only

Input data phase assumed

☒ Zero phase
☐ Minimum phase

Gabor transform parameters

Gaussian time windows specification

Standard Deviation (ms.)

Windows increment (ms.)

High cut frequency (Hz.)

Frequency smoothing (Hz.)

Attenuation estimation

☒ Use hyperbolic time-frequency smoothing
☐ Use time domain smoothing

Frequency attenuation power

Time smoothing length (ms.)

OK Help Cancel

Parameter Description:

Deconvolve and apply Q Compensation — If selected, applies a deconvolution and then a Q compensation filter.

Deconvolve only — If selected, applies a deconvolution only.

The **Input data phase assumed** specifies the phase data parameterization.

Zero phase — If selected, assumes that input seismic data is zero phase.

Minimum phase — If selected, assumes that input seismic data is minimum phase.

The **Gabor transform parameters** specify Gabor transform parameterization.

The **Gaussian time windows specification** specifies the Gaussian time windows parameterization.

Standard Deviation (ms.) — Enter the standard deviation of the Gaussian windows.

Windows increment (ms.) — Enter the Gaussian windows increment.

High cut frequency (Hz.) — Enter the high cut frequency to be filtered.

Frequency smoothing (Hz.) — Enter the frequency smoothing.

The **Attenuation estimation** specifies the attenuation parameterization.

Use hyperbolic time-frequency smoothing — If selected, uses an hyperbolic approximation for the time-frequency smoothing.

Frequency attenuation power — Enter the hyperbolic exponent for the frequency attenuation.

Use time domain smoothing — If selected, uses a time domain smoothing.

Time smoothing length (ms.) — Enter the time smoothing filter in milliseconds.

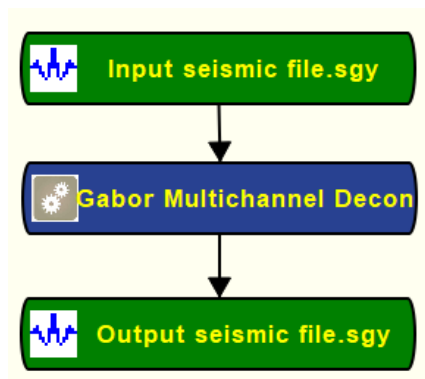
Gabor Multichannel Decon

Usage: The Gabor Multichannel Deconvolution step applies a spiking Gabor deconvolution on a trace-by-trace basis. Each trace is transformed to the frequency domain. For each frequency, Wiener filtering, with unity prediction in space, is used to predict the next sample. At the end of the process, data is mapped back to t-x domain.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

 Gabor Multichannel Deconvolut... ? X

☒ Deconvolve and apply Q compensation
☐ Deconvolve only

Input data phase assumed

☒ Zero phase
☐ Minimum phase

☐ Apply linear moveout...

velocity

Gabor transform parameters

Gaussian time windows specification

Standard Deviation (ms.)

Windows increment (ms.)

High cut frequency (Hz.)

Frequency smoothing (Hz.)

Attenuation estimation

☒ Use hyperbolic time-frequency smoothing
☐ Use time domain smoothing

Frequency attenuation power

Time smoothing length (ms.)

OK Help Cancel

Parameter Description:

Deconvolve and apply Q Compensation — If selected, applies a deconvolution and then a Q compensation filter.

Deconvolve only — If selected, applies a deconvolution only.

The **Input data phase assumed** specifies the phase data parameterization.

Zero phase — If selected, assumes that input seismic data is zero phase.

Minimum phase — If selected, assumes that input seismic data is minimum phase.

Apply linear moveout... — If checked, apply a linear moveout to the data.

Velocity — Enter the constant velocity for the linear moveout.

The **Gabor transform parameters** specify Gabor transform parameterization.

The **Gaussian time windows specification** specifies the Gaussian time windows parameterization.

Standard Deviation (ms.) — Enter the standard deviation of the Gaussian windows.

Windows increment (ms.) — Enter the Gaussian windows increment.

High cut frequency (Hz.) — Enter the high cut frequency to be filtered.

Frequency smoothing (Hz.) — Enter the frequency smoothing.

The **Attenuation estimation** specifies the attenuation parameterization.

Use hyperbolic time-frequency smoothing — If selected, uses an hyperbolic approximation for the time-frequency smoothing.

Frequency attenuation power — Enter the hyperbolic exponent for the frequency attenuation.

Use time domain smoothing — If selected, uses a time domain smoothing.

Time smoothing length (ms.) — Enter the time smoothing filter in milliseconds.

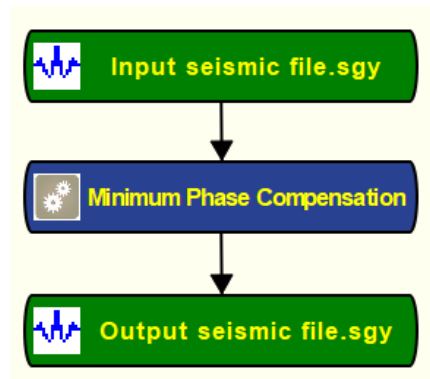
Minimum Phase Compensation

Usage: The Minimum Phase Compensation step correct for phase distortions in the seismic wavelet, transforming it toward a minimum phase response.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Minimum Phase Filter

Signature Input Options

- ☐ One pilot per dataset from auxiliary seismic file
- ☐ One pilot per record from auxiliary seismic file
- ☐ One pilot per trace from auxiliary seismic file
- ☐ Read pilot from auxiliary seismic using trace header

Trace header:

- ☒ One pilot per record from input data file

Sweep trace number:

First trace to kill:

Last trace to kill:

Pre-whitening (%):

Pilot length (ms):

Parameter Description:

The **Signature Input Options** selects the method of accessing the input pilot.

One pilot per dataset from auxiliary seismic file — Select the seismic file that contains the pilot.

One pilot per record from auxiliary seismic file — This option inputs one pilot trace in sequential order from an auxiliary file and cross correlates that pilot signature with the respective sequential record. Therefore, the number of pilot traces should equal the number of input records.

One pilot per trace from auxiliary seismic file — This option inputs one pilot trace in sequential order from an auxiliary file and cross correlates that pilot

signature with the respective sequential trace. Therefore, the number of pilot traces should equal the number of input traces.

Read pilot from auxiliary seismic using trace header — This option inputs one pilot trace based on the selected traced header from an auxiliary file and cross correlates that pilot signature with the respective sequential trace. Therefore, the number of pilot traces should equal the number of input traces.

Trace header — Select trace header to be used to select the pilot.

One pilot per record from input data file — This option uses one trace from each of the uncorrelated input records as the pilot trace for that record.

Sweep trace number — Enter the trace number to use as the pilot.

First trace to kill — If the data set is demultiplexed with the auxiliary traces to recover the pilot, the step allows to kill these auxiliary traces so that do not appear on output. Enter the first trace number to kill.

Last trace to kill — If the data set is demultiplexed with the auxiliary traces to recover the pilot, the step allows to kill these auxiliary traces so that do not appear on output. Enter the last trace number to kill.

Pre-whitening (%) — Enter the percentage of pre-whitening for the minimum phase compensation filter.

Pilot length (ms) — Enter the length of the pilot in milliseconds.

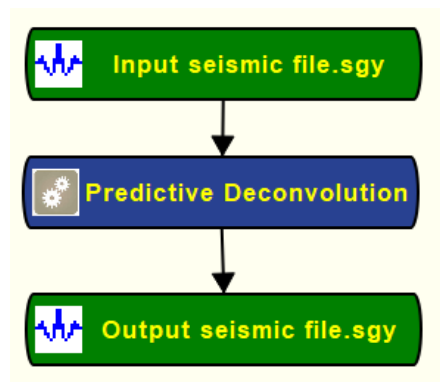
Predictive Deconvolution

Usage: The Predictive Deconvolution step is a Wiener-Levinson algorithm for applying a predictive multi-gate deconvolution to the seismic data. The user chooses the percent pre-whitening, filter length, number of operators, the overlap of the operator design windows, start time of each operator design window, and the design window lengths. For the predictive deconvolution method, the user must specify the predictive length of the wavelet. The user may also apply a linear moveout to the deconvolution design windows to allow a sliding window whose start time varies with offset.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Predictive Deconvolution

Number of operators:

☐ Apply reverse operator

Overlap between operators (ms): Ghost amplitude:

Operator	Prewhitened %	Operator length (ms)	Prediction length (ms)	Moveout	Velocity	Window start (ms)	Window length (ms)
1	0.10	150.00	20.00	☒	2000.00	0.00	1000.00

Parameter Description:

Number of operators — Enter the number of deconvolution operators to be used.

Overlap between operators (ms) — Enter the overlap in milliseconds between operators. This is the amount of the previous and/or next window to include in the calculation of the inverse filter for the current window.

Apply reverse operator — If checked, applies the reverse deconvolution operator to the data.

Ghost amplitude — Enter the amplitude value for the deconvolved ghost.

Operator — Sequential number of the operator to be used.

Prewhiten % — Enter the amount of white noise to add. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Operator length (ms) — Enter the length of the operator to be calculated and applied in milliseconds.

Prediction length (ms) — Enter the prediction length to be applied in milliseconds.

Moveout — If checked, a linear moveout will be applied to the deconvolution design window. The window start time will shift by: $\text{delta time} = \text{offset} / \text{velocity}$.

Velocity — Enter the velocity to be applied in the linear moveout.

Window start (ms) — Enter the start time in milliseconds of the deconvolution design window.

Window length (ms) — Enter the length in milliseconds of the deconvolution design window.

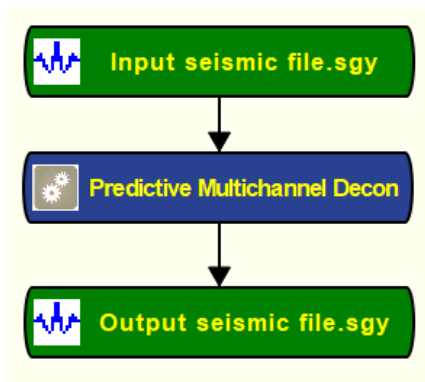
Predictive Multichannel Deconvolution

Usage: The Predictive Multichannel Deconvolution step is a Wiener-Levinson algorithm for applying a multi-channel predictive multi-gate deconvolution to your data. You choose the percent pre-whitening, filter length, number of operators, the overlap of the operator design windows, start time of each operator design window, and the design window lengths. For the predictive deconvolution method, you must specify the predictive length of your wavelet. You may also apply a linear moveout to your deconvolution design windows to allow a sliding window whose start time varies with offset.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Predictive Multichannel Deconvolution" contains the following settings:

- Number of operators: 1
- Overlap between operators (ms): 100.0
- ☐ Apply reverse operator
- Ghost amplitude: 0.85
- ☐ Range limit traces used in operator design
- Range limit header field: None
- Minimum range value: -1000000000.0
- Maximum range value: 1000000000.0
- ☐ Absolute value

Operator	Prewhiten %	Operator length (ms)	Prediction length (ms)	Moveout	Velocity	Window start (ms)	Window length (ms)
1	0.10	150.00	20.00	☒	2000.00	0.00	1000.00

Buttons: OK, Help, Cancel

Parameter Description:

Number of operators — Enter the number of deconvolution operators to be used.

Overlap between operators (ms) — Enter the overlap in milliseconds between operators. This is the amount of the previous and/or next window to include in the calculation of the inverse filter for the current window.

Apply reverse operator — If checked, applies the reverse deconvolution operator to the data.

Ghost amplitude — Enter the amplitude value for the deconvolved ghost.

Range limit traces used in operator design — Limit the number of input traces used in the operator design based on a trace header key.

Range limit header field — Select the trace header key to be used in the trace limit.

Minimum range value — Enter the minimum range value.

Maximum range value — Enter the maximum range value.

Absolute value — If checked, consider the absolute value of the selected trace header key.

Operator — Sequential number of the operator to be used.

Prewhiten % — Enter the amount of white noise to add. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Operator length (ms) — Enter the length of the operator to be calculated and applied in milliseconds.

Prediction length (ms) — Enter the prediction length to be applied in milliseconds.

Moveout — If checked, a linear moveout will be applied to the deconvolution design window. The window start time will shift by: $\Delta t = \frac{offset}{velocity}$.

Velocity — Enter the velocity to be applied in the linear moveout.

Window start (ms) — Enter the start time in milliseconds of the deconvolution design window.

Window length (ms) — Enter the length in milliseconds of the deconvolution design window.

Q Filter

Usage: The Q Filter step applies a frequency dependent “Q” attenuation compensation filter or an attenuation modeling filter to the input file. For both attenuation and modeling options, phase only or phase and amplitude filters may be applied.

Input Links: 1) Seismic data in any sort order (mandatory).

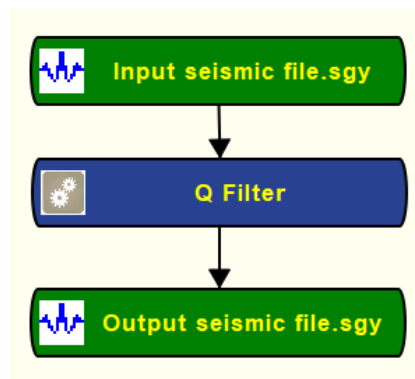
Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Hargreaves, N. D., Calvert A. J., 1991, Inverse Q filtering by Fourier Transform, Geophysics, 56, p. 519;

Hargreaves, N., 1992, Similarity and the inverse Q filter: Some simple algorithms for inverse Q filtering, Geophysics, 57, p. 994.

Wang, Y., 2002, A stable and efficient approach of inverse Q filtering, Geophysics, 67, p. 657.

Example Flowchart:



Step Parameter Dialog:

Q Filter

Operator type

☒ Inverse Q - compensation

☐ Forward Q - modelling

Compensation type

☒ Phase only

☐ Phase and amplitude

Constant Q

Reference frequency (Hz)

Gain limit (dB)

OK Help Cancel

Parameter Description:

The **Operator type** specifies the type of operator.

Inverse Q - compensation — If checked, attenuation will be removed from the input seismic traces.

Forward Q - modelling — If checked, the input seismic traces will have attenuation is to be introduced to.

The **Compensation type** specifies the compensation type.

Phase only — If selected, an all pass, phase-only filter is to be applied for forward or inverse Q filtering. This is a computationally efficient option.

Phase and amplitude — If selected, a phase and amplitude type filter is to be applied for forward or inverse Q filtering. This option is computer intensive.

Constant Q — Enter the value of Q for forward or inverse Q filtering.

Reference frequency (Hz) — Enter the reference frequency for forward or inverse Q filtering. There will be slight frequency dependent phase shifts with respect to this frequency.

Gain limit (dB) — Enter the maximum gain limit per frequency in the case of inverse Q filtering.

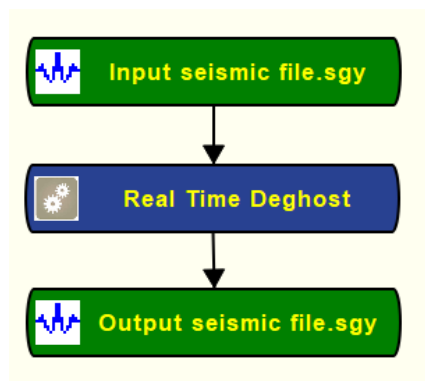
Real Time Deghost

Usage: The Real Time Deghost step applies a deghost filter in real time in the input seismic file based on a predictive deconvolution or frequency-domain deghosting. More than one channel per streamer must be defined

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Real Time Deghost

Set marine configuration

Set wavelets bandpass

Analysis records per source: 9

Sea water velocity: 1500.00

Input Headers

Seabed offset time (ms.) input header: User defined 2

Receiver/source depth

☒ Use input header

☐ Use constant value

Depth header: User defined 4

Depth (m.):

Seabed wavelet window

2.0 Start time before seabed

Window length (ms.) 6.0

1.0 Taper length (ms.)

Taper type: Hanning

Estimation method

☒ Predictive decon

Filter length (ms.): 5.0

☐ Frequency domain deghosting

% Whitening: 0.010

☐ Display deghosted wavelets in real time:

Select Display Channels

OK Help Cancel

Parameter Description:

Set marine configuration — Enter the number of sources and number of streamers used during the acquisition. If using the database, most of these parameters will be available in the dialog.

Set wavelets bandpass — Select the bandpass filter applied to wavelets.

Analysis records per source — Enter how many surrounding traces (an equal number each side) be used to perform this statistical analysis and repicking if necessary.

Sea water velocity — Enter the sea water velocity.

The **Input Headers** specify the trace header locations to be used in the deghosting.

Seabed offset time (ms) input header — Select the trace header locations with the seabed offset in milliseconds.

The **Receiver/source depth** specify the input source for the source or receiver depth.

Use input header — If selected, use the information store in the trace header for source/receiver depth.

Depth header — Select the trace header locations with the depth value in meters.

Use constant value — If selected, use a constant depth for source/receiver in meters.

Depth (m) — Enter the depth of source/receiver in meters.

The **Seabed wavelet window** specifies...

Start time before seabed — Enter the start time before seabed wavelet window.

Window length (ms.) — Enter the window length in milliseconds.

Taper length (ms.) — Enter the taper length of the seabed wavelet window in milliseconds.

Taper type — Select the taper type.

The **Estimation methods** specifies the deconvolution parameters for ghost prediction

Predictive decon — If selected, uses a predictive deconvolution for deghosting.

Frequency domain deghosting — If selected, performs deghosting in the frequency domain

Filter length (ms.) — Enter the filter length in milliseconds.

% Whitening — Enter the percentage of pre-whitening for the minimum phase compensation filter.

Display deghosted wavelets in real time: — If checked, display deghosted wavelets in real-time

Select Display channels — Select channels to be displayed in real-time.

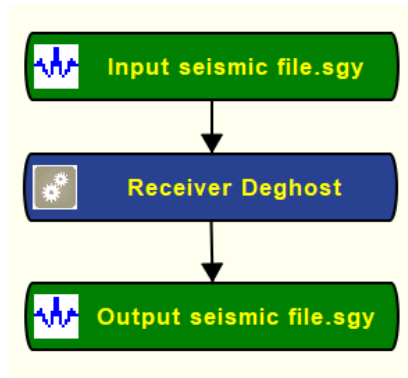
Receiver Deghost

Usage: The Receiver Deghost step applies a deghost filter in real time in the input seismic file based on a predictive deconvolution or frequency-domain deghosting based receiver depth and sabed offset time.

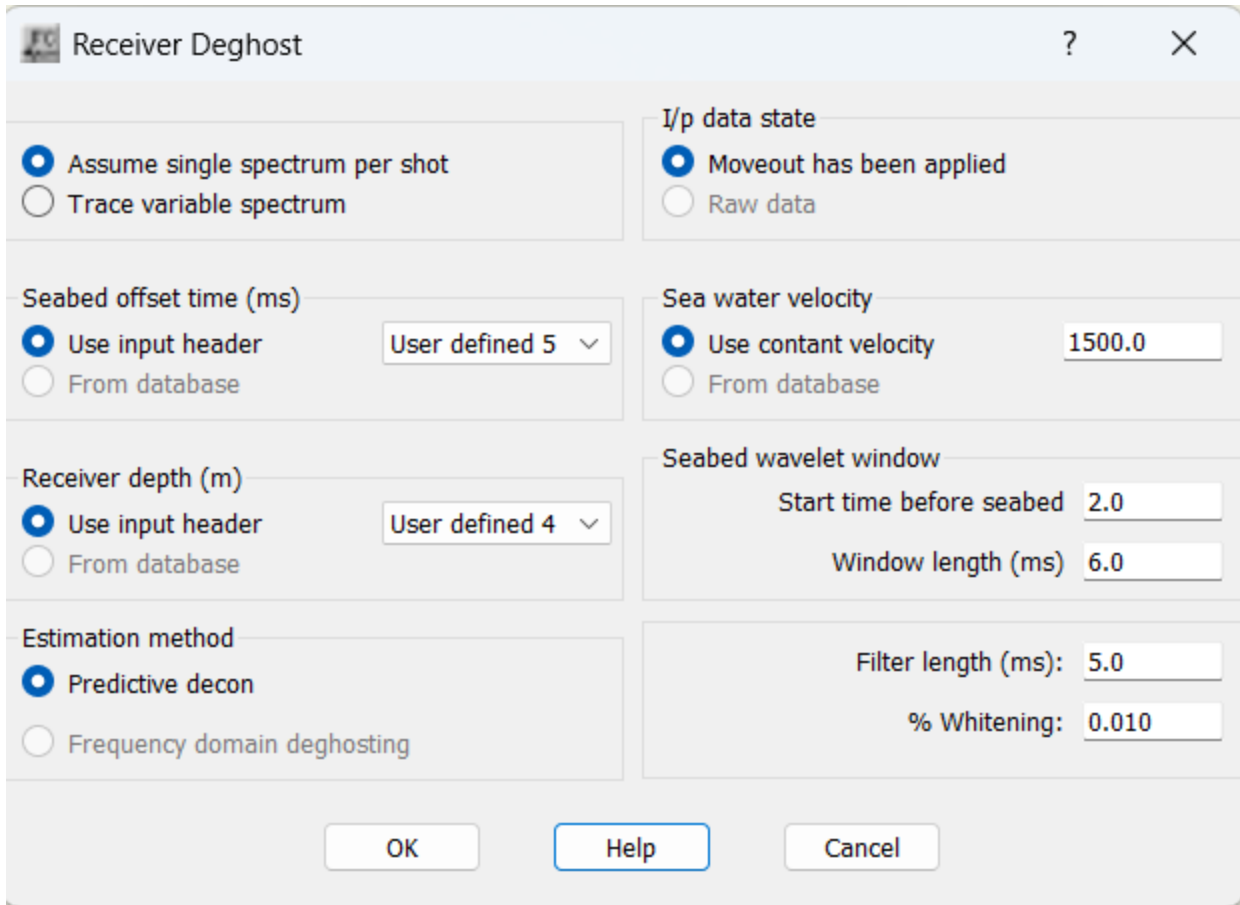
Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



The image shows a software dialog box titled "Receiver Deghost". It contains several groups of settings for seismic data processing. The "Assume single spectrum per shot" option is selected. The "I/p data state" section has "Moveout has been applied" selected. For "Seabed offset time (ms)", "Use input header" is selected with a dropdown set to "User defined 5". "Sea water velocity" has "Use constant velocity" selected with a value of "1500.0". "Receiver depth (m)" has "Use input header" selected with a dropdown set to "User defined 4". The "Seabed wavelet window" section has "Start time before seabed" set to "2.0" and "Window length (ms)" set to "6.0". The "Estimation method" has "Predictive decon" selected. The "Filter length (ms)" is set to "5.0" and "% Whitening" is set to "0.010". At the bottom are "OK", "Help", and "Cancel" buttons.

Section	Option / Parameter	Value / Selection
Assume single spectrum per shot	☒ Assume single spectrum per shot	Selected
	☐ Trace variable spectrum	Not selected
I/p data state	☒ Moveout has been applied	Selected
	☐ Raw data	Not selected
Seabed offset time (ms)	☒ Use input header	Selected
	☐ From database	Not selected
	User defined 5	Dropdown selection
Sea water velocity	☒ Use constant velocity	Selected
	☐ From database	Not selected
	1500.0	Text input
Receiver depth (m)	☒ Use input header	Selected
	☐ From database	Not selected
	User defined 4	Dropdown selection
Seabed wavelet window	Start time before seabed	2.0
	Window length (ms)	6.0
Estimation method	☒ Predictive decon	Selected
	☐ Frequency domain deghosting	Not selected
Filter length (ms)	Filter length (ms):	5.0
	% Whitening:	0.010

Parameter Description:

Assume single spectrum per shot — If selected, assumes a single spectrum per shot record.

Trace variable spectrum — If selected, assumes a variable spectrum per trace within a shot record.

The **I/p data state** specifies the input parameterization

Moveout has been applied — If selected, assumes that a moveout was applied to the data before deghosting.

Raw data — If selected, uses the data without any moveout correction.

The **Seabed offset times (ms)** specifies the location of the seabed offset times.

Use input header — If selected, seabed offset times in milliseconds are stored at a given trace header location to be selected.

From database — If selected, use the seabed offset times stored in the database.

The **Sea water velocity** specifies the seawater velocity parameterization.

Use constant velocity — If selected, use a constant sound speed for the water velocity, to be specified.

From database — If selected, use the sea water velocity stored in the database.

The **Receiver depth (m)** specifies the location of the receiver depths in meters.

Use input header — If selected, receiver depths in meters are stored at a given trace header location to be selected.

From database — If selected, use the receiver depths stored in the database.

The **Seabed wavelet window** specifies the seabed wavelet window parameterization.

Start time before seabed — Enter the start time of the window before seabed.

Window length (ms) — Enter the window length in milliseconds.

The **Estimation method** specifies the estimation method parameterization.

Predictive decon — If selected, uses a predictive deconvolution as the estimation method.

Filter length (ms) — Enter the predictive deconvolution filter length in milliseconds.

% Whitening — Enter the whitening percentage of the predictive deconvolution.

Frequency domain deghosting — If selected, specify that the receiver deghosting will be performed by removal in the frequency domain. (not yet implemented).

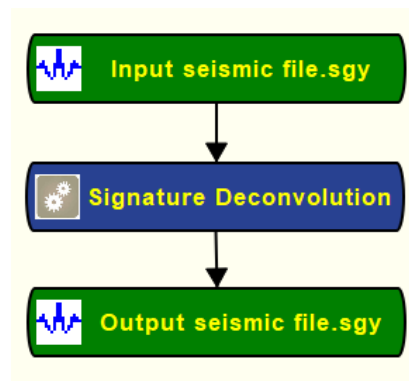
Signature Deconvolution

Usage: The Signature Deconvolution step removes a seismic signature from your data traces by calculating the inverse of a supplied signature trace and then filtering your data by this signature inverse. This is a common technique for use in processing marine data to remove the signature of the airguns.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box is titled "Signature Deconvolution" and contains two main sections: "Deconvolution parameters" and "Signature input options".

Deconvolution parameters:

- Pre-whitening (%)
- Filter length (ms)
- Input signature start time (ms)
- Input signature length (ms)
- Time shift for output (ms)
- ☐ Shape to a desired wavelet
 - Wavelet start time (ms)
 - Wavelet length (ms)
- ☒ Specify filter performance %:
- ☐ Specify filter length

Signature input options:

- ☐ One signature per dataset from auxiliary file
- ☐ One signature per record from auxiliary seismic file
- ☐ One signature per trace from auxiliary seismic file
- ☒ One signature per record from input data file

Trace selection:

Sweep trace number	1
First trace to kill	0
Last trace to kill	0

Buttons: OK, Help, Cancel

Parameter Description:

The **Deconvolution parameters** specify generic parameters of the deconvolution operator.

Pre-whitening (%) — Enter the pre-whitening multiplier. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Filter length (ms) — Enter the length of the filter to be calculated and applied in milliseconds.

Input signature start time (ms) — Enter the start time of the input signatures in milliseconds.

Input signature length (ms) — Enter the length of the input signatures in milliseconds.

Time shift for output (ms) — Enter the time shift for the output trace following signature deconvolution.

Shape to a desired wavelet — If checked, shapes the input signal to a desired wavelet.

Wavelet start time (ms) — Enter start time of the wavelet in milliseconds.

Wavelet length (ms) — Enter the length of the wavelet in milliseconds.

Specify filter performance % — If selected, the desired wavelet is specified by the filter performance percentage.

Specify filter length (ms) — If selected, desired wavelet is specified by the filter length in milliseconds.

The **Signature Input Options** specify the data input source of the signature trace or traces.

One signature per dataset from auxiliary file — This option inputs one signature trace per dataset from an auxiliary input file data and uses that trace as the signature trace for the entire dataset.

One signature per record from auxiliary seismic file — This option inputs one signature trace per record from an auxiliary input seismic data and uses that trace as the signature trace for all traces in the record in the signature deconvolution calculation.

One signature per trace from auxiliary seismic file — This option inputs one signature trace from an auxiliary input seismic file and uses that trace as the signature trace for the corresponding data trace in the signature deconvolution calculation.

One signature per record from input data file — This option uses one trace from each data record and uses that trace as the signature trace for all seismic traces in the record in the signature deconvolution calculation.

Sweep trace number — Enter the number of traces in the sweep.

First trace to kill — If you demultiplexed the data set with the auxiliary traces to recover the signature trace, you may wish to kill these auxiliary traces. Enter the first trace number to kill.

Last trace to kill — If you demultiplexed the data set with the auxiliary traces to recover the signature trace, you may wish to kill these auxiliary traces. Enter the last trace number to kill.

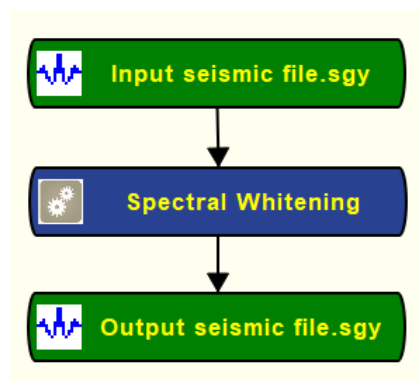
Spectral Whitening

Usage: The Spectral Whitening step is a multi-banded spectral whitening method for balancing the energy of the selected frequency bands of your data. You specify the beginning and ending frequencies in the pass zone, the number of bands within this zone, and the length of the AGC operator. The individual band-pass filter cut off values are linearly interpolated based on the low and high pass frequencies and the number of bands that you choose. Each band is given a Butterworth third order slope with the midpoints of each slope being the half power points. Within each band every trace is AGC'ed with respect to the maximum amplitude in the window. All AGC'ed bands are then summed. Optionally, you may specify the Low-cut / Low Pass / High Pass / High Cut (LC, LP, HP, HC) filter points and associated weights for summing of up to ten filter bands. For optimal balancing of the energy of your frequency bands, your filters should be designed such that the slopes of your filters exactly overlap as is illustrated below. Such a design optimally flattens the spectrum of your data without distorting the spectrum.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:


Spectral Whitening
?
×

Number of bands

AGC length (ms)

Start frequency (Hz)

End frequency (Hz)

Operator	Low cut	Low pass	High pass	High cut	Weights
1	4.0	5.0	30.5	34.8	1.0
2	30.5	34.8	60.3	64.5	1.0
3	60.3	64.5	90.0	94.3	1.0

Parameter Description:

Number of bands — Enter the number of frequency bands. Each trace is split into this number of frequency bands which are AGC'ed and then summed to create the output trace.

Start frequency (Hz) — Enter the low frequency pass band limit in hertz (Hz). This is the lowest frequency in the pass band.

AGC length — Enter the AGC operator length. This is the length of the AGC operator, which is applied to each frequency band.

End frequency (Hz) — Enter the high frequency pass band limit in hertz (Hz). This is the highest frequency in the pass band. It may not exceed one-half the Nyquist frequency.

Operator — Sequential number of the operator to be used.

Low cut — Enter the filter low frequency cutoff point in hertz (Hz).

Low pass — Enter the filter low frequency pass point in hertz (Hz).

High pass — Enter the filter high frequency pass point in hertz (Hz).

High cut — Enter the filter high frequency cutoff point in hertz (Hz).

Weights — Enter the filter band relative weight.

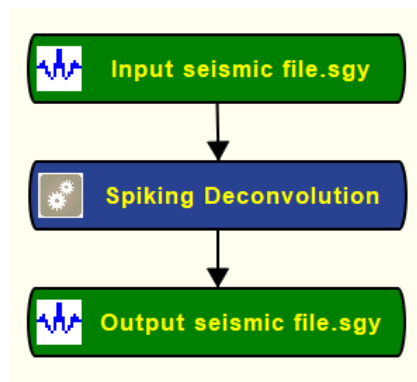
Spiking Deconvolution

Usage: The Spiking Deconvolution step is a Wiener-Levinson algorithm for applying a spiking multi-gate deconvolution to your data. You choose the percent pre-whitening, filter length, number of operators, the overlap of the operator design windows, start time of each operator design window, and the design window lengths. For the predictive deconvolution method, you must specify the predictive length of your wavelet. You may also apply a linear moveout to your deconvolution design windows to allow a sliding window whose start time varies with offset.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Spiking Deconvolution" contains the following parameters:

- Number of operators: 1
- Overlap between operators (ms): 100.0
- Ghost amplitude: 0.85
- Apply reverse operator: ☐

Operator	Prewritten %	Operator length (ms)	Moveout	Velocity	Window start (ms)	Window length (ms)
1	0.10	150.00	☒	2000.00	0.00	1000.00

Buttons: OK, Help, Cancel

Parameter Description:

Number of operators — Enter the number of deconvolution operators to be used.

Overlap between operators (ms) — Enter the overlap in milliseconds between operators. This is the amount of the previous and/or next window to include in the calculation of the inverse filter for the current window.

Apply reverse operator — If checked, applies the reverse deconvolution operator to the data.

Ghost amplitude — Enter the amplitude value for the deconvolved ghost.

Operator — Sequential number of the operator to be used.

Prewhiten % — Enter the amount of white noise to add. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Operator length (ms) — Enter the length of the operator to be calculated and applied in milliseconds.

Moveout — If checked, a linear moveout will be applied to the deconvolution design window. The window start time will shift by: $\text{delta time} = \text{offset} / \text{velocity}$.

Velocity — Enter the velocity to be applied in the linear moveout.

Window start (ms) — Enter the start time in milliseconds of the deconvolution design window.

Window length (ms) — Enter the length in milliseconds of the deconvolution design window.

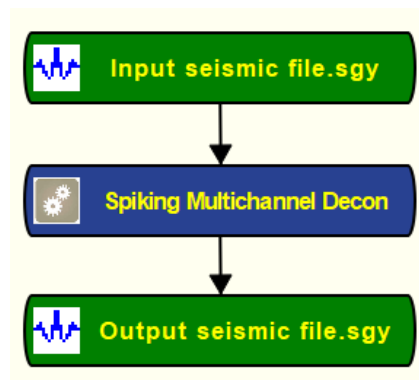
Spiking Multichannel Deconvolution

Usage: The Spiking Multichannel Deconvolution step is a Wiener-Levinson algorithm for applying a multi-channel spiking multi-gate deconvolution to your data. You choose the percent pre-whitening, filter length, number of operators, the overlap of the operator design windows, start time of each operator design window, and the design window lengths. For the predictive deconvolution method, you must specify the predictive length of your wavelet. You may also apply a linear moveout to your deconvolution design windows to allow a sliding window whose start time varies with offset.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

The dialog box titled "Spiking Multichannel Deconvolution" contains the following parameters:

- Number of operators: 1
- Overlap between operators (ms): 100.0
- ☐ Apply reverse operator
- Ghost amplitude: 0.85
- ☐ Range limit traces used in operator design
 - Range limit header field: None
 - Minimum range value: -1000000000.0
 - Maximum range value: 1000000000.0
- ☐ Absolute value

Operator	Prewhiten %	Operator length (ms)	Moveout	Velocity	Window start (ms)	Window length (ms)
1	0.10	150.00	☒	2000.00	0.00	1000.00

Buttons: OK, Help, Cancel

Parameter Description:

Number of operators — Enter the number of deconvolution operators to be used.

Overlap between operators (ms) — Enter the overlap in milliseconds between operators. This is the amount of the previous and/or next window to include in the calculation of the inverse filter for the current window.

Apply reverse operator — If checked, applies the reverse deconvolution operator to the data.

Ghost amplitude — Enter the amplitude value for the deconvolved ghost.

Range limit traces used in operator design — Limit the number of input traces used in the operator design based on a trace header key.

Range limit header field — Select the trace header key to be used in the trace limit.

Minimum range value — Enter the minimum range value.

Maximum range value — Enter the maximum range value.

Absolute value — If checked, consider the absolute value of the selected trace header key.

Operator — Sequential number of the operator to be used.

Prewhiten % — Enter the amount of white noise to add. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Operator length (ms) — Enter the length of the operator to be calculated and applied in milliseconds.

Moveout — If checked, a linear moveout will be applied to the deconvolution design window. The window start time will shift by: $\Delta t = \frac{\text{offset}}{\text{velocity}}$.

Velocity — Enter the velocity to be applied in the linear moveout.

Window start (ms) — Enter the start time in milliseconds of the deconvolution design window.

Window length (ms) — Enter the length in milliseconds of the deconvolution design window.

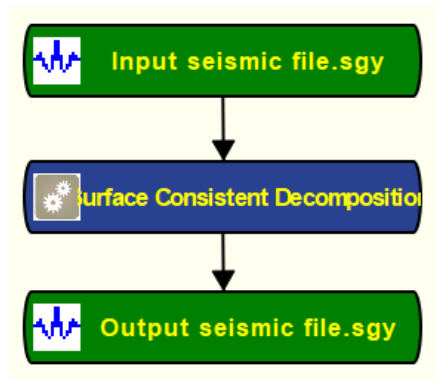
Surface Consistent Decomposition

Usage: The Surface Consistent Decomposition step uses a Gauss-Seidel iterative method to perform a four-component surface-consistent decomposition of the amplitude spectra of the input seismic data into source, receiver, offset, and CMP components. Output component spectra can then be used as input to Surface Consistent Deconvolution step.

Input Links: 1) Seismic data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

 Surface Consistent Decomposition ? X

Design window

☐ Use window design

Design Window

Design window start time (ms)

Design window stop time (ms)

☐ Apply linear moveout to data window

Linear moveout velocity

Offset bins

☐ Specify offset bin size:

☐ Offset limit the traces used

Offset range

Minimum offset

Maximum offset

Spectral decomposition

RMS error change for termination

Midpoint smoothing radius (bins)

Compute source spectra

Compute receiver spectra

Compute midpoint spectra

Compute offset spectra

OK Help Cancel

Parameter Description:

The **Design window** specifies the window where surface-consistent decomposition will be performed.

Use window design — If checked, use a fixed time window to build a pilot.

Design window start time (ms) — Enter start time of the pilot window in milliseconds.

Design window stop time (ms) — Enter the end time of the pilot window in milliseconds.

Apply linear moveout to data window — If checked, design window is defined as an offset-dependent linear moveout.

Linear moveout velocity — Enter the linear moveout velocity.

The **Offset bins** specify bins size of the offsets.

Specify offset bin size: — If checked, enter the offset bin size.

Offset limit the traces used — If checked, traces for the analysis are limited in terms of offset.

Minimum offset — Enter the minimum offset to be considered.

Maximum offset — Enter the maximum offset to be considered.

The **Spectral decomposition** specifies the consistent spectra decomposition parameters.

RMS error change for termination — Enter the minimum RMS error for the iterative procedure to be considered finished.

Midpoint smoothing radius (bins) — Enter the radius (in number of bins) of the midpoint smoothing operator.

Compute source spectra — Select yes to compute source spectra.

Compute receiver spectra — Select yes to compute receiver spectra.

Compute midpoint spectra — Select yes to compute midpoint spectra.

Compute offset spectra — Select yes to compute offset spectra.

Surface Consistent Deconvolution

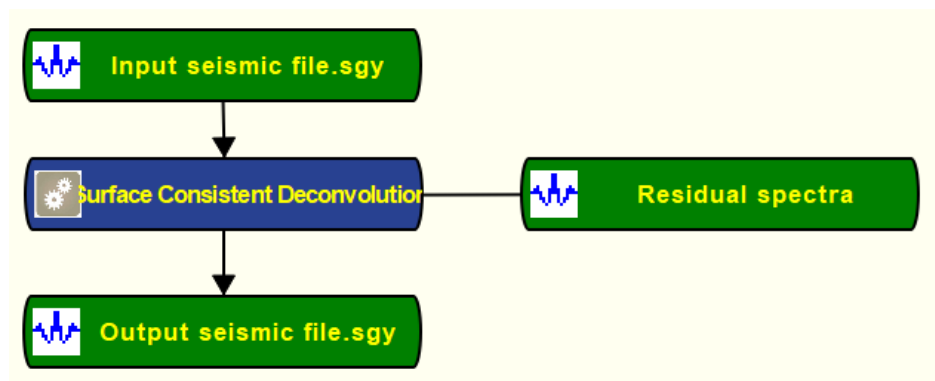
Usage: The Surface Consistent Deconvolution step uses a Gauss-Seidel iterative method to perform a four-component surface-consistent decomposition of the amplitude spectra of the input seismic data into source, receiver, offset, and CMP components. Deconvolution operators are constructed from the source and receiver components of this decomposition. The user specifies whether the deconvolution will be of the spiking or predictive type, the design window, operator length, and percent white noise.

Input Links: 1) data in any sort order (mandatory).

Output Links: 1) Seismic data in any sort order (mandatory).

Reference: Cary, P. M., and Lorentz, G. A., 1993, Four-component surface-consistent deconvolution: Geophysics, 58, 383-392.

Example Flowchart:



Step Parameter Dialog:

Surface Consistent Deconvolution ? X

Deconvolution parameters

☐ Spiking deconvolution

☒ Predictive deconvolution

Prediction length (ms) 24.00

Pre-whitening (%) 2.00

Inverse filter length (ms) 180.00

Output type

☒ Output deconvolved trace data

☐ Output estimated min phase wavelet

☐ Output deconvolution operators

OK Help Cancel

Parameter Description:

The **Deconvolution parameters** specify the type of deconvolution to perform: Spiking or Predictive.

Spiking deconvolution — If selected, use a spiking deconvolution.

Predictive deconvolution — If selected, use a predictive or gapped deconvolution.

Prediction length (ms) — Enter the prediction length in milliseconds.

Pre-whitening (%) — Enter the pre-whitening multiplier. The zero lag of the autocorrelation function is increased by this amount to induce stability in the matrix solution.

Inverse filter length (ms) — Enter the length of the filter to be calculated and applied in milliseconds.

The **Output type** specifies the type of output.

Output deconvolved trace data — If selected, deconvolution operators are applied to the output data.

Output estimated min phase wavelet — If selected, output the estimated minimum phase wavelet used in the deconvolution.

Output deconvolution operators — If selected, deconvolution operators are the output and can be used in other processing steps. No deconvolution is applied to input data.

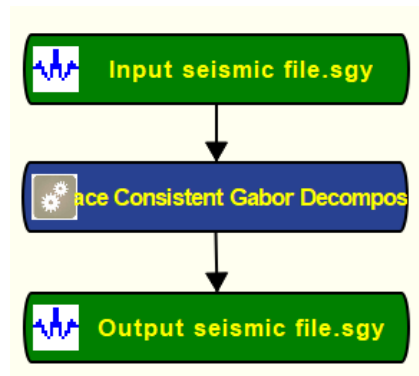
Surface Consistent Gabor Decomposition

Usage: The Surface Consistent Gabor Decomposition step applies the Gabor transform while honoring surface consistency accounting for variations in source and receiver depths, as well as near-surface effects. By decomposing seismic traces into localized frequency components using the Gabor transform, this step enables high-resolution spectral characterization of the wavefield.

Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:

Surface Consistent Gabor Decomposition ? X

Gabor transform parameters

Standard Deviation (ms.)

Windows increment (ms.)

High cut frequency (Hz.)

Wavelet freq. smoothing (Hz.)

Time-frequency attenuation

Frequency attenuation power

Offsets

☐ Specify offset bin size: Offset bin size

☐ Limit offsets used

Offset range

Minimum offset

Maximum offset

Spectral decomposition

RMS error change for termination

☐ Smooth Midpoints: Smoothing radius (bins)

☐ Smooth Offsets: Smoothing radius (bins)

☐ Smooth Sources: Smoothing radius (bins)

☐ SmoothReceivers: Smoothing radius (bins)

OK Help Cancel

Parameter Description:

The **Gabor transform parameters** specifies the Gaussian filters parameterization.

Standard Deviation (ms.) — Enter the standard deviation in milliseconds of the Gaussian windows.

Windows increment (ms.) — Enter the Gaussian windows increment in milliseconds.

High cut frequency (Hz.) — Enter the high cut frequency in Hertz to be filtered.

Wavelet freq. smoothing (Hz) — Enter the width in Hertz of the convolution frequency filter to be used.

The **Time-frequency attenuation** specifies the attenuation parameterization.

Frequency attenuation power — Enter the hyperbolic exponent for the frequency attenuation.

The **Offsets** specify the offset range of application.

Specify offset bin size — If checked, specifies the offset bin size.

Offset bin size — Enter the offset bin size.

Limit offsets used — If checked, specifies the offset limits.

Minimum offset — Enter the smallest offset to be considered.

Maximum offset — Enter the maximum offset to be considered.

The **Spectral decomposition** specifies the spectral decomposition parameterization.

RMS error change for termination — Enter the RMS error threshold for termination.

Smooth Midpoints — If checked, smooths midpoints given a radius in number of bins.

Smoothing rations (bins) — Enter the number of neighbor bins for smoothing.

Smooth Offsets — If checked, smooths offsets given a radius in number of bins.

Smoothing rations (bins) — Enter the number of neighbor bins for smoothing.

Smooth Sources — If checked, smooths sources given a radius in number of bins.

Smoothing rations (bins) — Enter the number of neighbor bins for smoothing.

Smooth Receivers — If checked, smooths receivers given a radius in number of bins.

Smoothing rations (bins) — Enter the number of neighbor bins for smoothing.

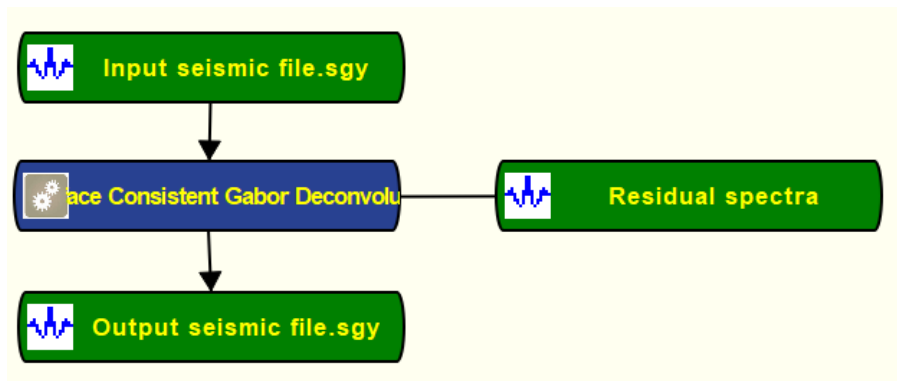
Surface Consistent Gabor Deconvolution

Usage: The Surface Consistent Gabor Deconvolution step apply a deconvolution using a Gabor Deconvolution accounting for near-surface effects and the location of sources and receivers.

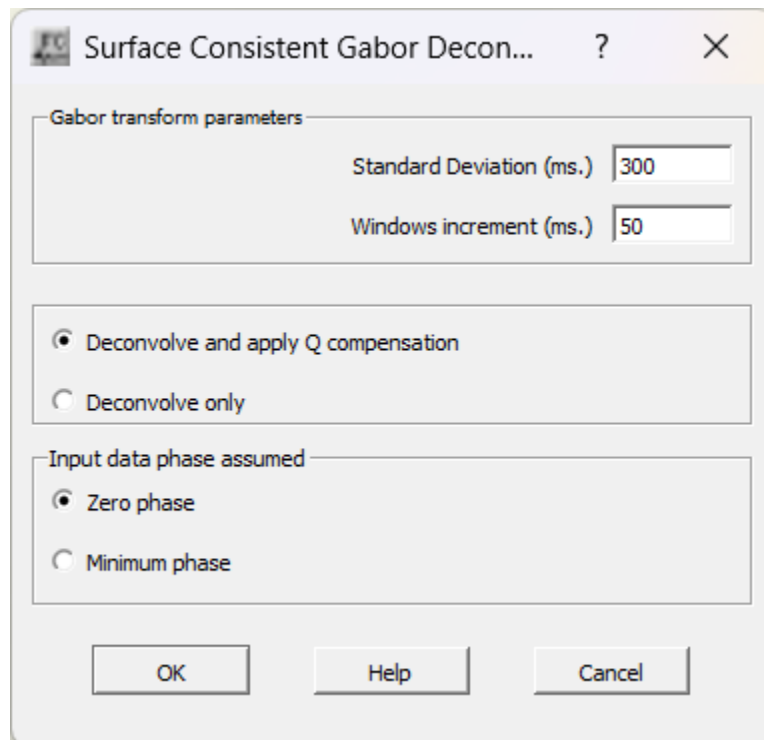
Input Links: 1) Seismic data in any sort order (mandatory)

Output Links: 1) Seismic data in any sort order (mandatory).

Example Flowchart:



Step Parameter Dialog:



Parameter Description:

The **Gabor transform parameters** specify the Gaussian filters parameters.

Standard Deviation (ms.) — Enter the standard deviation in milliseconds of the Gaussian windows.

Windows increment (ms.) — Enter the Gaussian windows increment in milliseconds.

Deconvolve and apply Q compensation — If selected, applies a deconvolution followed by a Q compensation filter.

Deconvolve only — If selected, applies a deconvolution only.

The **Input data phase assumed** specifies the phase of the input data.

Zero phase — If selected, assumes input data as zero phase.

Minimum phase — If selected, assumes input data as minimum phase.