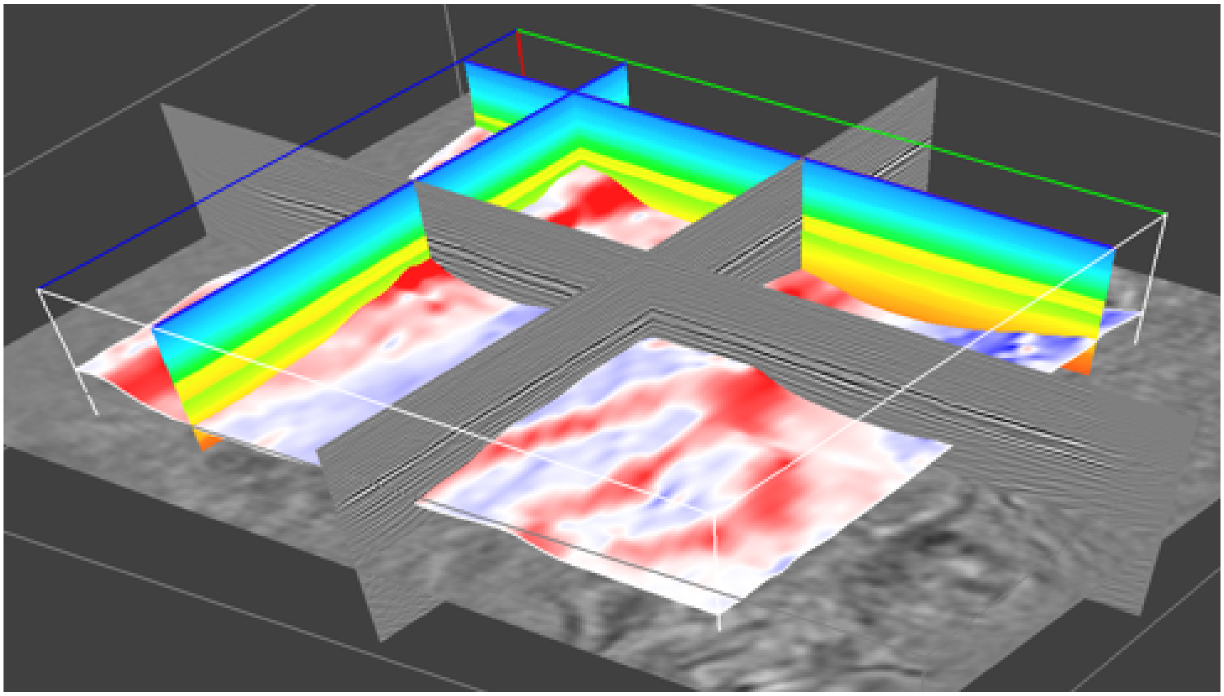
MARVEL™ Reference Manual

Version 2.1.1



Panorama Technologies

www.panoramatech.com

MARVEL Reference Manual

Contents

About This Book

This book contains information about installing and licensing the MARVEL program developed by Panorama Technologies.

The book is intended for people doing seismographic data analysis, specifically migration, residual velocity analysis, and interpretation. This includes students in applied geophysics and employees of the petroleum industry, particularly those who deal with seismic migration as processors or interpreters, as well as anyone who is interested in the methodology of subsurface imaging using reflection seismology.

The book assumes that you are familiar with the following topics:

- using the operating systems and applications in your enterprise
- editing and saving text files
- performing seismographic data analysis

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Conventions

This book uses the following special conventions:

- `All syntax, operating system terms, and literal examples are presented in this typeface.`
- Variable text in path names, system messages, or syntax is displayed in italic text: `testsys/instance/`*fileName*.
- File names and paths are displayed as `path/filename`.
- The symbol => connects items in a menu sequence. For example, `Actions => Create Test` instructs you to choose the `Create Test` command from the `Actions` menu.
- If you move the cursor over text shown in blue, such as Chapter 1, the cursor will change to a pointer. If you then click the cursor, Acrobat Reader displays the location indicated by the text.
- Web and email addresses are shown as underlined blue text, such as www.panoramatech.com, and will open your default web browser when you click the mouse cursor on the link.

Chapter 1

Introduction

This chapter provides a brief overview of the MARVEL Migration and Residual Velocity Analysis program by Panorama Technologies.

Determining the structure, composition, and state of the earth's subsurface from measured data is the principal task of many geophysical experiments or surveys. Standard procedures involve the recording of appropriate data sets followed by the application of data analysis techniques to extract the desired information.

Panorama Technologies provides a complete suite of interpretive processing software for the oil and gas industry, including fast, flexible Kirchhoff migration, common azimuth migration, shot profile migration, and full wave-equation velocity inversion. Our fully-distributed software is the fastest and most accurate in the industry for prestack time migration and prestack depth migration.

Table 1 contains short descriptions of the chapters and appendices in the book.

Table 1. Chapter Descriptions

Chapter	Title	Description
1	Introduction	Provides a brief introduction to the book contents.
2	Project Operations	Defines the relationship between global and local coordinates. These relationships allow the various technologies in MARVEL to process and position the output data relative to its true surface location(s).
4	jobBuilder Operations	Constructs the processing stream and parameters for specific distributed seismic processing jobs.
5	Inline Section Operations	Enables you to visually inspect and interact with line-oriented data.
6	XLine Operations	Enables you to visually inspect and interact with crossline-oriented data.
7	CDP Gathers Operations	Enables you to visually inspect and interact with display data. You can also pick time-velocity pairs and time-mute pairs.
8	Shot Gathers Operations	Enables you to perform a visual inspection of shot records and to select the shot range you want to process.
9	eyeGlass Cluster Monitor Operations	Provides the ability to monitor current CPU status and define the cluster on which distributed jobs will be executed.
A	File Formats	Provides information about the XML data structures used in the MARVEL control files.
B	Topographic Migration Velocity Analysis	Provides a work flow on which topographic migration velocity analysis can be based, including specific information about using topographic migration analysis in MARVEL.
C	3D Surface Related Multiple Elimination	Explains the parameters defining Panorama Technologies' 3D Surface Related Multiple Elimination algorithm (SRME3D) and provides a brief explanation of the assumptions underlying the process.

Chapter 2

Project Operations

Project Operations defines the relationship between global or world coordinates and local coordinates. These relationships allow the various technologies in MARVEL to process and position the output data relative to its true surface location(s). The data is stored as an XML file having a `.project` extension. You can edit an existing project file using the Project panel or with any text editing tool, such as `vi`.

Project Panel

The Project Panel enables you to select the seismic files you want to process with MARVEL, including datasets, models and output. Figure 1 shows the data tab, while Figure 2 shows the preferences tab. The fields on the panel are described in Table 2.

Figure 1. Project Panel, Data Tab

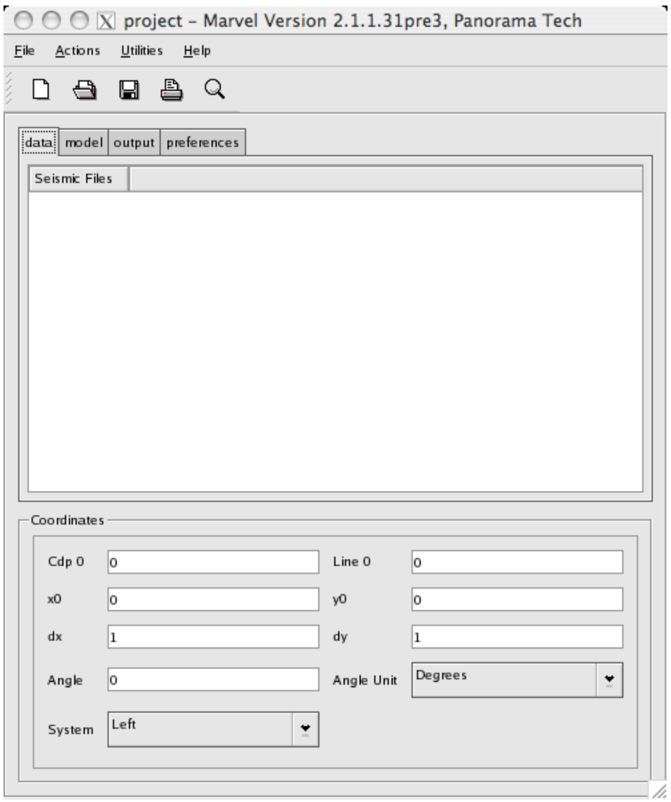

Figure 2. Project Panel Preferences Tab

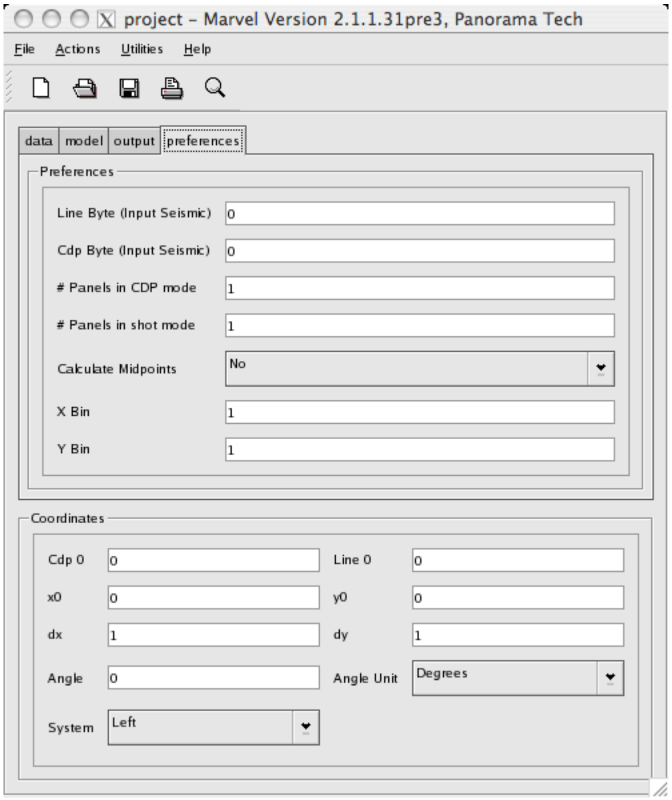

Table 2. Project Panel Fields

Tab	Description
Tabs	
data	Displays a list of all open seismic files in the Seismic Files display area. Seismic files are selected from the File menu (see File Menu).
model	Displays a list of all open model files in the Model Files display area. Model files are selected from the File menu (see Project Menus and Toolbar).
output	Displays a list of all selected output volumes in the Output Volumes display area. Output volumes are selected from the File menu (see Project Menus and Toolbar).
preferences	Enables you to modify project preferences.

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Table 2. Project Panel Fields–continued

Tab	Description
Coordinates	
Cdp 0	Default: 0
Line 0	Default: 0
x0	Default: 0
y0	Default: 0
dx	Defines the CDP spacing. Default: 1
dy	Defines the line spacing. Default: 1
Angle	Default: 0
Angle Unit	The angle unit associated with the angle, either degrees or radians. Default: Degrees
System	Defines the model system to be used for the current display, that is, whether the project is to be a left-hand or a right-hand system. Default: Left
Preferences	
Line Byte (Input Seismic)	
Cdp Byte (Input Seismic)	
# Panels in CDP mode	The default number of panels to display in CDP mode.
# Panels in shot mode	The default number of panels to display in shot mode.
Calculate midpoints	
X Bin	
Y Bin	

Project Menus and Toolbar

Project operations has a File menu, an Actions menu, and a toolbar.

File Menu

The Project operations File menu, Figure 3 contains the eight commands described in Table 3.

Figure 3. File Menu

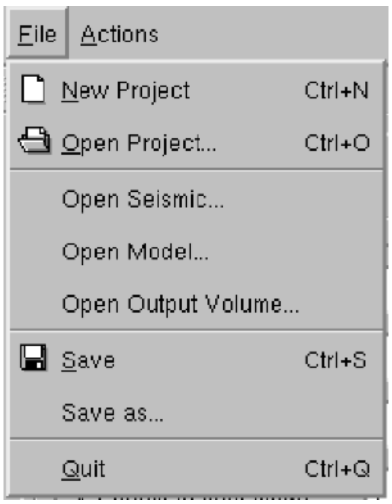


Table 3. File Menu Commands

Menu Item	Description
New Project	Creates a new project, resetting all project settings to their default values, and clearing the project files lists.
Open Project...	Displays standard File Open dialog box enabling you to open an existing project file having a `.project` extension.
Open Seismic...	Displays standard File Open dialog box enabling you to open an existing seismic data file having a `.segy` extension.
Open Model...	Displays standard File Open dialog box enabling you to open an existing model file having a `.segy` extension.
Open Output Volume...	Displays standard File Open dialog box enabling you to open an existing output data file having a `.segy` extension.

continues on next page

Table 3. File Menu Commands–continued

Menu Item	Description
Save	Saves the displayed project data as a project file. Open a Save As dialog box if you are attempting to save an unnamed project.
Save as...	Opens a Save As dialog box enabling you to save the project data to the file you specify.
Quit	Quits the MARVEL program.

Actions Menu

The Project operations Actions menu, Figure 4, contains the four items described in Table 4.

Figure 4. Actions Menu

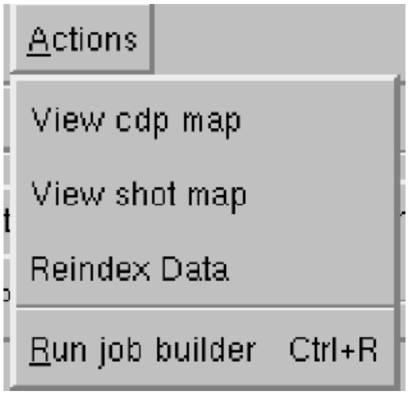


Table 4. Actions Menu Commands

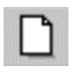
Menu Item	Description
View cdp map	Displays a map of the CDP versus EP (shotpoint) values. See View CDP and Shot Maps.
View shot map	Displays a map of the shot versus EP (shotpoint) values. See View CDP and Shot Maps.
Reindex Data	
Run job builder	Displays the JobBuilder panel. See jobBuilder Operations.

Toolbar

The Project operations toolbar, Figure 5 contains the five items described in Table 5.

Figure 5. Project Toolbar

Table 5. Toolbar Commands

Symbol	Description
	Creates a new project, resetting all project settings to their default values, and clearing the project files lists.
	Opens a project dataset.
	Saves the project using the current project name.
	Sends the project XML file to the default printer.
	Scans the model identified in the project to get the coordinates specified in the model for display in the Coordinates pane at the bottom of this window.

View CDP and Shot Maps

Figure 6 shows a sample CDP map displayed in MARVEL. Note that the figure shows a selection of the CDPs, shown in black. Figure 7 shows a sample shot map displayed by MARVEL. The fields in the figure are defined in Table 6. The items in the File menu and the Actions menu are defined in Table 7 and Table 8, respectively.

Figure 6. Sample CDP Map with Selection

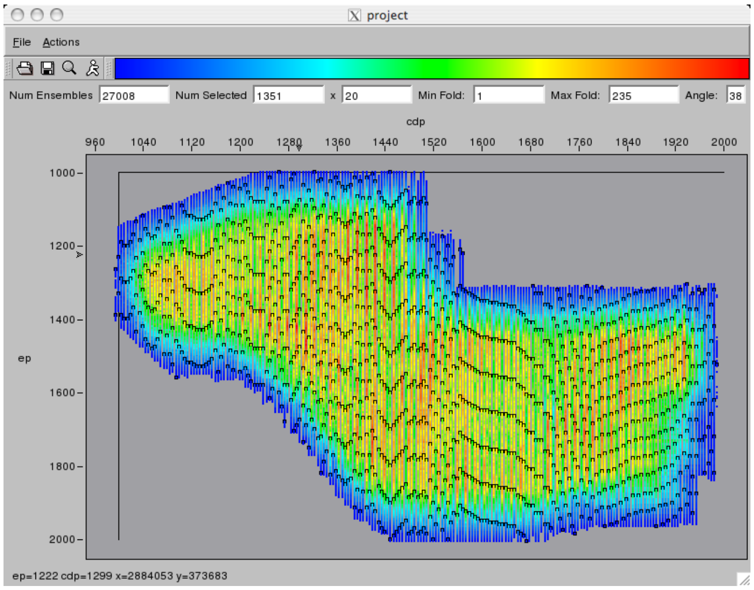


Figure 7. Sample Shot Map

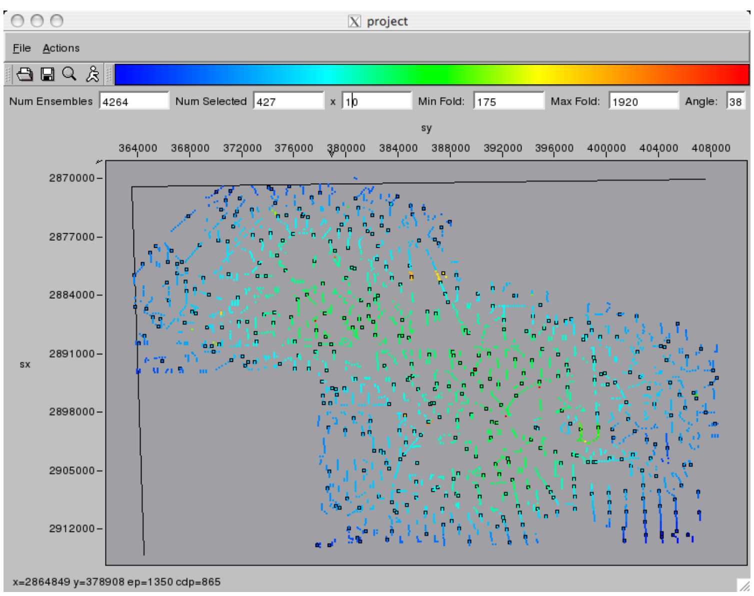


Table 6. View CDP and Shot Data Fields

Data Field	Description
Num Ensembles	The actual number of CDPs or shots in the project.
Num Selected	The number of CDPs or shots that have been selected (in black in Figure 6).
Min Fold	The smallest number of traces in a CDP or shot map.
Max Fold	The maximum number of traces in a CDP or shot map.

Table 7. File Menu

Command	Description
Open...	Opens a new dataset. MARVEL displays a new CDP map of the dataset.
Save	Saves the selected area of the CDP map into a dataset.
Save as...	Saves the selected area of the CDP map into a dataset.
Quit	Closes the Project module and display.

Table 8. Actions Menu

Command	Description
View	Displays selected CDP or shot maps. The number of sequential maps displayed at one time depends on the value of the panel setting. This command is the same as the magnifying glass.
Run	Job Runs the JobBuilder program (see jobBuilder Operations). The parameters from this panel are entered automatically in the appropriate locations in the JobBuilder panel.

Chapter 3

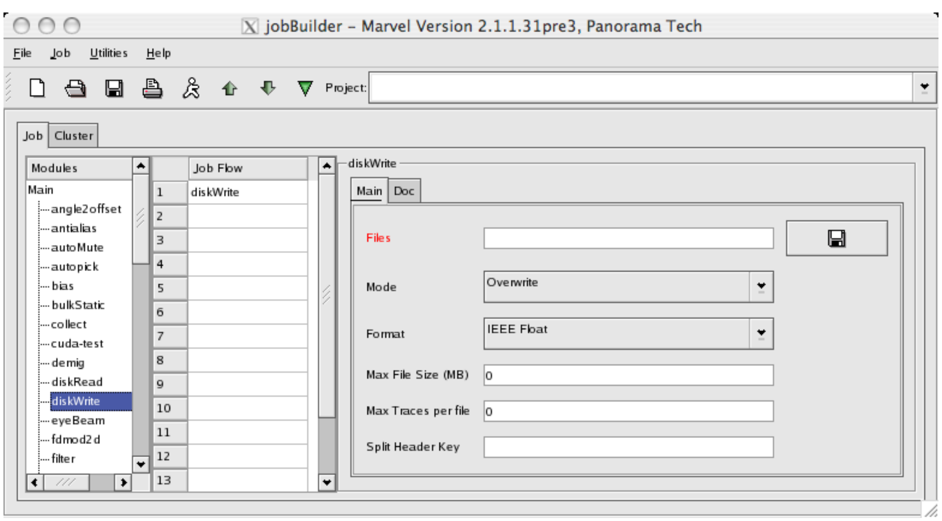
jobBuilder Operations

jobBuilder Operations constructs the processing stream and parameters for specific distributed seismic processing jobs.

Note:

A field name shown in red, such as Files in Figure 8, indicates that the field is a required entry. Also, if a tab name is underlined, such as the Main tab in this figure, at least one of the fields in the tab is a required entry.

Figure 8. Example jobBuilder Panel



jobBuilder Panel

Figure 9 shows the jobBuilder panel. This panel enables you to select the components you want to use to process your seismic data set. Table 9 defines the terms used on the panel.

Figure 9. jobBuilder Panel

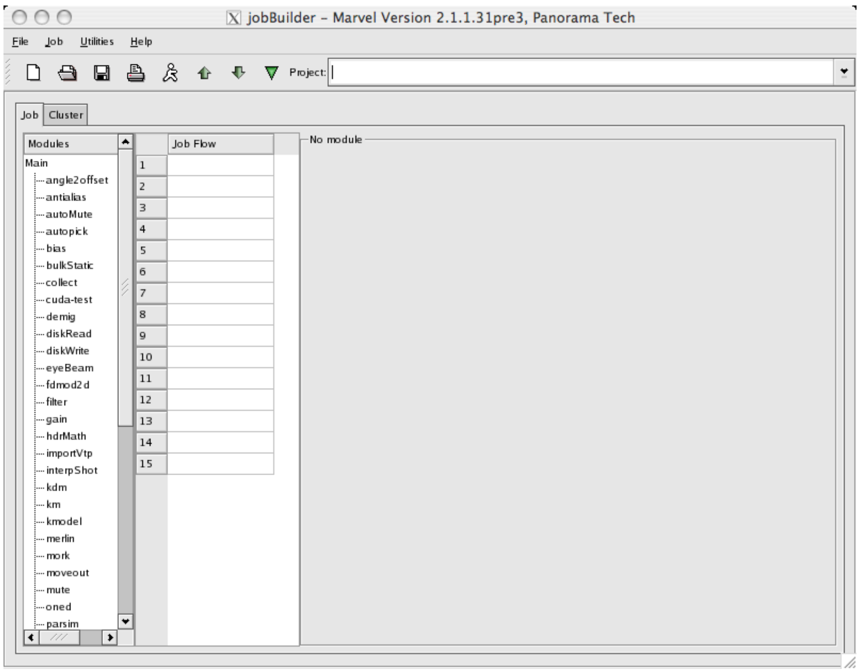


Table 9. jobBuilder Modules

Module	Description
angle2offset	
antialias	Enables you to eliminate unwanted portions of the spectra and frequencies that might cause aliasing when the sample rate is decreased during seismic processing.
autoMute	Reads and automatically extracts mute information from an input data stream. The mute information is then written to a mute (`.pick`) output file.
autopick	Uses a shifted-hyperbola technology to calculate the semblance and constant velocity stacks of an input CDP.
bias	Calculates the trace bias (dc) within a sliding window, and either outputs the debiased trace or the bias function.

continues on next page

Table 9. jobBuilder Modules–continued

Tab	Description
bulkStatic	Applies a bulk static to each trace in an input data stream.
collect	Stacks output from migrations.
deimg	
diskRead	Controls reading information from `.segy` data files.
diskWrite	Controls writing MARVEL output data to a data file.
eyeBeam	Panorama Technologies' parsimonious beam migration program.
fdmod2d	
filter	Applies a (f, k) domain pie shaped filter to an input ensemble or gather of traces. This gather can be a line, cdp, or shot record, but you are responsible for selecting the appropriate data and building the job stream to supply it to dipFilter.
gain	Scales each input trace by either a fixed power of time or a time-variant automatic gain control, or both.
hdrMath	Changes header words.
kmodel	
importVtp	Imports VIEWS VTP or FOCUS HANDVEL time-velocity pairs from an input file and converts them to the internal format used by Panorama Technologies. The output file name is just the input file name with `.picks` appended.
interpshot	
kdm	Performs Kirchhoff Depth Migration.
km	Performs Kirchhoff curved-ray time migration.
Merlin	Panorama Technologies' two-way wave equation program for modeling, velocity analysis and depth imaging.
MORK	Panorama Technologies' one-way migration module.
moveout	Applies normal moveout (NMO) or the inverse of NMO to input traces.
mute	Mutes above, below, or along a linearly interpolated curve whose width is defined by the times in the mute file, or by the mute X and T values.
oned	
parsim	

continues on next page

Table 9. jobBuilder Modules–continued

Tab	Description
pef	
postproc	
pruneShooter	Provides an interface to a dynamic-anisotropic-maximum-energy traveltime generator. **Note:** The pruneshooter and shooter modules are provided for compatibility purposes only. You should use the rayshooter module, instead.
raw	
rayshooter	Provides an interface to a dynamic-anisotropic-maximum-energy traveltime generator. The rayshooter module completely replaces the pruneshooter, rayshooter, and shooter modules.
resamp3d	
resample	
rtmodel	Provides an interface to the reverse time modeling module.
scan	Performs scans, thresholds input traces and outputs various statistical quantities.
semblance	Computes the semblance panel for a given CDP gather.
shooter	Provides an interface to a dynamic-anisotropic-maximum-energy traveltime generator. **Note:** The pruneshooter and shooter modules are provided for compatibility purposes only. You should use the rayshooter module, instead.
smoother	Enables you to control the smoothing operation performed on the output data.
stack	Stacks all traces in a given gather.
staticShift	Calculates and applies elevations statics. The statics can be calculated from information stored in the trace headers, or the module can simply apply a single static shift already stored in an appropriate header location. The module assumes that appropriate elevations are already stored in the trace headers.
timeDepth	Converts time-to-depth and depth-to-time.
trsum	Performs basic operations on the input data stream.

continues on next page

Table 9. jobBuilder Modules–continued

Tab	Description
trWindow	Performs a spatial windowing operation on the input data stream.
wem	Panorama Technologies' wave-equation migration module. This module can run in either the common-shot mode for pre-stack shot-profile migrations, or it can run in the poststack mode for post-stack migrations. Regardless of which mode is selected, this is a one-way phase panel method.

jobBuilder Menus and Toolbar

The jobBuilder module has a File menu (Figure 10), a Job menu(Figure 11), and a toolbar (Figure 12).

File Menu

Figure 10. File Menu

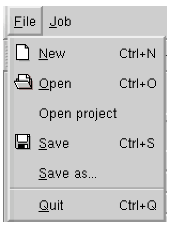


Table 10. File Menu Commands

Command	Description
New	Removes all modules from the job flow.
Open	Displays a dialog box enabling you to select and open an existing MARVEL job (`.job` extension).
Open project	Displays a dialog box enabling you to select and open an existing MARVEL project (`.project` extension).
Save	Saves the current jobBuilder information to the open job file.
Save as...	Displays a dialog box that enables you to save to jobBuilder information to the file you specify.

Job Menu

The Job menu, Figure 11, contains only one command that enables you to run the open job against a project.

Figure 11. Job Menu

Toolbar

The jobBuilder toolbar, Figure 12, enables you to perform certain operations without accessing the menu items.

Figure 12. jobBuilder Toolbar

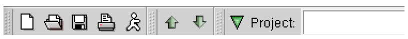


Table 11. jobBuilder Toolbar Commands

Icon	Description
	Removes all modules from the job flow in preparation for creating a new job.
	Displays a dialog box enabling you to select and open an existing MARVEL job (`.job` extension).
	Saves the current jobBuilder information to the open job file.
	Sends the current job file to the default printer.
	Runs the open job against a project.
	Changes the order modules in the job list.
 Project:	Changes the order of modules in the job list.

angle2offset Module

Figure 13. angle2offset Panel

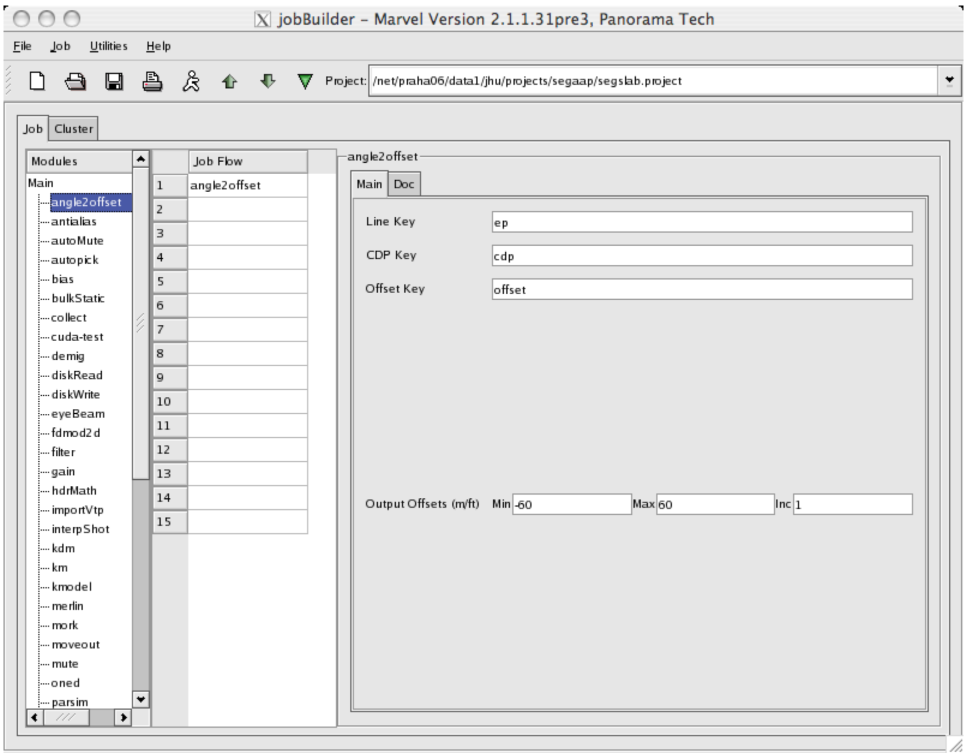


Table 12. angle2offset Panel Fields

Field	Description
Line Key	The header key specifying where line data is stored in the trace. default: ep
CDP Key	The header key specifying where CDP data is stored in the trace. default: cdp
Offset Key	The header key specifying where offset data is stored in the trace. default: offset
Output Offsets (m/ft)	Min (default: -60), Max (default: 60), Inc (default:1)

antialias Module

This module enables you to eliminate unwanted portions of the spectra and frequencies that might cause aliasing when the sample rate is decreased during seismic processing.

Figure 14. antialias panel

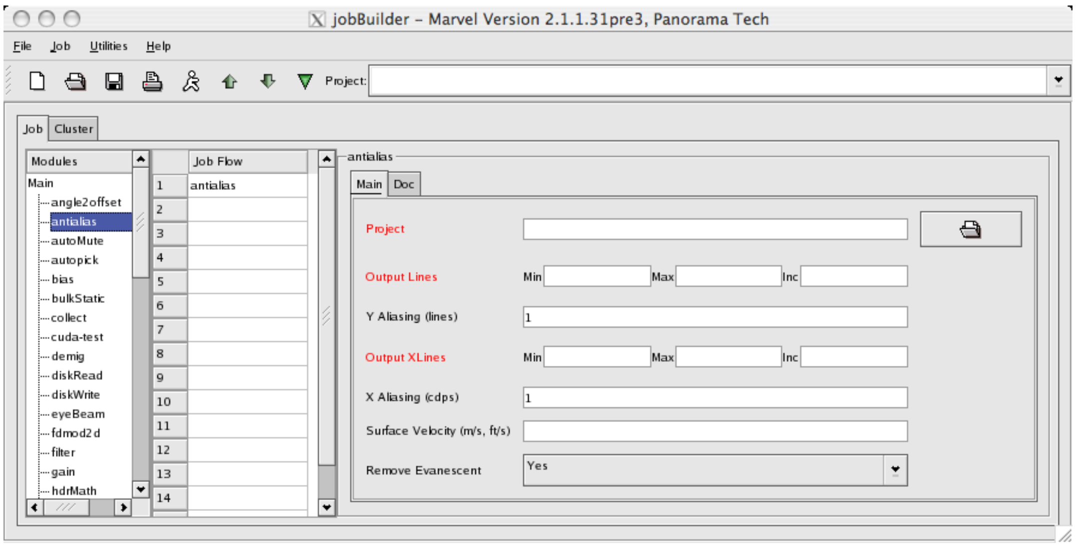


Table 13. antialias Panel Fields

Field	Description
Project	The project file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a required entry.** default: Project selected with `File=>Open Project` command.
Output Lines	Min, max, and increment for lines in the output volume. **This is a required entry.**
Y Aliasing (lines)	The inline anti-aliasing distance, in units of lines.
Output XLines	Min, max, and increment for xlines (cdps) in the output volume. **This is a required entry.**
X Aliasing (cdps)	The crossline anti-aliasing distance, in units of lines.
Surface Velocity (m/s, ft/s)	The near surface velocity in Equation 2 on page 25.

continues on next page

Table 13. antialias Panel Fields–continued

Field	Description
Remove Evanescent	Do you want to remove seismic noise from the processing (which is typically in the form of exponentially decaying evanescent waves)? Yes or No

autoMute Module

This module reads and automatically extracts mute information from an input data stream. The mute information is then written to a mute (`.pick`) output file.

Figure 15. autoMute Panel

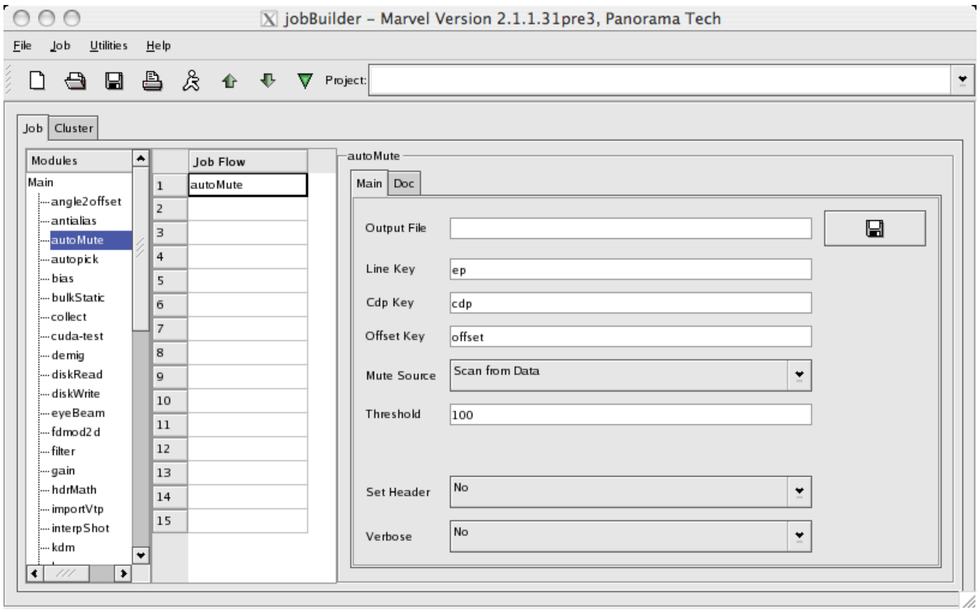


Table 14. autoMute Panel Fields

Field	Description
Output File	The name of the `.pick` file that will be created by autoMute.
Line Key	The header key specifying where line data is stored in the trace. default: ep
Cdp Key	The header key specifying where CDP data is stored in the trace. default: cdp
Offset Key	The header key specifying where offset data is stored in the trace. default: offset
Mute Source	Scan from Data, Read from Header
Threshold	Percentile threshold for mute detection. This field is displayed only if the Mute Source is Scan from Data. default: 100
Mute Key	Header key signifying the start of the mute values. default: muts

continues on next page

Table 14. autoMute Panel Fields–continued

Field	Description
Set Header	If this toggle is set to Yes, set the indicated header in the output trace.
Verbose	Switch for turning debug printing on and off. default: No

autopick Module

Theory

The autopick module uses a sophisticated shifted-hyperbola technology based loosely on the paper, Normal Moveout Revisited: Inhomogeneous Media and Curved Interfaces, by Eric de Bazelaire in the February 1988 issue of GEOPHYSICS. The module is able to calculate the semblance and constant velocity stacks of an input CDP rapidly using this technology. The computed ensembles are then used to automatically determine the optimum RMS stacking or migration velocity. The time-velocity pairs specifying peak semblance values at each time-increment are selected, and then edited to assure that the number of spurious values is held to a manageable level.

Traditionally, normal moveout is governed by an equation of the form shown in Equation 1, where t_0 is vertical time and t is the arrival time at half-offset h. In this case, v is the velocity of a homogenous medium with a single reflector at depth $0.5vt_0$.

Equation 1:

$$t^2 = t_0^2 + \frac{h^2}{4v^2}$$

While this equation has been used effectively for velocity analysis for many years, it has several deficiencies. The primary deficiency is that using it to correct large offset data dynamically to vertical time requires excessive stretching, and as a result can significantly reduce the frequency content of the data.

A second deficiency occurs because the stretch, as specified by $t - t_0$, has considerable variation as a function of h and v, calculating multiple stacks or semblance panels can become computationally expensive when the number of such panels is large. In addition, if the medium is not homogeneous and has even a few curved interfaces, the difference between the stacking velocity estimated by the traditional equation, Equation 1, and the true RMS velocity can be quite large.

In his 1988 paper, de Bazelaire showed that both of the difficulties with the traditional equation, Equation 1 are overcome by using an equation of the form shown in Equation 2, where v_a is a near surface velocity and t_p is related to the time of a shifted hyperbola fitting the arrival time curve on a given gather.

Equation 2:

$$(t - t_0 + t_p)^2 = t_p^2 + \frac{h^2}{4v_a^2}$$

You can rewrite the hyperbola equation as a shift, as shown in Equation 3.

Equation 3:

$$t - t_0 = \Delta t = t_p + \sqrt{t_p^2 + \frac{h^2}{4v_a^2}}$$

You can see that calculating stacking or semblance panels is purely a function of a single shift used for every time value in a trace. Note that the two variables of interest in Equation 3 are Δt and t_p. Thus, you are computing and picking (t_0, t_p) panels computed through Δt.

For any given (t_0, t_p) pair, the correct stacking velocity can then be obtained from Equation 4.

Equation 4:

$$v = v_a\sqrt{\frac{t_0}{t_p}}$$

Thus, this approach provides an efficient approach to computing accurate stacking velocities in a fully automatic manner over the entire 3D project volume.

autopick Input Model Panels

The autopick module has three forms of the Input Model panel, depending on the Model Type you select: Single Function (Figure 16), Gridded Seismic (Figure 17), or Picks (Figure 18). The parameter fields on these panels are described in Table 15.

Figure 16. autopick Module Input Model–Single Function Model Panel

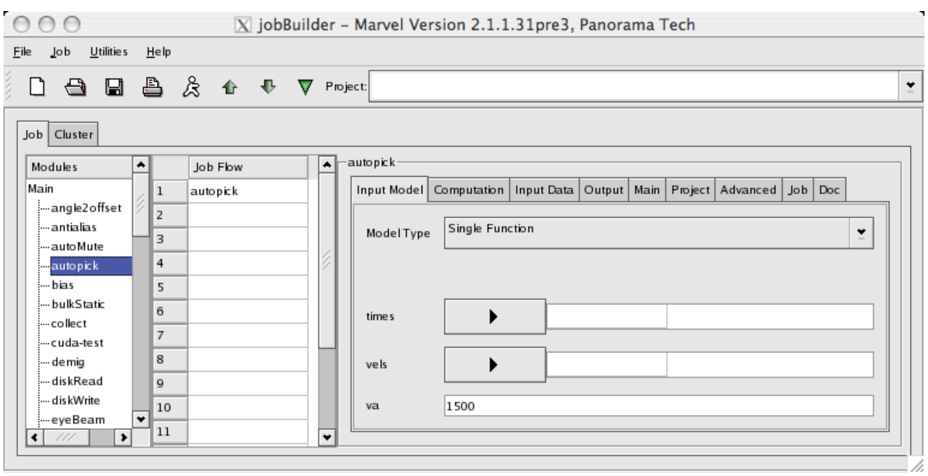


Figure 17. autopick Module Input Model–Gridded Seismic Model Panel

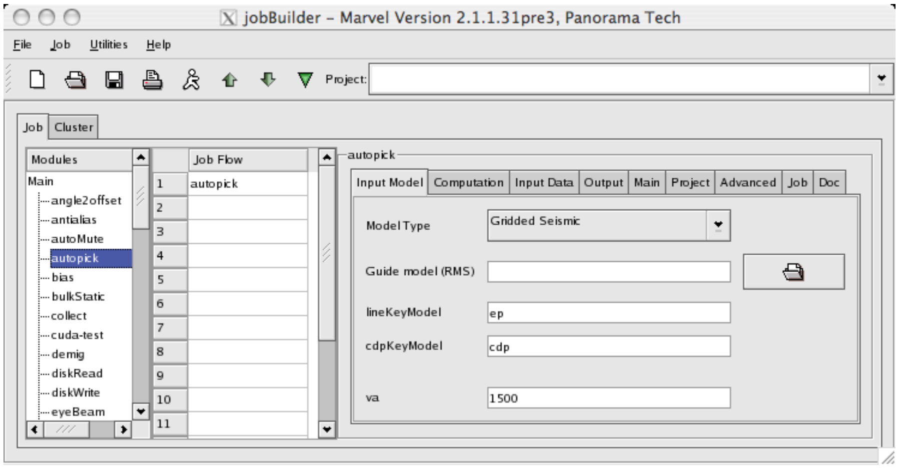


Figure 18. autopick Module Input Model–Picks Model Panel

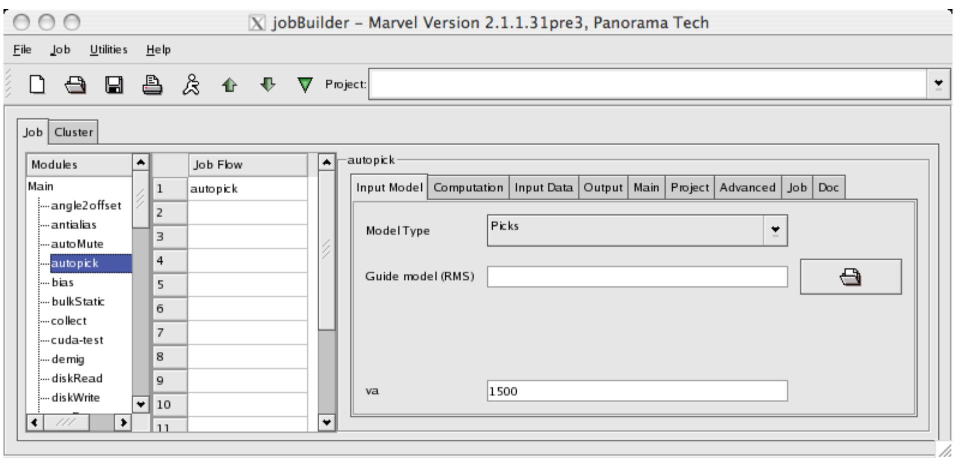


Table 15. autopick Input Model Panel Fields

Field	Description
Model Type	Type of guide model input: Single Function, Gridded Seismic, or Picks. default: Single Function
times	Pick times for a (single) guide function.
vels	Pick velocities for a (single) guide function.
va	The near surface velocity in Equation 2 on page 25. default: 1500

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Table 15. autopick Input Model Panel Fields–continued

Field	Description
Guide Model (RMS)	RMS velocity guide function.
lineKey Model	Header key for line data in model. default: same as data
cdpKey Model	Header key for CDP data in model. default: same as data

autopick Computation Panel

The autopick Computation panel shown in Figure 19 enables you to set the values of several parameters used in generating autopicks. The fields are described in Table 16.

Figure 19. autopick Module Computation Panel

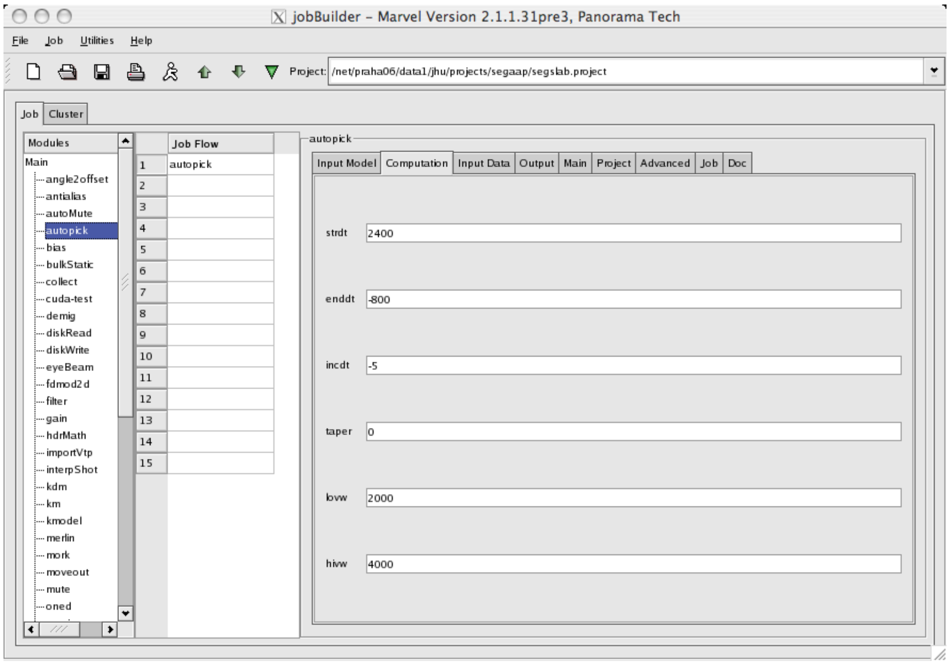

Table 16. autopick Computation Panel Fields

Field	Description
strdt	Starting dt value for the (t0, tp) analysis. default: 2400
enddt	Ending dt value for the (t0, tp) analysis. default: -800
incdt	Increment for the dt value. The value should always be negative. default: -5
taper	The number of traces to taper. default: 0
loovw	The short-time velocity width of the picking window. default: 2000
hivw	The long-time velocity width of the picking window. default: 4000

autopick Input Data Panel

The autopick module has two forms of the Input Data panels, depending on whether you set Mute Input to No (Figure 20), or Yes (Figure 21). The parameter fields on these panels are described in Table 17.

Figure 20. autopick Input Data Panel, Mute Input No

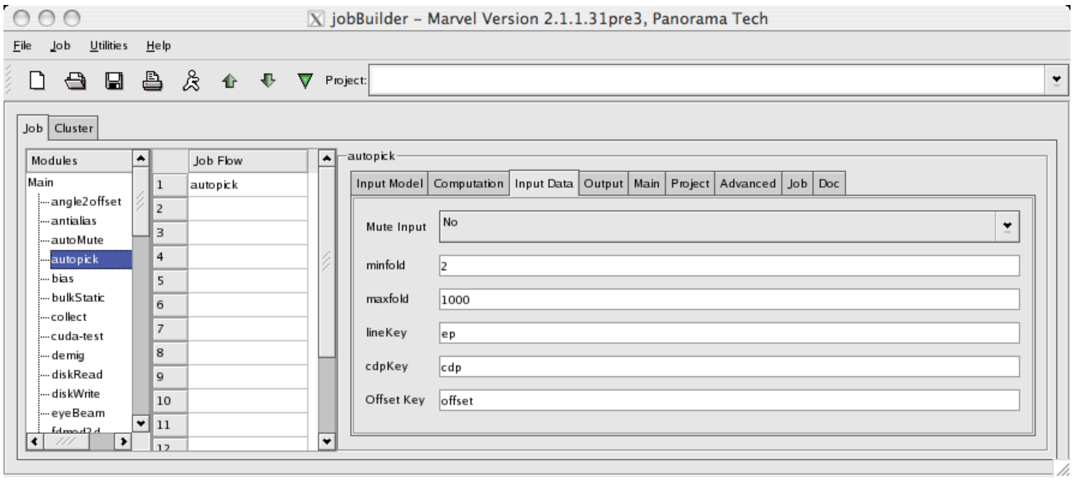

Figure 21. autopick Input Data Panel, Mute Input Yes

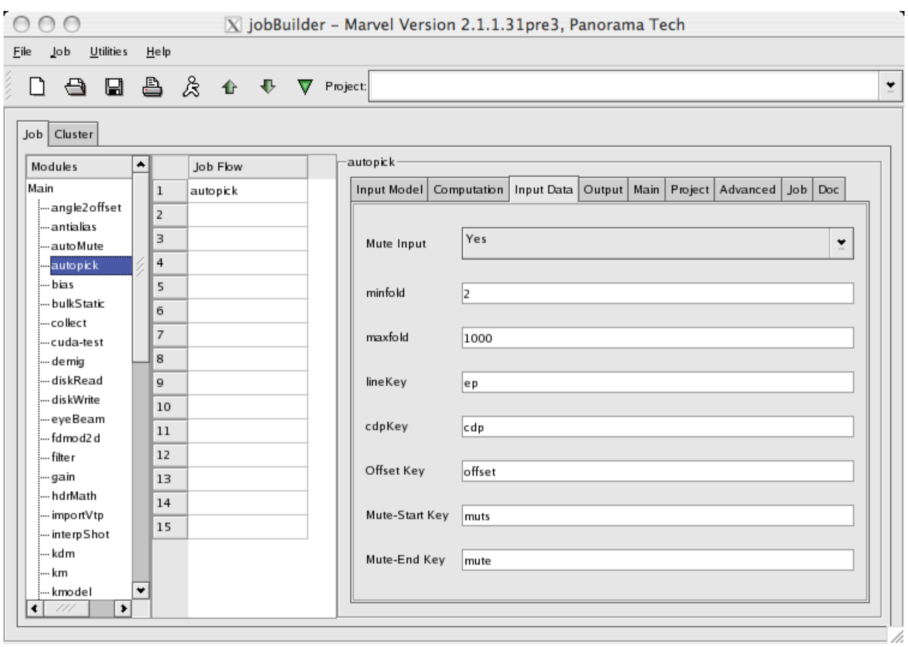

Table 17. autopick Input Data Panel Fields

Field	Description
Mute Input	Flag indicating whether or not the data is to be muted internally. default: No
minfold	This is the minimum input data fold. Nothing is done for smaller gathers. default: 2
maxfold	The maximum input data fold. default: 1000
lineKey	Header key for a line in the trace. default: ep
cdpKey	Header key for a CDP in the trace. default: cdp
Offset Key	Header key for offset in the trace. default: offset
Mute Start Key	Header key signifying the start of the mute values. default: muts
Mute End Key	Header key signifying the end of the mute values. default: mute

autopick Output Panel

The autopick Output panel contains only one variable, Output. You can set the value to Picked Trace, Stack and Velocity Trace, TP Panel, TP Semblance, or Velocity Trace. The default value is Picked Trace.

autopick Main Panel

Figure 22 enables you to change the values of several parameters used in the autopicking process, Table 18.

Figure 22. autopick Module Main Panel

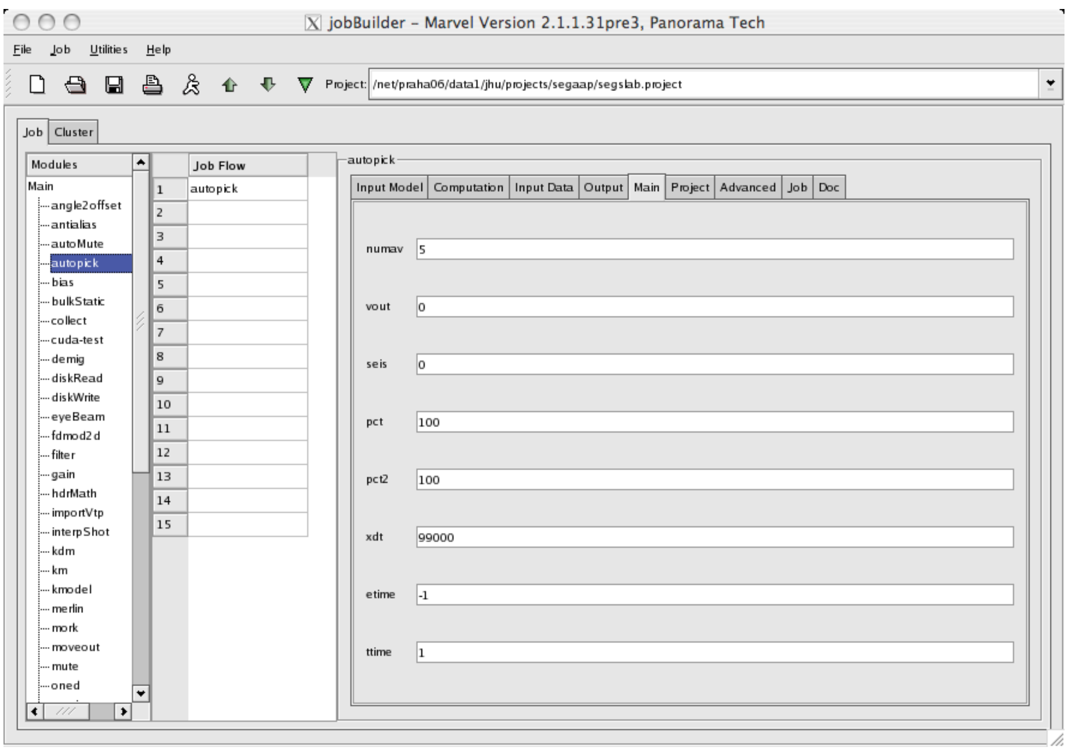

Table 18. autopick Main Panel Fields

Field	Description
numav	The number of iterations of a two-point, two-dimensional running average that is applied to computed (t0, tp) panels to stabilize the picking process. default: 5

continues on next page

Table 18. autopick Main Panel Fields–continued

Field	Description
vout	The velocity output format, vout, can be set to 0, 1, 2, 3, or 4, where • 0 tells autopick to output velocities • 1 outputs picked velocities • 2 outputs reference velocities • 3 outputs interval velocities using the Dix equation • 4 outputs reference velocities default: 0
seis	The kind of seismic data to output. The value can be set to 0 or 1, where 0 means to output the stacked trace, while 1 means to output the amplitudes at the pick points only. default: 0
pct	The percent of the current picked function to add to the current reference function to use in picking the next CDP. default: 100
pct2	The percent of the current picked function to add to the new model velocity trace to generate the next reference function. default: 100
xdt	The maximum deviation from current reference. default: 99000
etime	An override time at which picking stops and the reference function is used to define velocities. Normally, this is set to the maximum trace time. default: -1
ttime	The duration used to merge picked and reference times. This parameter is normally set to the sampling increment. default: 1

autopick Project Panel

The autopick Project panel enables you to set the CDP and line spacing.

- *dx* defines the CDP spacing. The default is 12.5.
- *dy* defines the line spacing. The default is 12.5.

autopick Advanced Panel

The autopick Advanced panel contains two variables that enable debugging control.

- *verbose* is a switch for turning debug printing on and off.
- *debug* is a switch for turning debug on and off.

autopick Job Panel

There are two fields on this job control panel: *MasterisWorker* and *RunWorkersLowPriority*.

- *MasterisWorker* controls whether the master I/O controller is also used for migrating data. The default is *Yes*.
- If *Runworkerslowpriority* is set to *Yes*, workers will be spawned with reduced priority. although the master process will remain at high priority. This can be useful especially when *MasterIsWorker* is set, so that one worker does not slow down collection or submission of shots for all of the others.

bias Module

The bias module calculates the trace bias (dc) within a sliding window, and either outputs the debiased trace, or the bias function. The bias panel is shown in Figure 23, and the fields are described in Table 19.

Figure 23. bias Panel

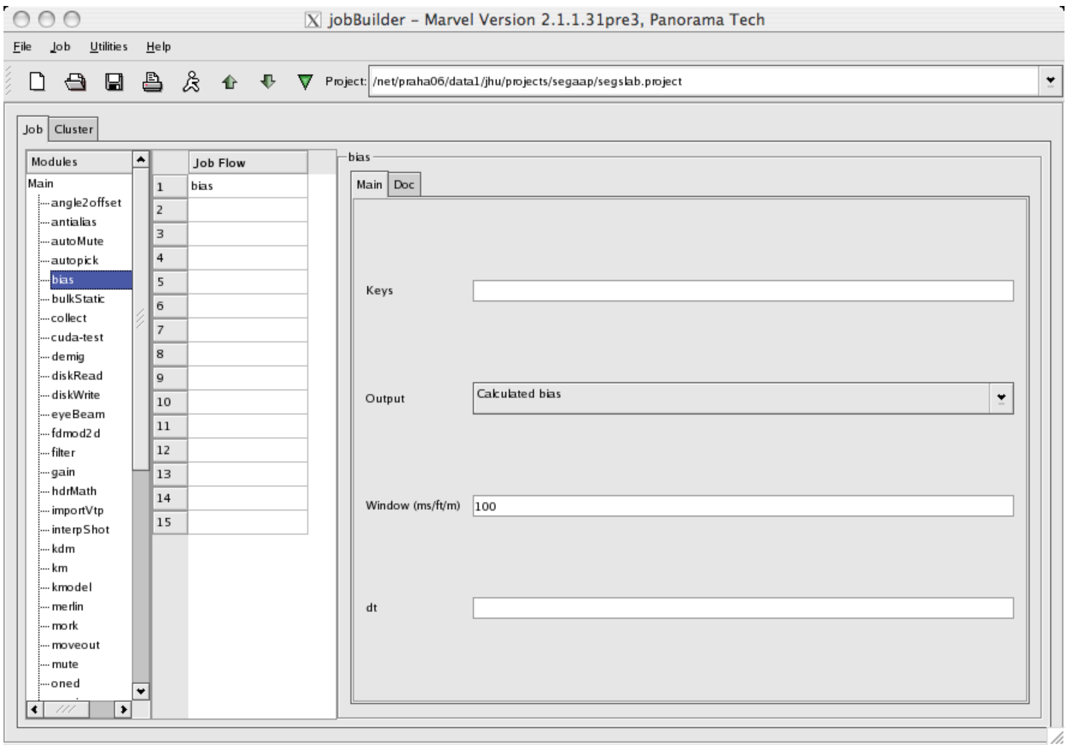

Table 19. bias Panel Fields

Field	Description
Keys	The keys defining an ensemble.
Output	What kind of data to output: debiased data or calculated bias data. default: Calculated bias
Window (ms/ft/m)	default: 100
dt	Time interval to use if the value is incorrect in the header.

bulkStatic Module

The bulkStatic module applies a bulk static correction to each seismic trace in time in an input data stream. A common static correction is the weathering correction, which compensates for a layer of low seismic velocity material near the surface of the Earth. Other corrections compensate for differences in topography and differences in the elevations of sources and receivers. The bulkStatic panel is shown in Figure 24, and the fields are described in Table 20.

Figure 24. bulkStatic Panel

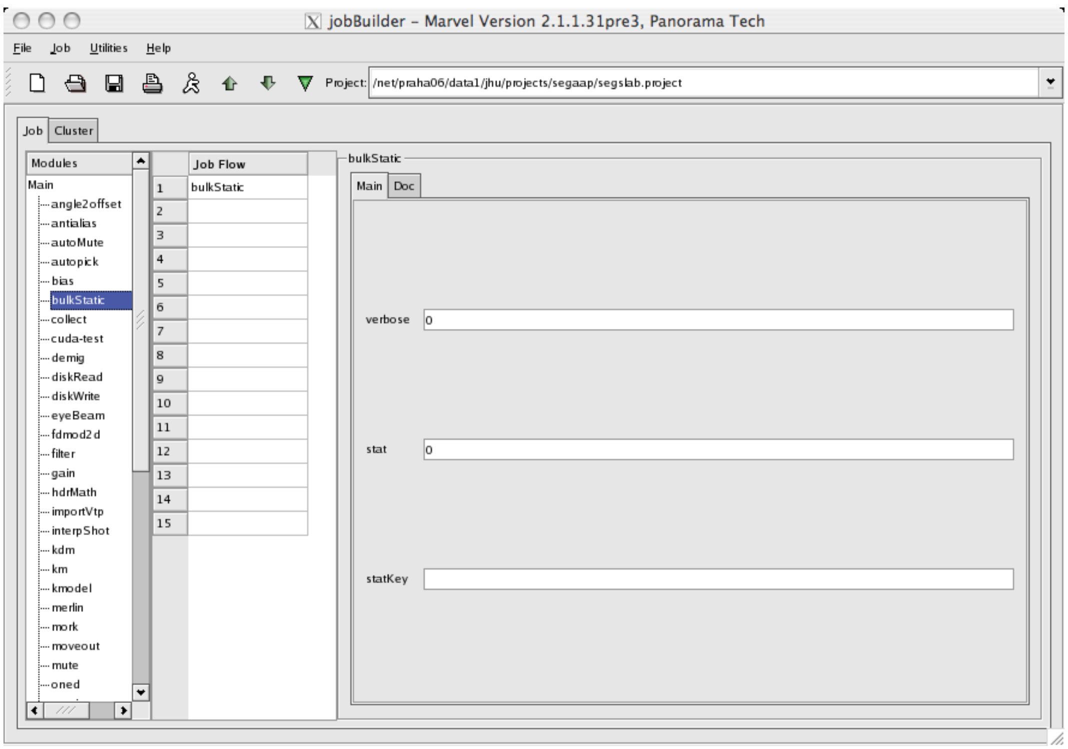

Table 20. bulkStatic Panel Fields

Field	Description
verbose	Switch for turning debug printing on and off. default: 0
stat	Bulk static correction to be applied to the data. default: 0
statKey	The key word to be used for statics data in the MARVEL format.

collect Module

The collect module is designed to stack output from migrations. By default, it does this first-come, first-served, and the output files will be unsorted. Choose the Preallocate Volume option in the collect panel to avoid this behavior.

The collect module panels are shown in Figure 25, Figure 26, and Figure 27, and the fields are described in Table 21.

Figure 25. collect Main Panel

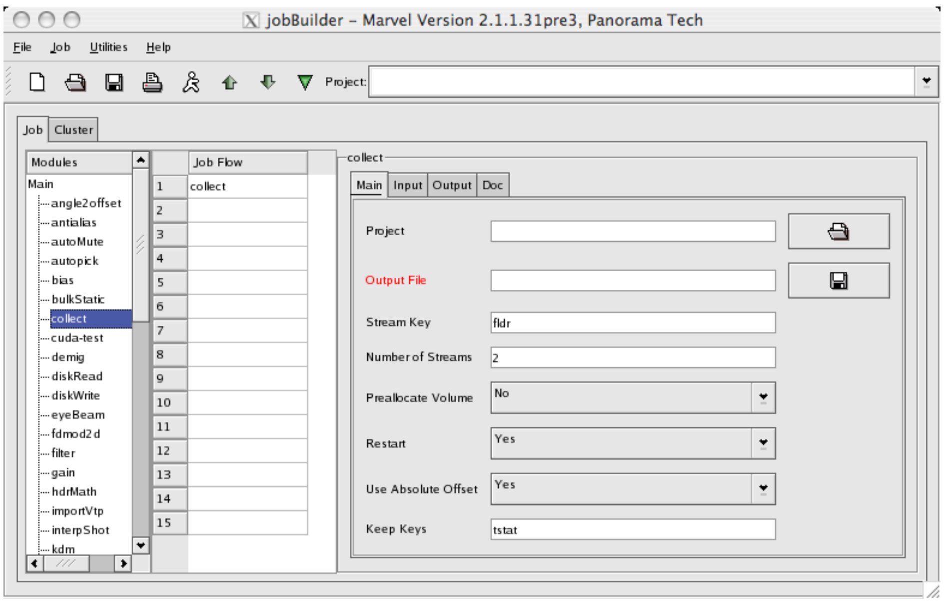

Figure 26. collect Input Panel

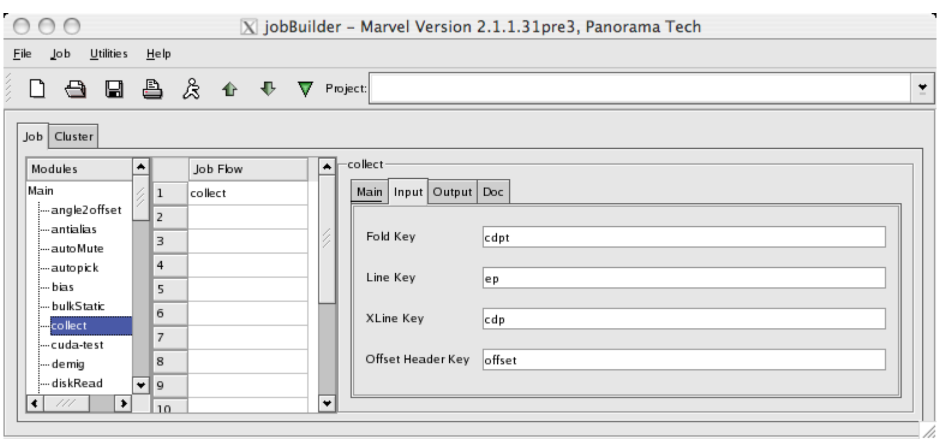

Figure 27. collect Output Panel

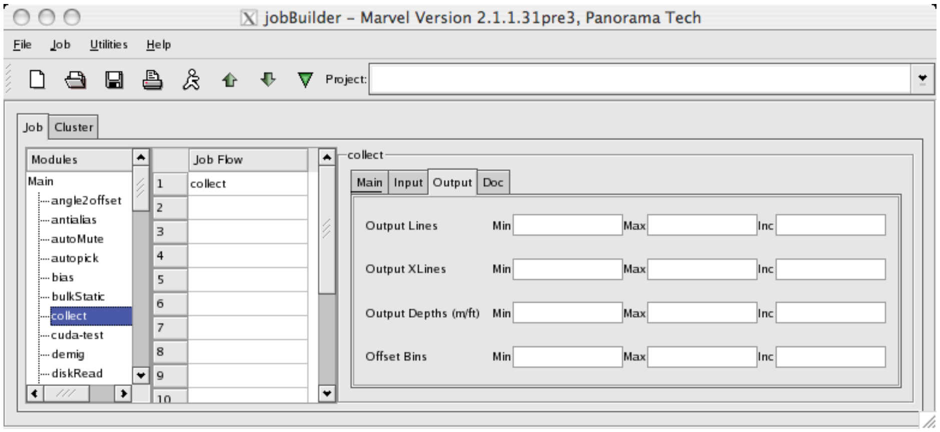

Table 21. collect Panel Fields

Field	Description
Main Panel	
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Output File	The name of the file to be used for output.
Stream Key	default: fldr
Number of Streams	default: 2
Preallocate Volume	Do you want MARVEL to allocate space for the output data before the job starts? Default: No
Restart	Do you want to be able to restart the job? If Yes, the application will keep information about shots already processed in a restart file. Default: Yes
Use Absolute Offset	
Keep Keys	default: tstat
Input Panel	
Fold Key	The key word to be used for FOLD in the MARVEL format. default: cdpt

continues on next page

Table 21. collect Panel Fields–continued

Field	Description
Line Key	The key word to be used for LINE in the MARVEL format. default: ep
XLine Key	The key word to be used for XLINE in the MARVEL format. default: cdp
Offset Header Key	The key word to be used for OFFSET in the MARVEL format. default: offset
Output Panel	
Output Lines	The number of lines to be contained in the output data.
Output XLines	The number of crosslines to be contained in the output data.
Output Depths	The number of depths to be contained in the output data.
Offset Bins	Specifies the offset bins in which to read the data.

deimg Module

Figure 28. deimg Main Panel

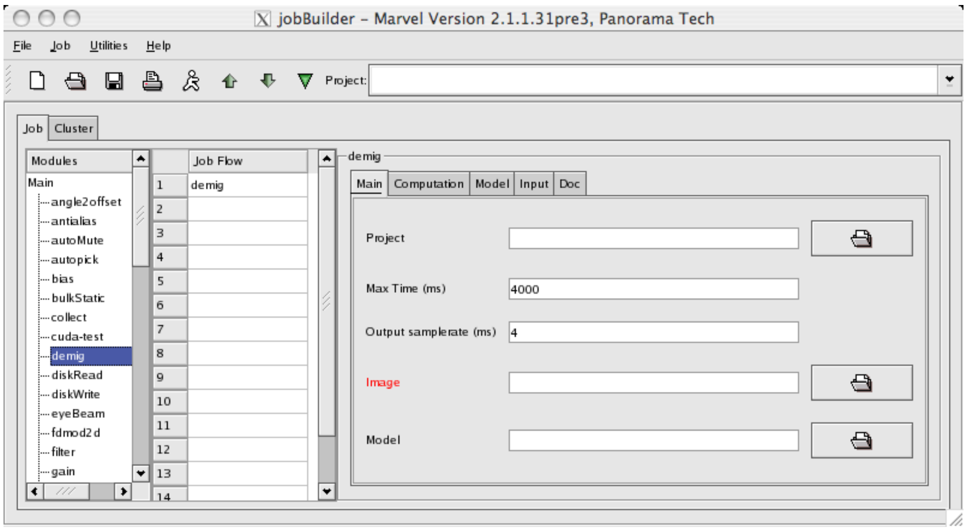

Table 22. deimg Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Max Time (ms)	default: 4000
Output sample rate (ms)	default: 4
Image	**This is a REQUIRED entry.**
Model	

deimg Computation Panel

Figure 29. deimg Module Computation Panel

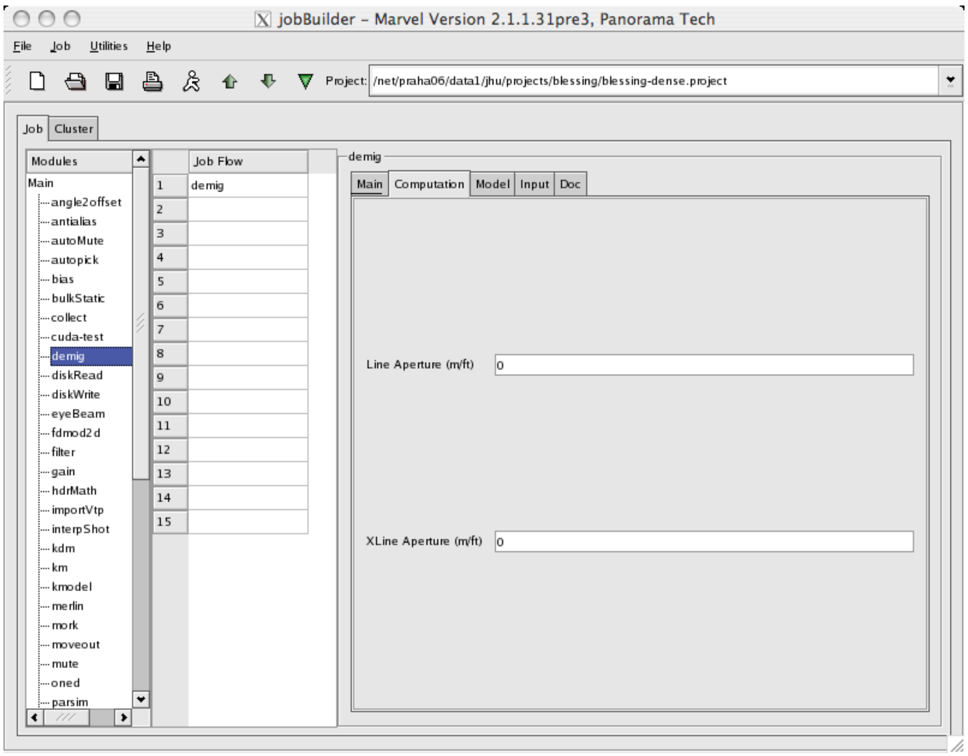

Table 23. deimg Main Panel Fields

Field	Description
Line Aperture (m/ft)	The length, in meters or feet, of the line direction aperture limit.
XLine Aperture (m/ft)	The length, in meters or feet, of the crossline direction aperture limit.

deimg Model Panel

Figure 30. deimg Model Panel

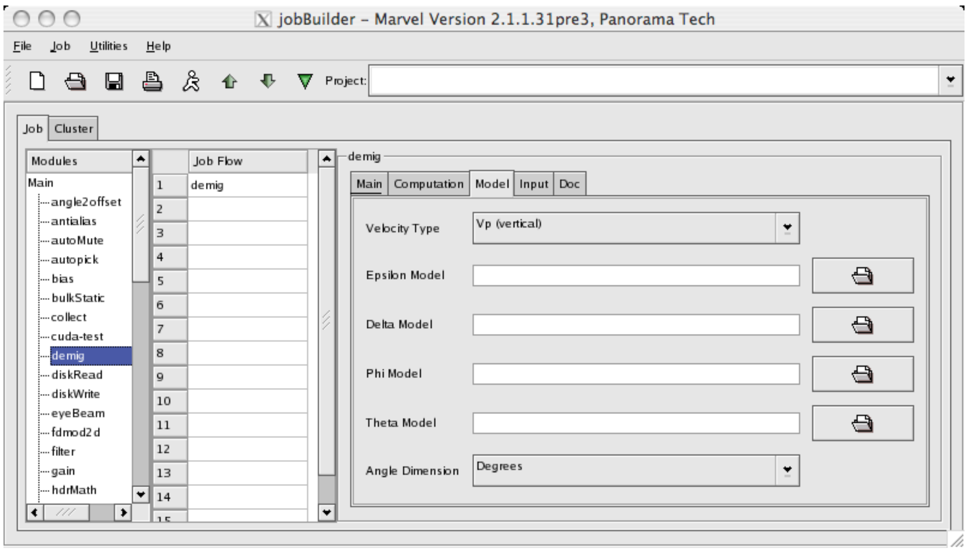

Table 24. deimg Model Panel Fields

Field	Description
Velocity Type	Vp (vertical) or VNMO (vertical)
Epsilon Model	File containing a model of Thomsen's Epsilon.
Delta Model	File containing a model of Thomsen's Delta.
Phi Model	File containing a model of Thomsen's Phi.
Theta Model	File containing a model of Thomsen's Theta.
Angle Dimension	Degrees or Radians

deimg Input Panel

Figure 31. deimg Module Input Panel

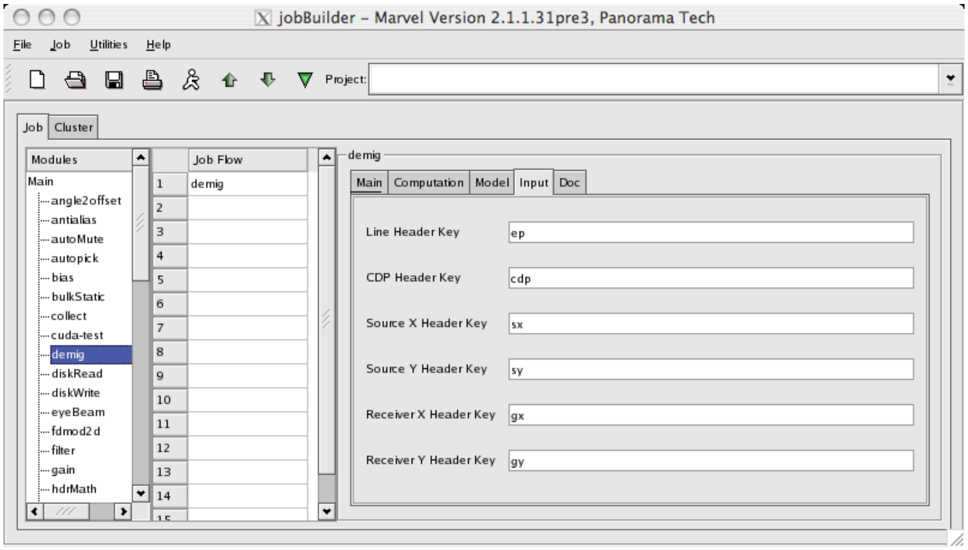

Table 25. deimg Input Panel Fields

Field	Description
Line Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: ep
CDP Header Key	Header key containing CDP designators. MARVEL usually uses cdp, which is a 4-byte integer at location 21 in SEG-Y files. default: cdp
Source X Header Key	Header key specifying where inline source locations are stored in the trace. default: sx
Source Y Header Key	Header key specifying where crossline source locations are stored in the trace. default: sy
Receiver X Header Key	Header key specifying where inline geophone data is stored in the trace. default: gx
Receiver Y Header Key	Header key specifying where crossline geophone data is stored in the trace. default: gy

diskRead Module

The diskRead module enables you to select the seismic files you want to read. It also enables you to set parameters that control how this data is handled by MARVEL.

diskRead Main Panels

The format of the diskRead Main panel depends on the Mode you select on the panel: General (Figure 32), Kirchhoff Migration (Figure 33), Beam Migration (Figure 34), or Shot Migration (Figure 35). The data fields are defined in Table 26.

Figure 32. diskRead Main Panel, General

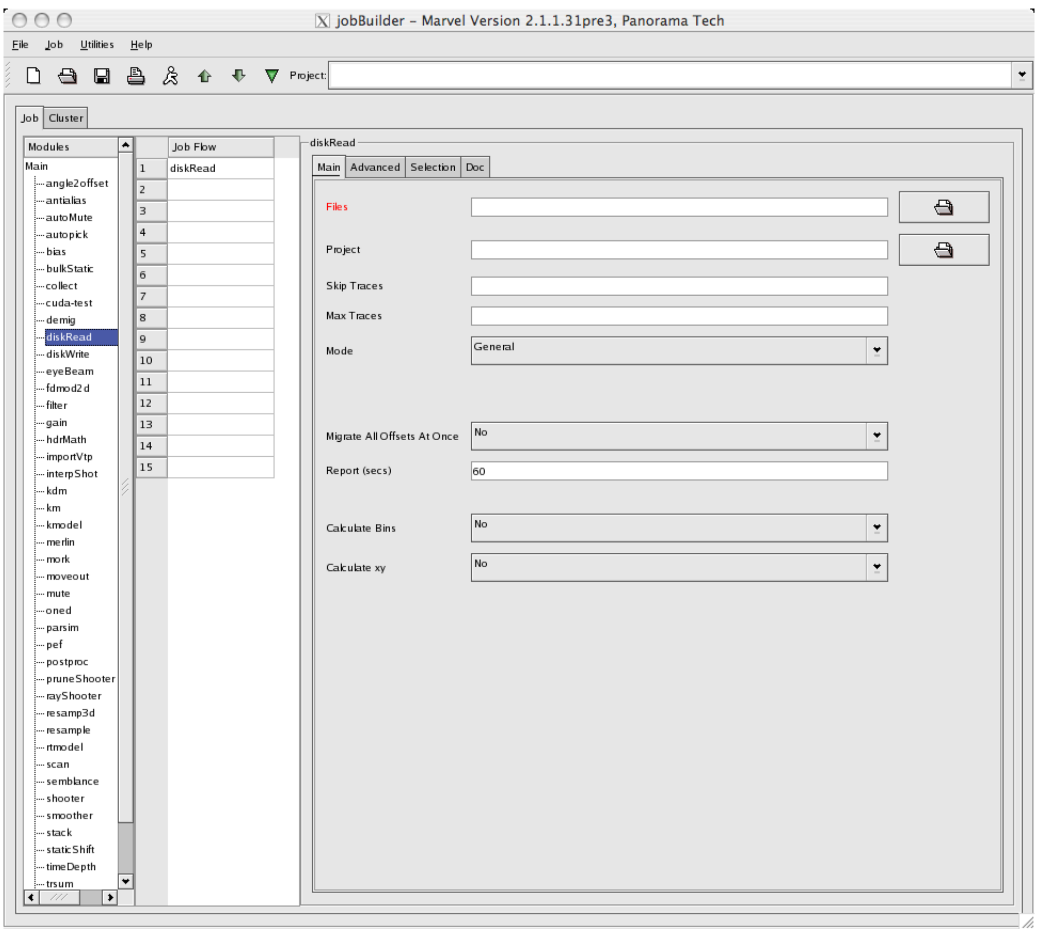

Figure 33. diskRead Main Panel, Kirchhoff Migration

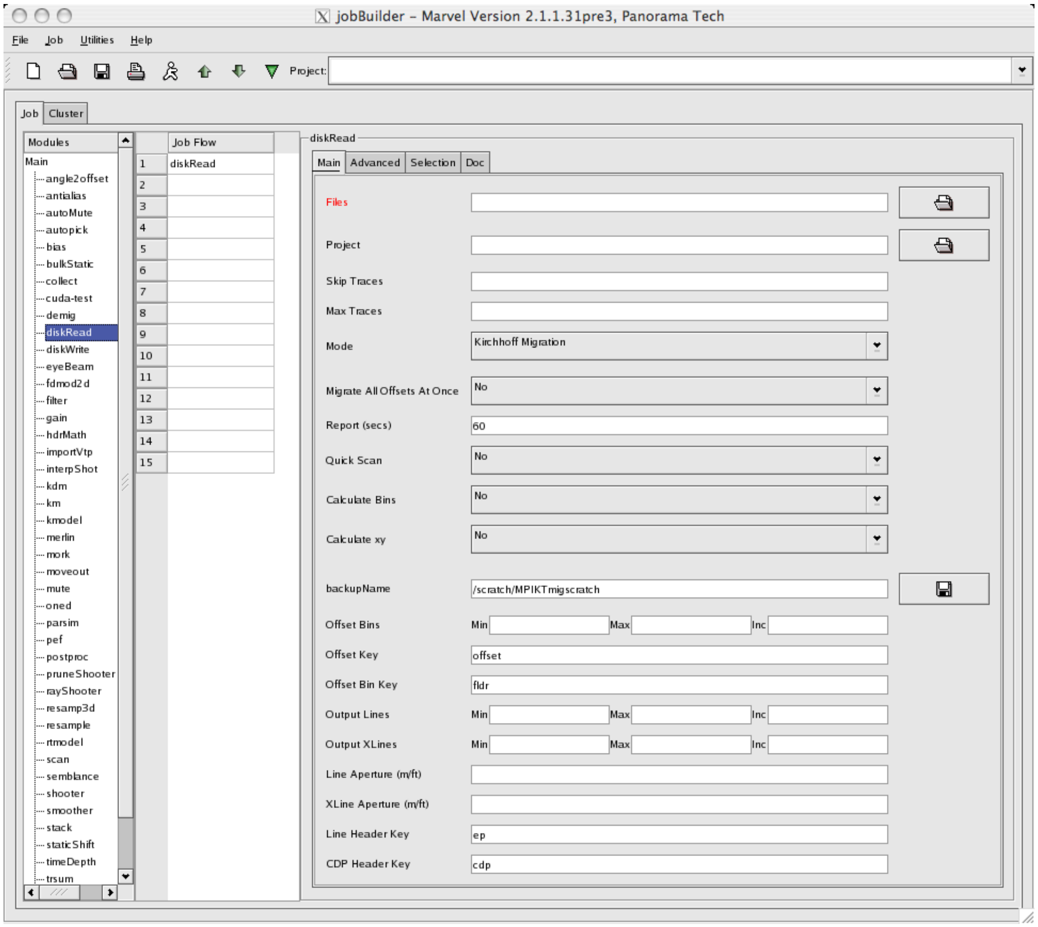

Figure 34. diskRead Main Panel, Beam Migration

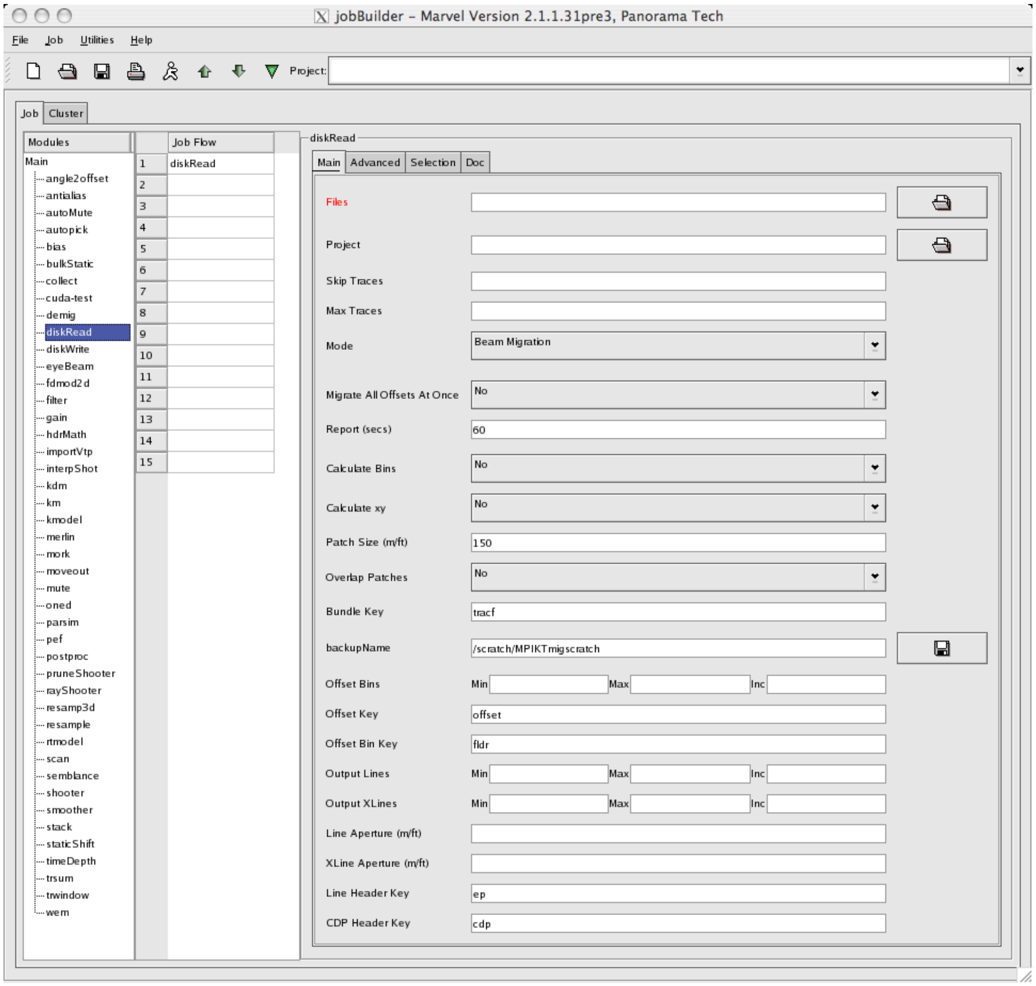

Figure 35. diskRead Main Panel, Shot Migration

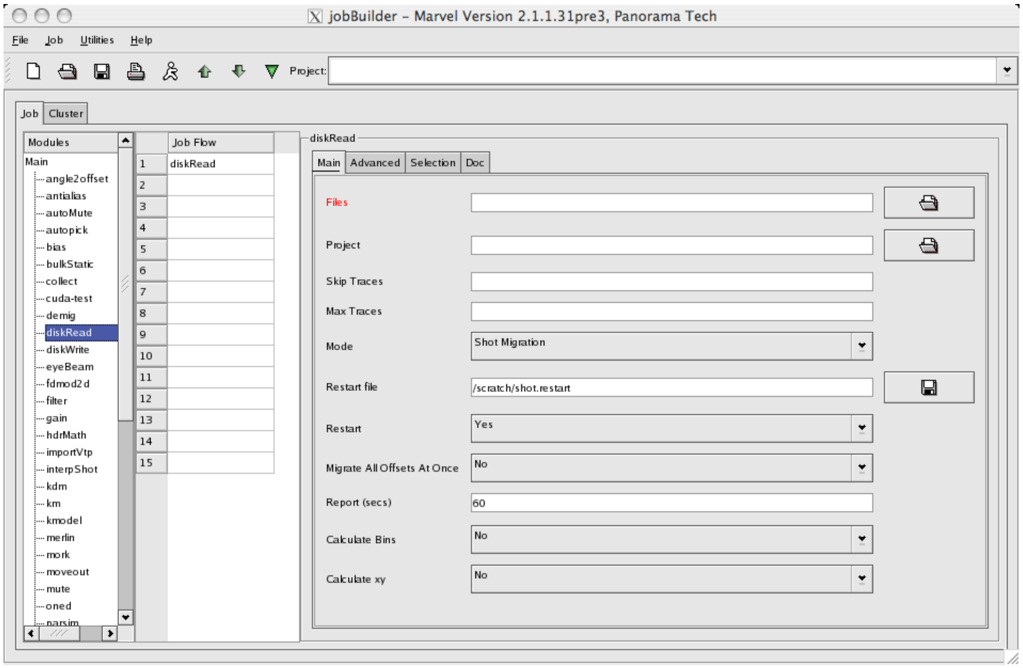

Table 26. diskRead Main Panel Fields

Field	Description
Mode: General	
Files	List of the input files to be read.
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Skip Traces	The maximum number of traces to skip.
Max Traces	The maximum number of traces to read.
Mode	Mode to read data for specific applications: General, Kirchhoff Migration, or Shot Migration. The selection in this field determines the complement of fields you see on this panel. default: General
Migrate All Offsets At Once	Enables all offsets to be held in memory at one time. This is good for increasing I/O performance. default: No
Report (secs)	How often to report output, in seconds. default: 60

continues on next page

Table 26. diskRead Main Panel Fields–continued

Field	Description
Calculate Bins	
Calculate xy	
Mode: Kirchhoff Migration	
Quick Scan	default: no
backupName	The name of the file to contain backup data if a restart becomes necessary. default: */scratch/KDmigscratch* **Note: This file is not deleted when a job finishes successfully. You must delete the file manually.**
Offset Bins	Specifies the offset bins in which to read the data.
Offset Key	Header key defining the location of the offset in the trace.
Offset Bin Key	The header key for the offset bin parameter.
Output Lines	The number of lines to be contained in the output data.
Output XLines	The number of crosslines to be contained in the output data.
Line Aperture (m/ft)	The length, in meters or feet, of the line direction aperture limit.
XLine Aperture (m/ft)	The length, in meters or feet, of the crossline direction aperture limit.
Line Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: ep
CDP Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: cdp
Line Aperture	The length, in meters or feet, of the line direction aperture limit.
XLine Aperture	The length, in meters or feet, of the crossline direction aperture limit.
Line Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: ep

continues on next page

Table 26. diskRead Main Panel Fields–continued

Field	Description
CDP Header Key	Header key containing CDP designators. MARVEL usually uses cdp, which is a 4-byte integer at location 21 in SEG-Y files. default: cdp
Restart File	The application keeps information about shots already processed in this file. It is usually best to put it in the same directory where your output files are located and to give it a similar name. default: */scratch/shot.restart*
Calculate Bins	default: No
Calculate xy	default: No
Mode: Beam Migration	
Patch Size (m/ft)	default: 150
Overlap Patches	default: No
Bundle Key	default: tracf
Mode: Shot Migration	
backupName	The name of the file to contain backup data if a restart becomes necessary. default: */scratch/KDmigscratch* **Note: This file is not deleted when a job finishes successfully. You must delete the file manually.**
Report (secs)	default: 60
Quick scan	default: 60

diskRead Advanced Panel

This panel enables you to define the advanced parameters for the module. Currently there is only one parameter on the panel: Number of Traces to Map. The default value is 10000.

diskRead Selection Panel

The diskRead Selection panel identifies the file to which the MARVEL output data will be written. The panel is shown in Figure 36, and the terms are defined in Table 27.

Figure 36. diskRead Selection Panel

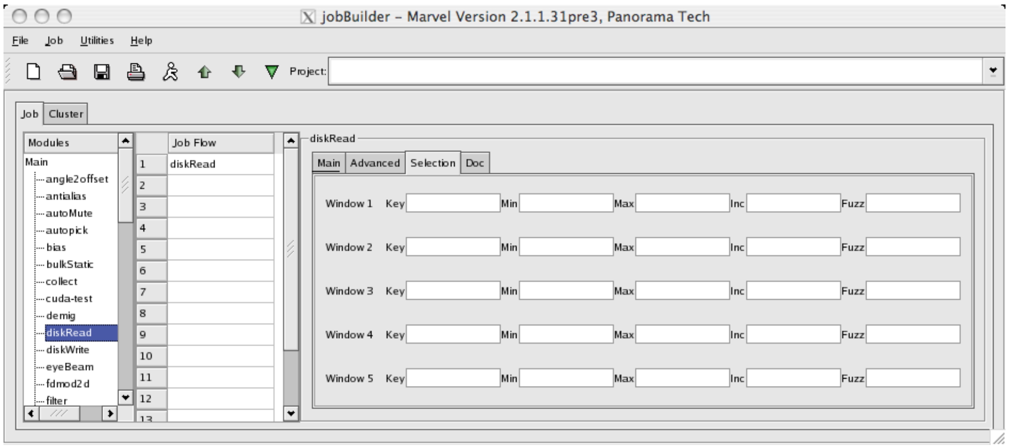

Table 27. diskRead Selection Panel Fields

Field	Description
Files	The names of the file to write. **This is a REQUIRED entry.**
Mode	The mode to write the files: Overwrite or Append.
Format	The format to be used for the output data: • IEEE floating • IBM floating • Scaled short
Max File Size	The maximum size of the file that MARVEL should write. default: 0, no size limit

diskWrite Module

The diskWrite module identifies the file to which the MARVEL output data will be written. The diskWrite panel is shown in Figure 37, and the terms are defined in Table 28.

Figure 37. diskWrite Panel

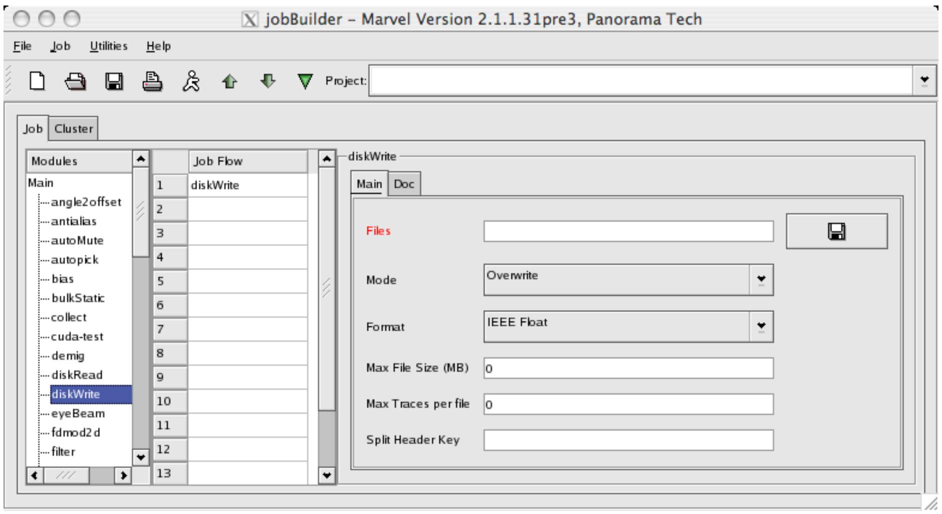

Table 28. diskWrite Panel Fields

Field	Description
Files	The names of the file to write. **This is a REQUIRED entry.**
Mode	The mode to write the files: Overwrite or Append.
Format	The format to be used for the output data: • IEEE floating • IBM floating • Scaled short
Max File Size (MB)	The maximum size of the file that MARVEL should write. default: 0, no size limit
Max Traces per file	The maximum number of traces to be included in a file. default: 0, no size limit
Split Header Key	

eyeBeam Module

The eyeBeam module is Panorama Technologies' parsimonious beam migration program. The module decomposes seismic data into effective beamlets and images those beamlets along rays generated by the anisotropic raytracer (see rayshooter Module).

Figure 38. eyeBeam Main Panel, Stack Mode

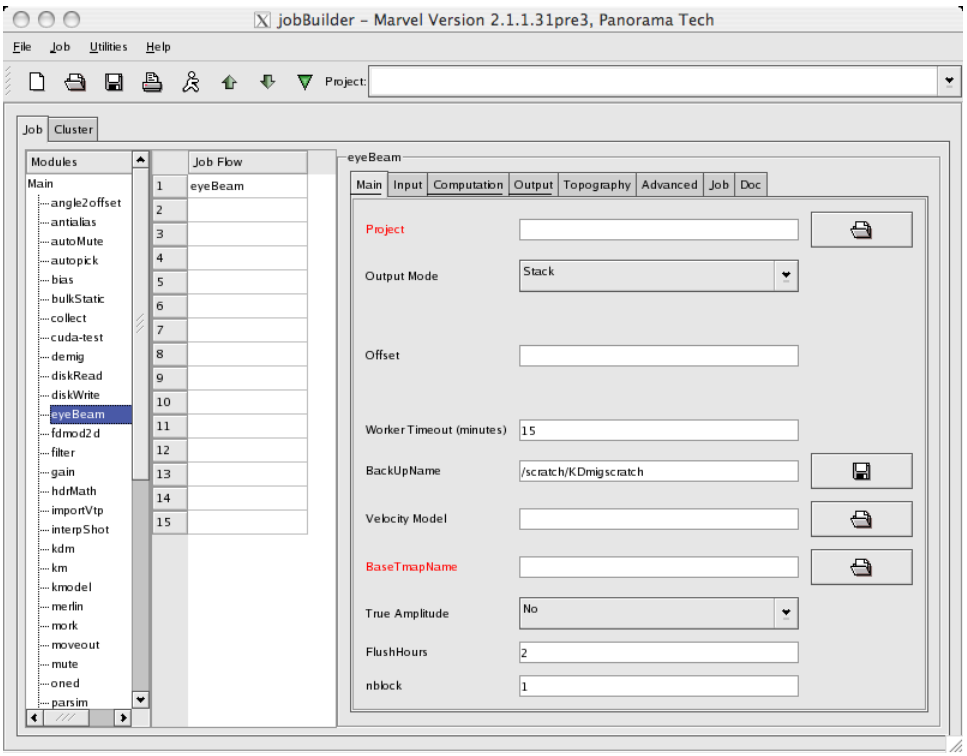

Figure 39. eyeBeam Main Panel, Offsets Mode

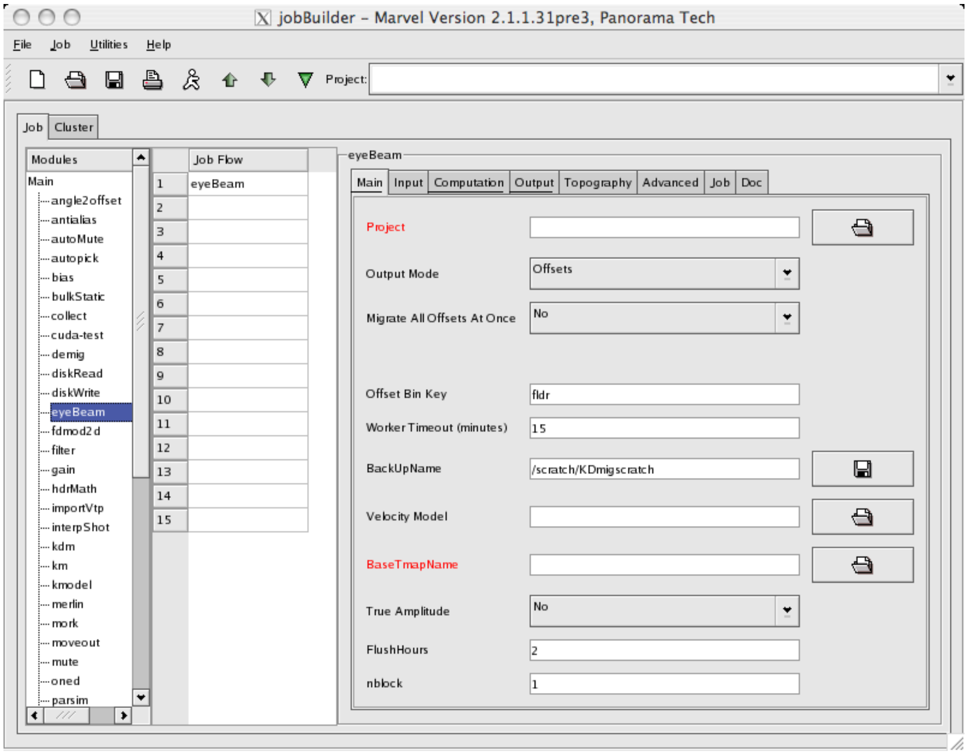

Table 29. eyeBeam Main Panel Fields

Field	Description
Mode: Stack	
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a REQUIRED entry.**
Output Mode	The mode to write the files: Stack or Offsets.
Offset	
Worker Timeout (minutes)	Worker components that have not responded in this amount of time are assumed to be dead. default: 15 minutes
BackupName	The name of the file to contain backup data if a restart becomes necessary. default: */scratch/KDmigscratch* **Note: This file is not deleted when a job finishes successfully. You must delete the file manually.**

continues on next page

Table 29. eyeBeam Main Panel Fields–continued

Field	Description
Velocity Model	The path and filename of the velocity model to be used in the calculations. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data. The velocity model serves two purposes. It provides the necessary velocity information for differential moveout of the traces in each super gather to the average offset of that ensemble. It also defines the near surface velocity for computation of take-off angles.
BaseTmapName	Base name of the required traveltime data. This name is the tmap file name without the `.tmap` extension. **Note: This is a REQUIRED entry.**
True Amplitude	When set to YES, eyeBeam will use the amplitudes computed during the generation of traveltimes by rayShooter. default: N
Flush Hours	The time, in hours, between backups. default: 2
nblock	The size of the trace block. **Note: This parameter should not be set when using eyeBeam.** default: 1
Mode: Offsets	
Output Mode	The mode to write the files: Stack or Offsets.
Migrate All Offsets At Once	If set to YES, traces are read in exactly the order they are stored. If set to NO, traces are read in common offset order. This should be set to NO for Beam Migrations. default: No
Offset Bin Key	The header key for the offset bin parameter. default: fldr

eyeBeam Input Panel

Figure 40. eyeBeam Input Panel

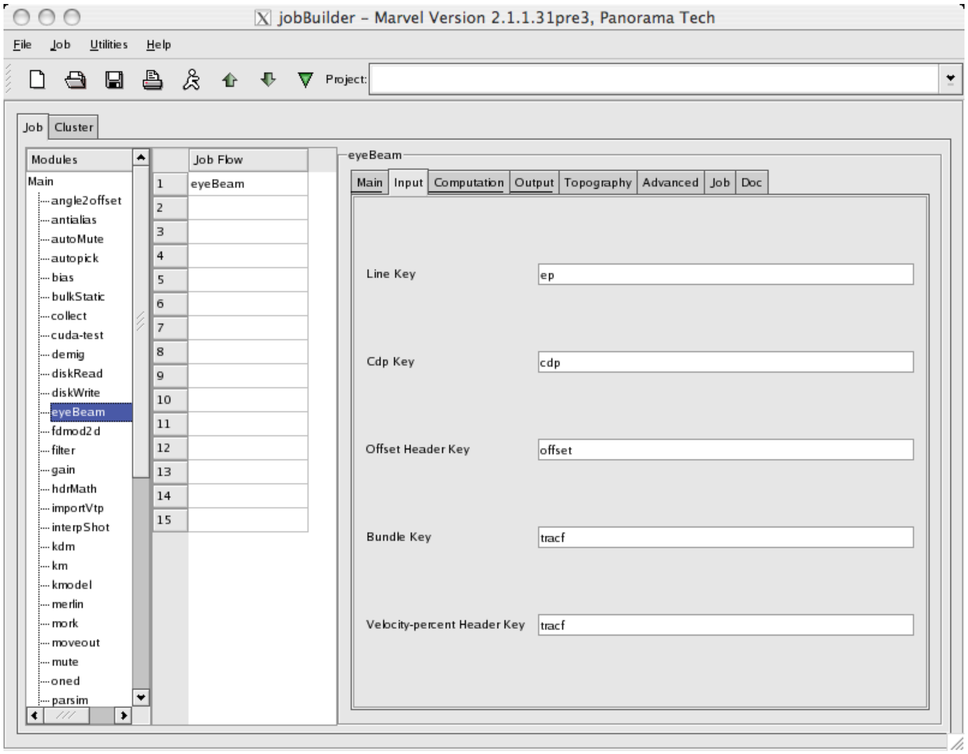

Table 30. eyeBeam Input Panel Fields

Field	Description
Line key	The header key specifying where line data is stored in the trace. default: ep
Cdp key	The header key specifying where CDP data is stored in the trace. default: cdp
Offset header key	Header key for the offset parameter. default: offset
Bundle key	default: tracf
Velocity-percent Header key	default: tracf

eyeBeam Computation Panel

Figure 41. eyeBeam Computation Panel, Max Stack Search Method

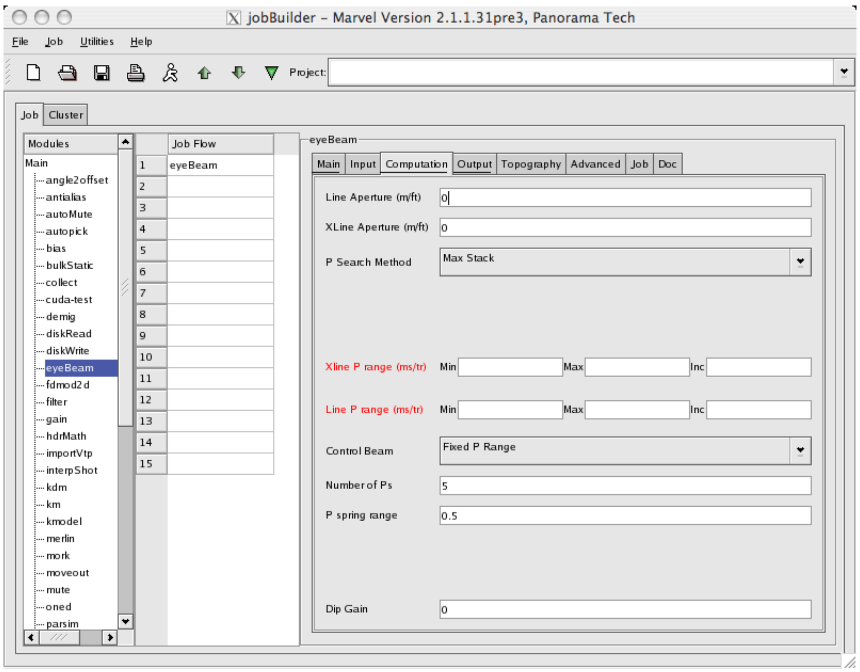

Figure 42. eyeBeam Computation Panel, Max Semblance Search Method

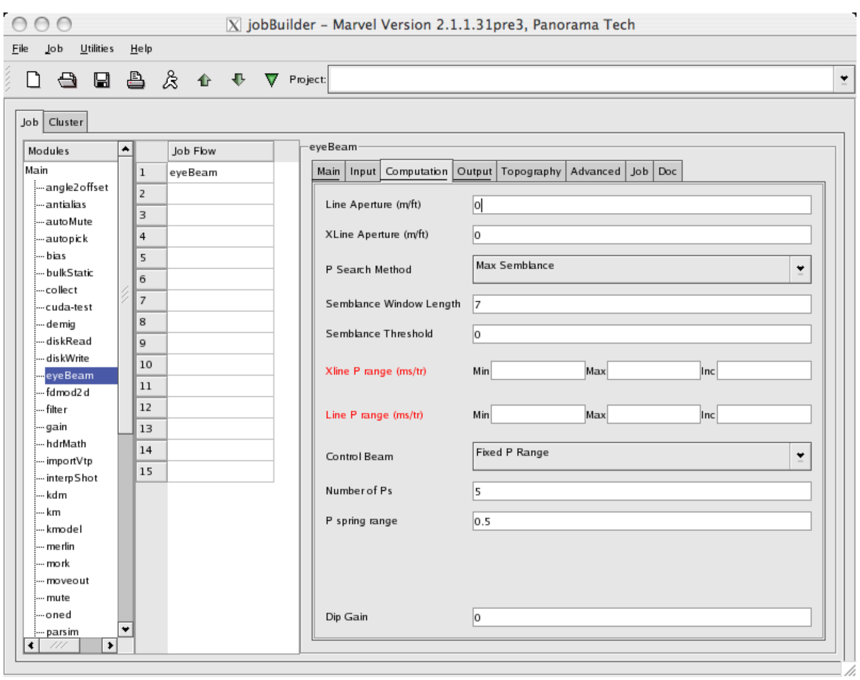

Figure 43. eyeBeam Computation Panel, Fixed P Range Control Beam

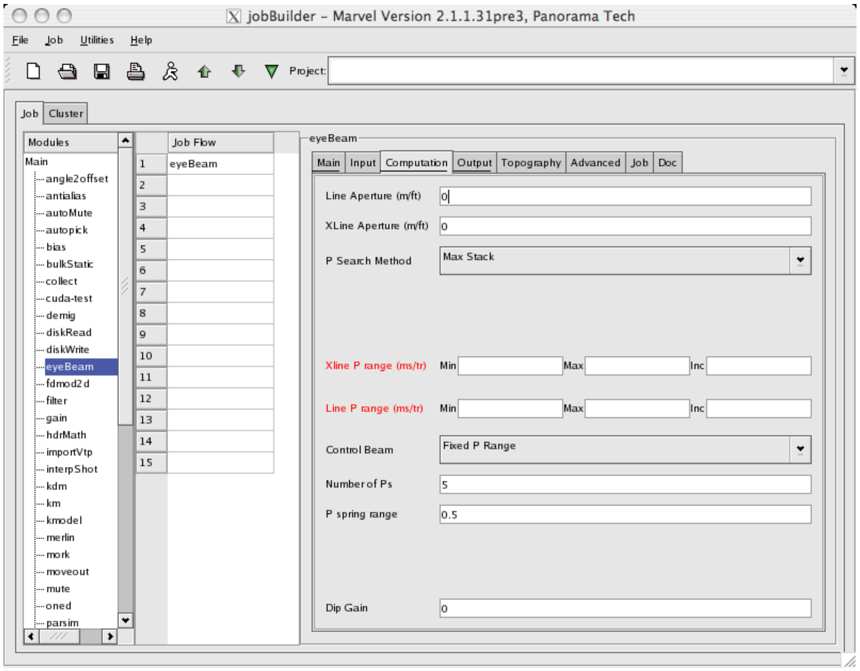

Figure 44. eyeBeam Computation Panel, Automatic Control Beam

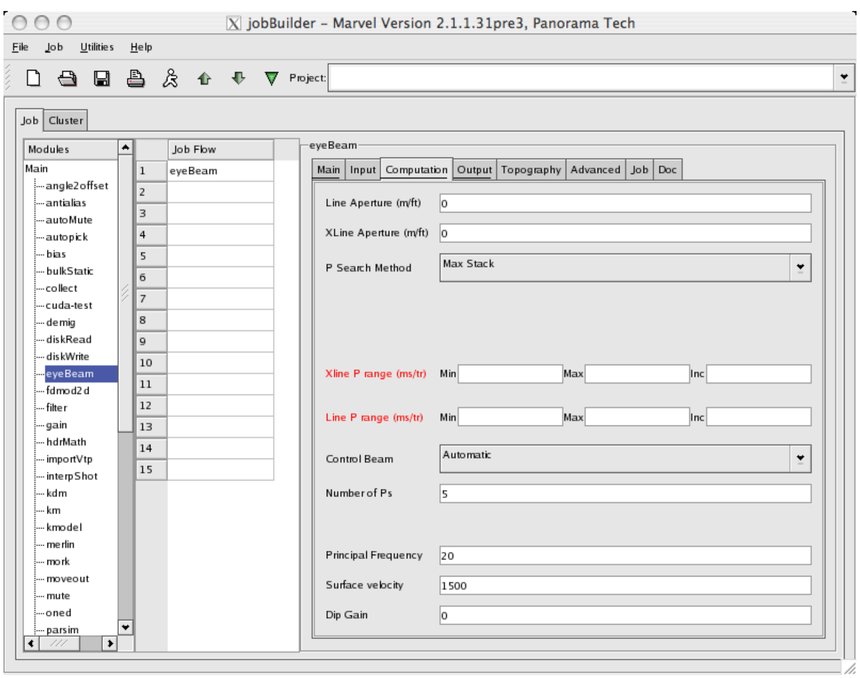

Figure 45. eyeBeam Computation Panel, No Control Beam

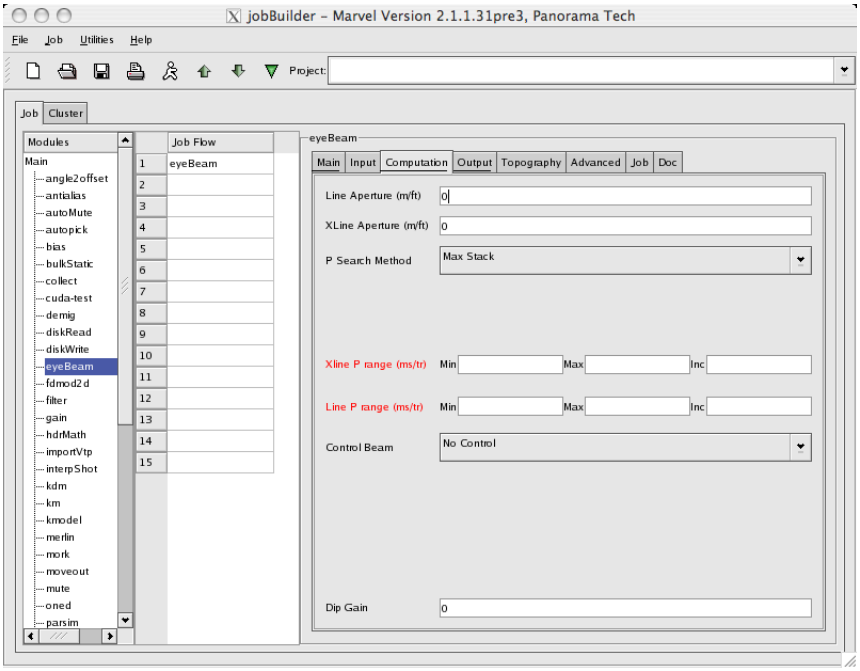

Table 31. eyeBeam Computation Panel Fields

Field	Description
Line Aperture (m/ft)	The length, in meters or feet, of the line direction aperture limit.
XLine Aperture (m/ft)	The length, in meters or feet, of the crossline direction aperture limit.
P Search Method	Max Stack or Max Semblance.
Semblance Window Length	The window length, in seconds, of the window to use in the semblance spectra. The window length should include a full wavelength. **This field is only displayed if P Search Method is set to Max Semblance.** default: 0
Semblance Threshold	**This field is only displayed if P Search Method is set to Max Semblance.** default: 7

continues on next page

Table 31. eyeBeam Computation Panel Fields–continued

Field	Description
XLine P range (ms/tr)	The max value and increment. The range is then defined from negative max to max. **This is a REQUIRED entry.**
Line P range (ms/tr)	The max value and increment. The range is then defined from negative max to max. **This is a REQUIRED entry.**
Control Beam	• No Control • Fixed P Range (default) • Automatic
Number of Ps	The actual number of p-values to migrate when Control Beam is Automatic. **This field is shown only for a Fixed P Range and Automatic Control Beam.** default: 5
P spring range	**This field is shown only for a Fixed P Range Control Beam.** default: 0.5
Principal Frequency	The Principal Frequency is used to define the Fresnel Zone. **This field is shown only for an Automatic Control Beam.** default: 20
Surface velocity	If no initial velocity volume is provided, this value defines the near surface velocity. The near surface velocity in Equation 2 on page 25. **This field is shown only for an Automatic Control Beam.** default: 1500
Curvature Correction	When set to 1, this flag causes the eyeBeam algorithm to correct for local curvature.
Dip Gain	When set, a linearly increasing scale factor will be applied to higher dips. The value can range from 0 through 100. default: 0, do not apply a gain

eyeBeam Output Panel

Figure 46. eyeBeam Output Panel

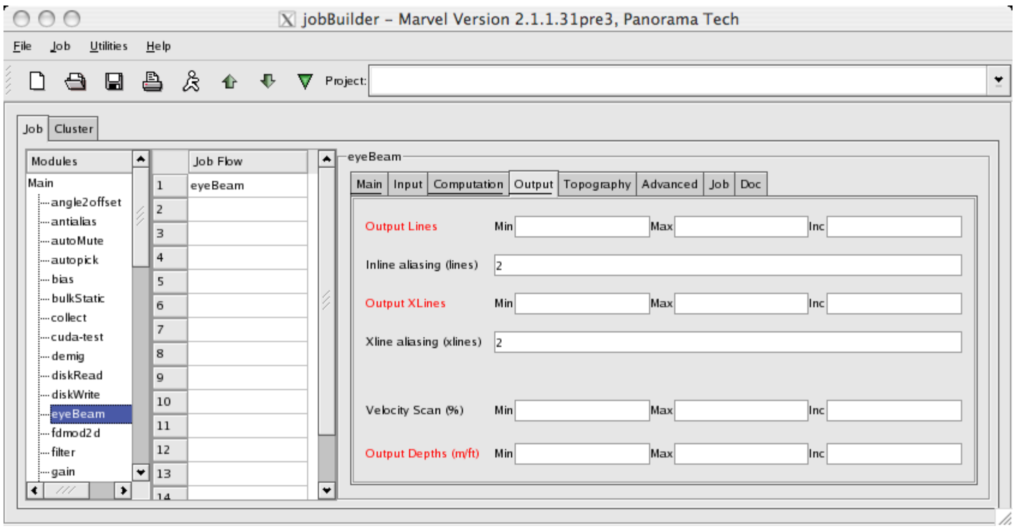

Table 32. eyeBeam Output Panel Fields

Field	Description
Output Lines	The number of lines to be contained in the output data. **This is a REQUIRED entry.**
Inline aliasing (lines)	Attempt to compensate for aliasing in the inline direction (units: lines). **Note: This can be a costly operation.** **default: 2**
Output XLines	The number of crosslines to be contained in the output data. **This is a REQUIRED entry.**
Xline aliasing (lines)	Defines the desired spacing length for antialiasing. The larger this value is, the more anti-aliasing is applied. (units: lines). **Note: This can be a costly operation.** **default: 2**
Velocity scan (%)	
Output Depths (m/ft)	**This is a REQUIRED entry.**

eyeBeam Topography Panel

The eyeBeam Topography Panel defines the surface topography for the project. There are two variables on the panel.

- *TopoSurfaceFile* is the path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values,, for example: ep=100 cdp=500 z=20.

- *TopoSurfaceName* is the header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

eyeBeam Advanced Panel

The eyeBeam Module Advanced panel, Figure 47, enables you to define several advanced usage parameters. The parameters are defined in Table 33.

Figure 47. eyeBeam Advanced Panel

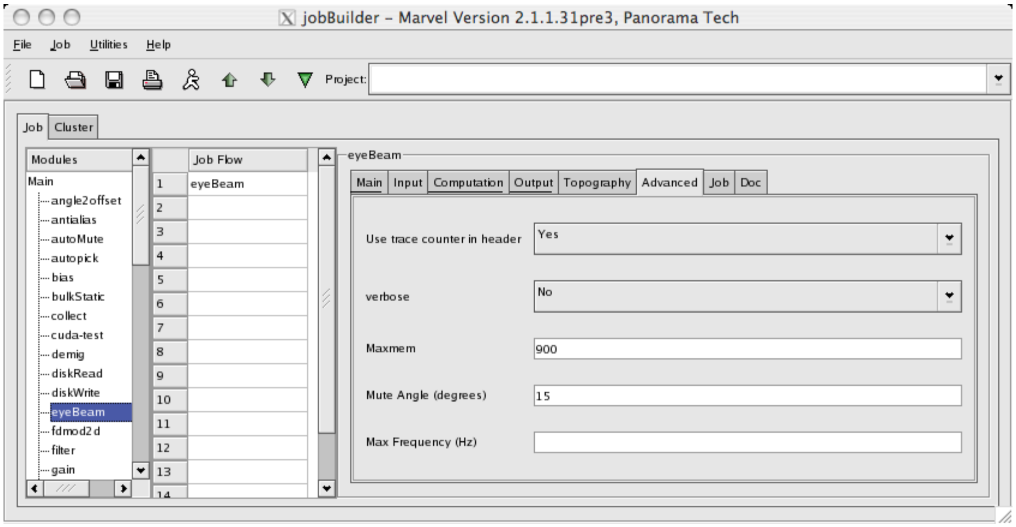

Table 33. eyeBeam Advanced Panel Fields

Field	Description
Use trace counter in header	Flag indicating whether or not the trace counter that diskRead puts in the trace header will be used. default: Yes
verbose	Switch for turning debug printing on and off. default: No
Maxmem	Maximum amount of memory to be used by MARVEL per kdm instance. default: 900
Mute Angle	The angle, in degrees, measured down from the surface defining a cone limiting the near surface aperture. default: 15
Max Frequency	The maximum frequency allowed by the filtering process. Default: 0, do not filter

eyeBeam Job Panel

This panel, Figure 48, enables you to define the basic parameters for the module. Table 34 describes the terms used on both panels.

Figure 48. eyeBeam Job Panel

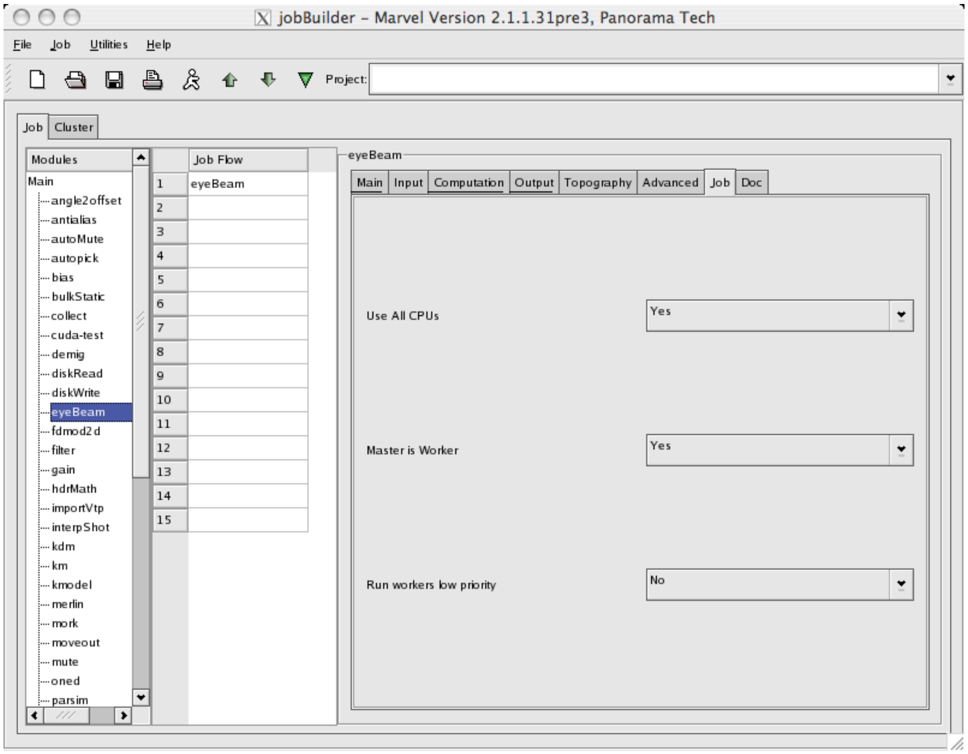

Table 34. eyeBeam Job Panel Fields

Field	Description
Use All CPUs	This really means that each worker should use multiple threads. If No, then there will be one independent worker spawned for each CPU (or core) in the cluster. default: Yes
Master is Worker	Flag that controls whether the master I/O controller is also used for performing calculations. default: Yes
Run workers low priority	If Yes, workers will be spawned with reduced priority, although the master process will remain at high priority. This can be useful, especially when *MasterIsWorker* is set, so that one worker does not slow down collection or submission of shots for all of the others. default: No

fdmod2d Module

Figure 49. fdmod2d Main Panel

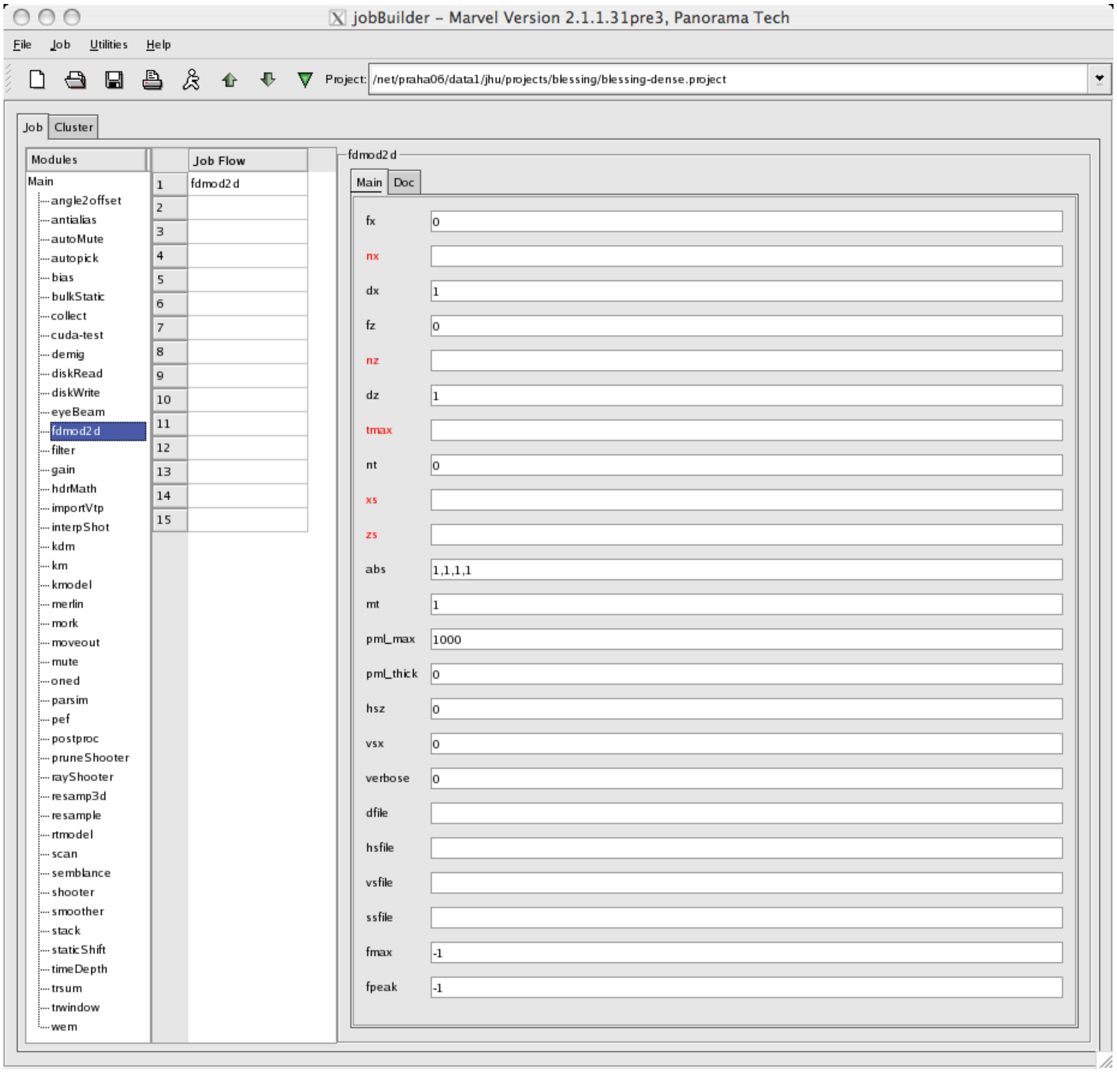

Table 35. fdmod2d Panel Fields

Field	Description
fx	default: 0
nx	**This is a REQUIRED entry.**

continues on next page

Table 35. fdmod2d Panel Fields–continued

Field	Description
dx	default: 1
fz	default: 0
nz	**This is a REQUIRED entry.**
dz	default: 1
tmax	**This is a REQUIRED entry.**
ny	default: 0
xs	**This is a REQUIRED entry.**
zs	**This is a REQUIRED entry.**
abs	default: 1,1,1,1
mt	default: 1
pml_max	default: 1000
pml_thick	default: 0
hsz	default: 0
vsx	default: 0
verbose	Switch for turning debug printing on and off. default: 0
dfile	

continues on next page

Table 35. fdmod2d Panel Fields–continued

Field	Description
hsfile	
vsfile	
ssfile	
fmax	default: -1
fpeak	default: -1

filter Module

The filter module applies a (f,k) domain pie-shaped filter to an input ensemble or gather of traces. This gather can be a line, CDP, or shot record, but you are responsible for selecting the appropriate data, and for building the job stream to supply it to the filter module.

Figure 50. filter Panel

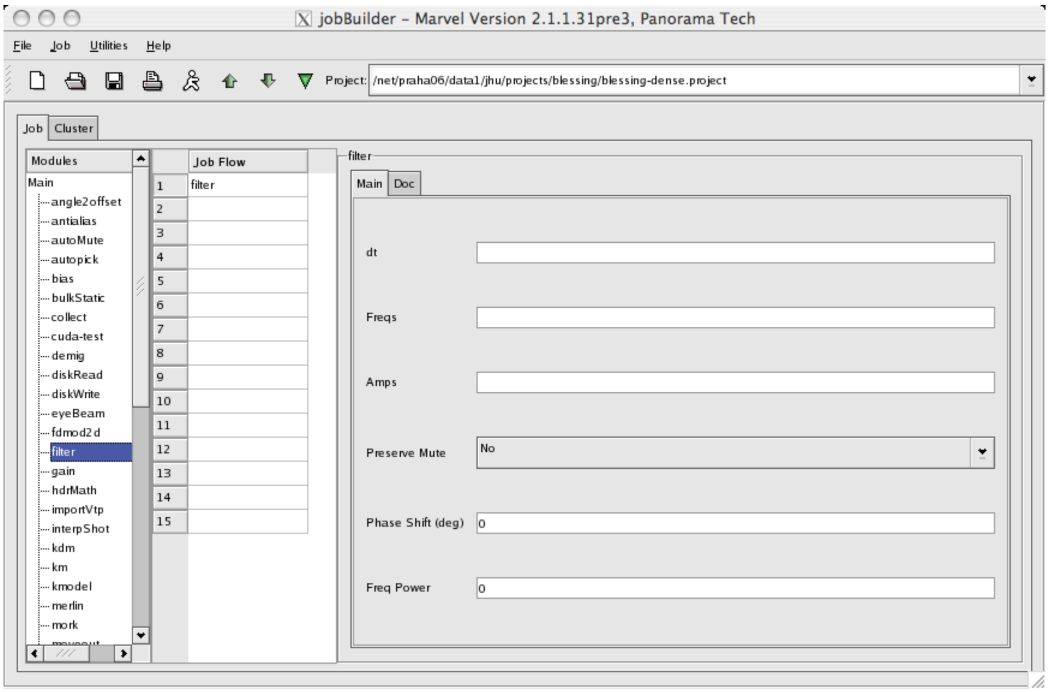

Table 36. filter Panel Fields

Field	Description
dt	
Freqs	Specifies the filter frequencies.
Amps	Specifies the filter amplitudes.
Preserve Mute	If enabled, autodetect the upper mute zone and reapply the mute after the filter has been run.
Phase Shift (deg)	default: 0
Freq Power	default: 0

gain Module

The gain module scales each input trace by either a fixed power of time or a time-variant automatic gain control, or both. There are six panels used with the gain module, shown in Figure 51 through Figure 56, and the fields are described in Table 37.

Figure 51. gain Powers Panel

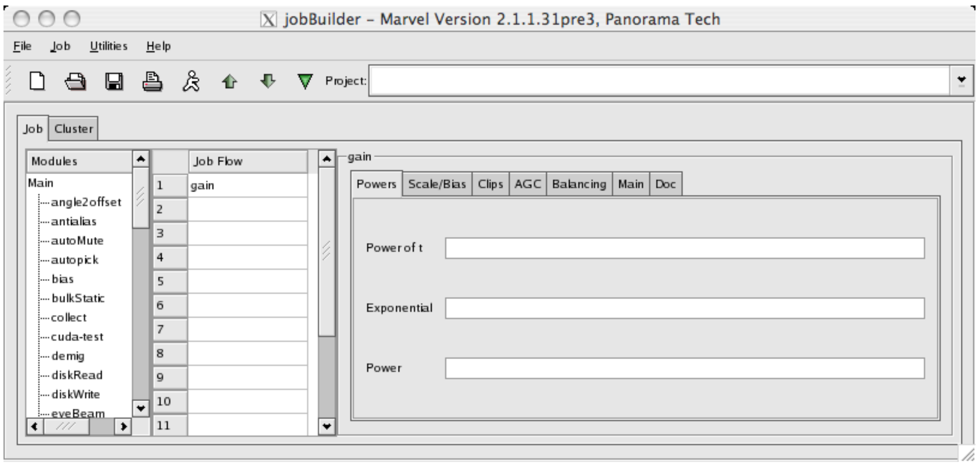

Figure 52. gain Scale/Bias Panel

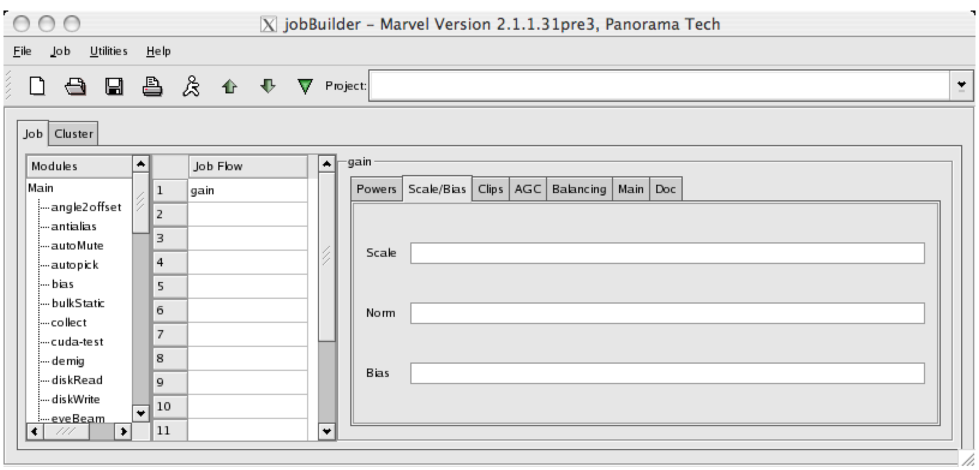

Figure 53. gain Clips Panel

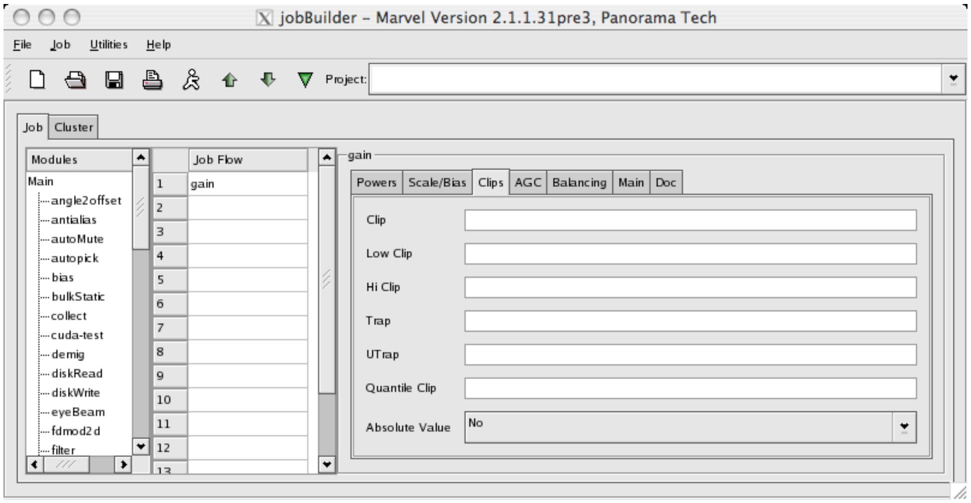

Figure 54. gain AGC Panel

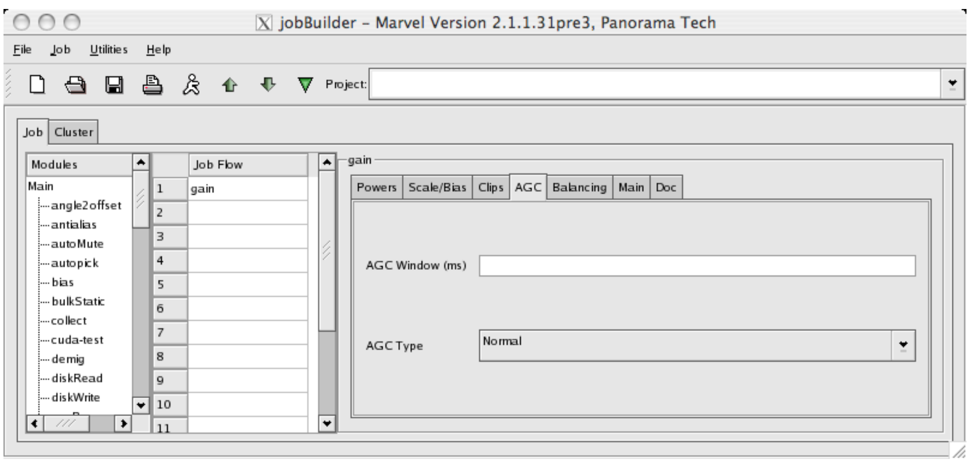

Figure 55. gain Balancing Panel

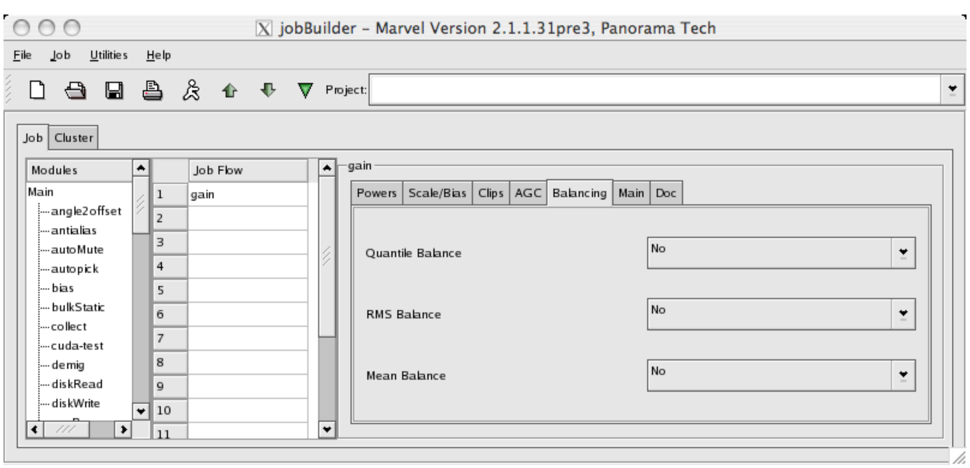

Figure 56. gain Main Panel

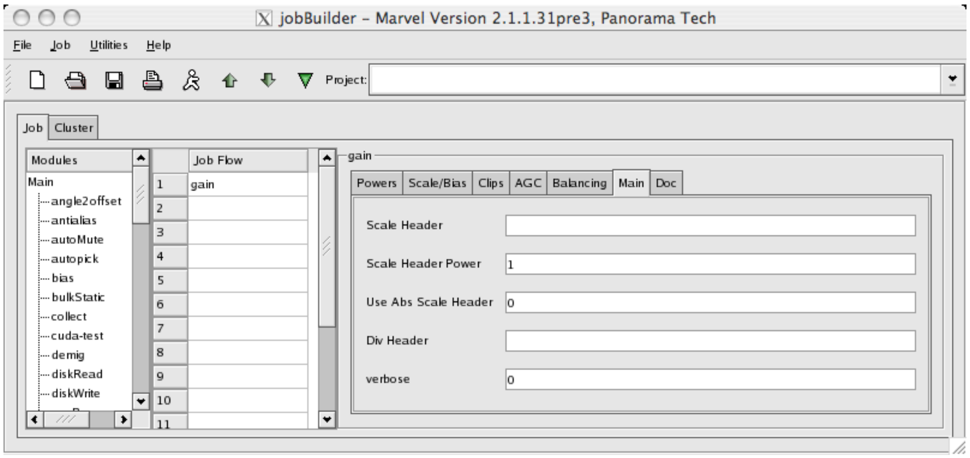

Table 37. gain Panel Fields

Panel	Field	Description
Powers	Power of t	Value used to apply *Tpow* to each input trace. See Gathers Settings Window.
	Exponential	
	Power	
Scale&Bias	Scale	
	Norm	
	Bias	
Clips	Clip	
	Low Clip	
	Hi Clip	
	Trap	
	UTrap	
	Quantile Clip	
	Absolute Value	default: No

continues on next page

Table 37. gain Panel Fields–continued

Panel	Field	Description
AGC	AGC Window	The automatic gain control window is the length of the time gate used to calculate the time-varying gain function, in ms. default: 0
	AGC Type	Specifies the type of taper to be applied to the input trace. The taper may be either Normal or Gaussian Taper. default: Normal
Balancing	Quantile Balance	
	RMS Balance	
	Mean Balance	
Main	Scale Header	
	Scale Header Power	This is a fixed constant to be applied to each trace. default: 1
	Use Abs Scale Header	default: 0
	Div Header	
	verbose	Switch for turning debug printing on and off.

hdrMath Module

The hdrMath module changes header words through a simple formula shown in Equation 5, where *ihw* in the value extracted from the input header word.

Equation 5:

$$value = \frac{(shift + scale * ihw)}{div}$$

The hdrMath panel is shown in Figure 57, and the fields are defined in Table 38.

Figure 57. hdrMath Panel

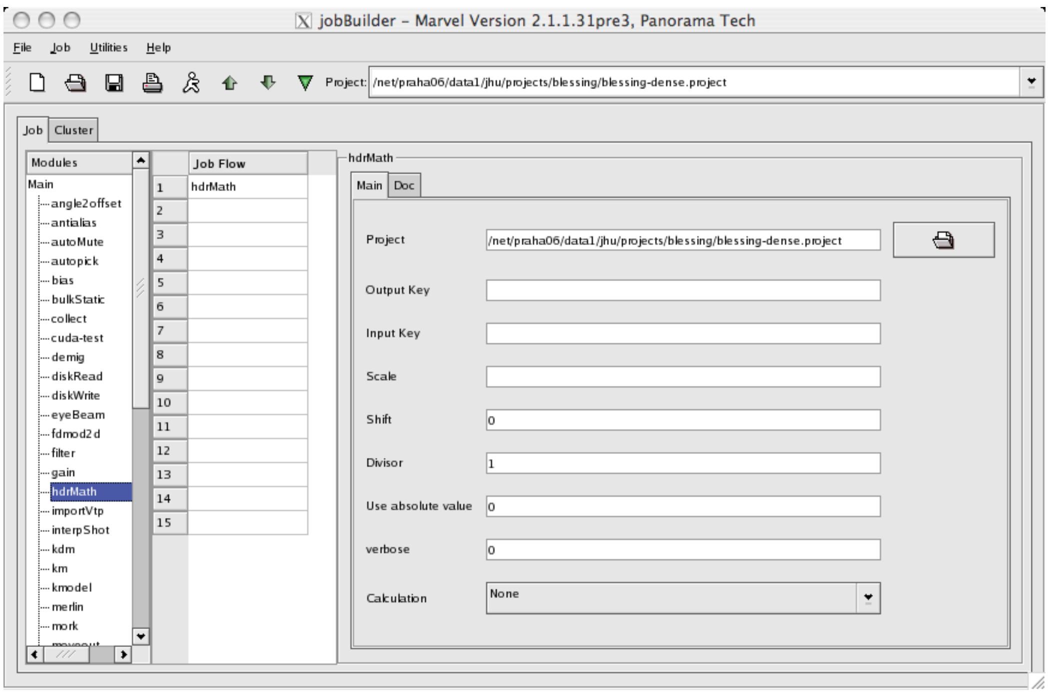

Table 38. hdrMath Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Output Key	Output header key defines the output header location to change.
Input Key	Input header key defines the input header key to use in the calculation.
Scale	A list of floating point numbers used to scale the input header value.

continues on next page

Table 38. hdrMath Panel Fields–continued

Field	Description
Shift	A list of floating point numbers used to shift the input header value. default: 0
Divisor	A list of divisors used to divide each calculated header number. default: 1
Use absolute value	default: 0
verbose	Switch for turning debug printing on and off. default: 0
Calculation	• None • World Coordinates from CDP • World Coordinates from CDP and Offset • CDP from World Coordinates • Offset from World Coordinates • Shift World Coordinates with Offset default: None

importVtp Module

The importVtp module imports VIEWS VTP and FOCUS HANDVEL time-velocity pairs from an input file and converts them to the internal data format used by Panorama Technologies. The output file name is just the input file name with `.pick` appended. The importVtp panel is shown in Figure 58 and the fields are defined in Table 39.

Figure 58. importVtp Panel

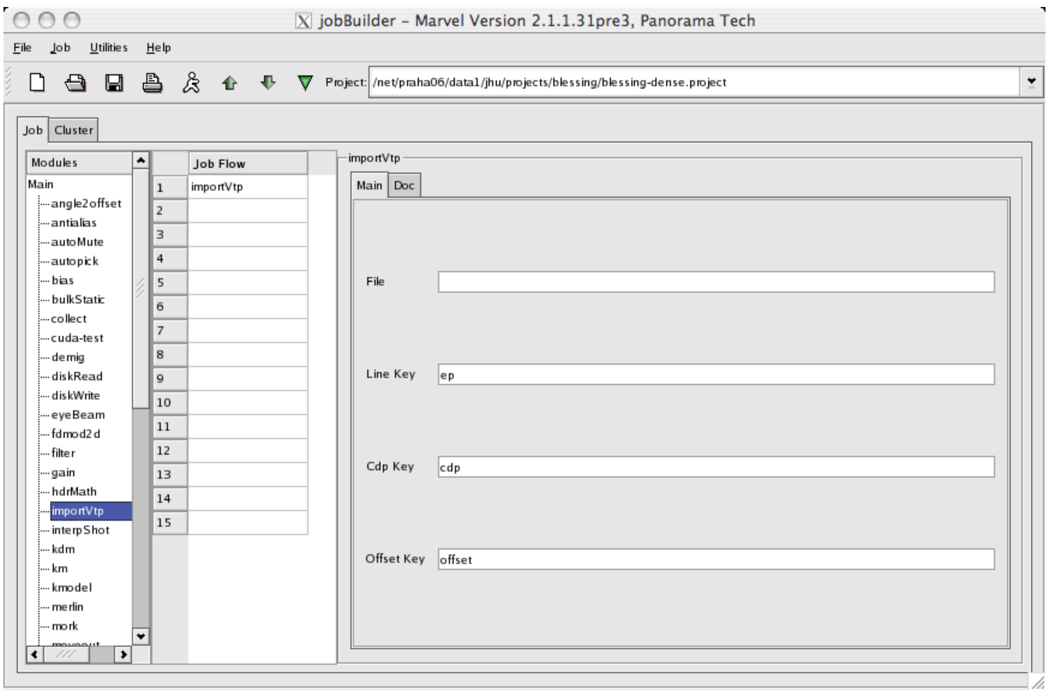

Table 39. importVTP Panel Fields

Field	Description
File	The name of the input file to be imported.
Line Key	The key word used for LINE in the MARVEL format. default: ep
Cdp Key	The key word to be used for CDP in the MARVEL format. default: cdp
Offset Key	The key word to be used for OFFSET in the MARVEL format. default: offset

interpShot Module

The two interpShot panels are shown in Figure 59 and Figure 60. The fields are defined in Table 40 and Table 41.

interpShot Main Panel

Figure 59. interpShot Main Panel

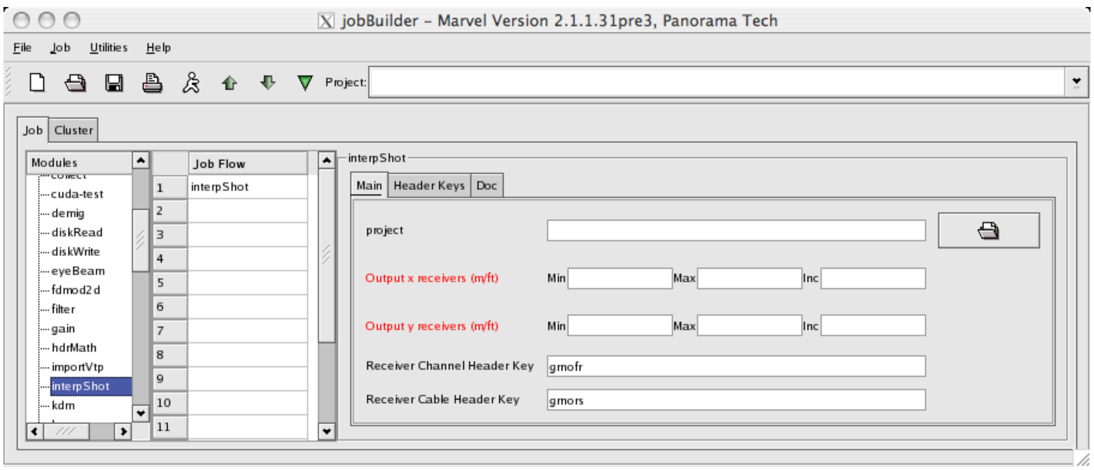

Table 40. interpShot Module Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Output x receivers (m/ft)	**Note: This is a REQUIRED entry.**
Output y receivers (m/ft)	**Note: This is a REQUIRED entry.**
Receiver Channel Header Key	default: gmofr
Receiver Cable Header Key	default: gmors

interpShot Header Keys Panel

Figure 60. interpShot Header Keys Panel

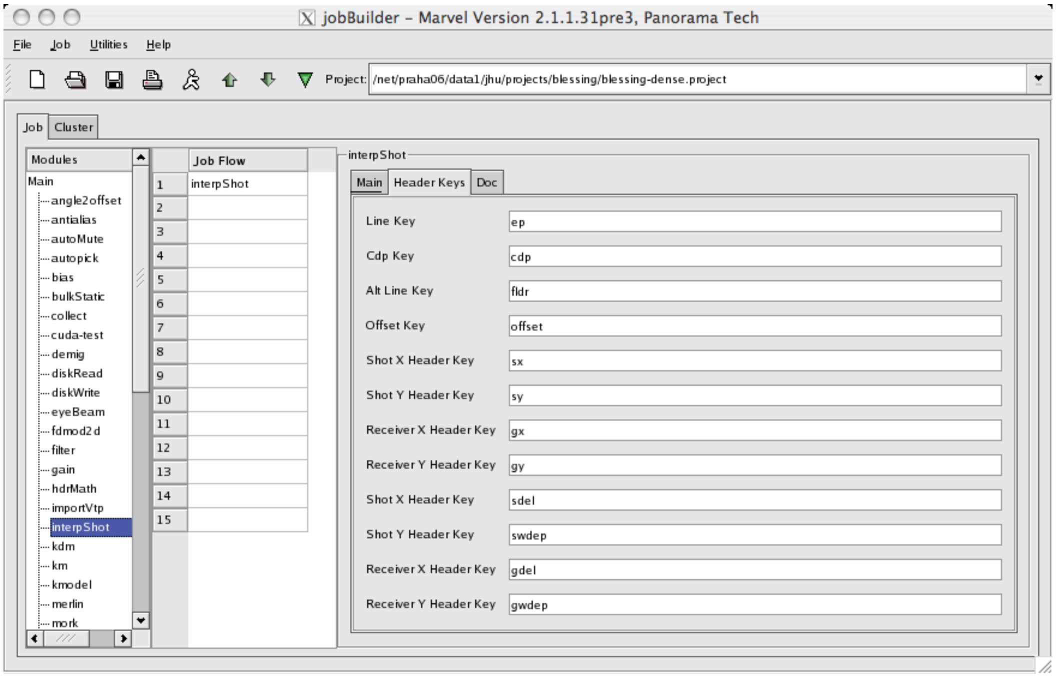

Table 41. interpShot Header Keys Panel Fields

Field	Description
Line Key	The header key specifying where line data is stored in the trace. default: ep
Cdp Key	The header key specifying where CDP data is stored in the trace. default: cdp
Alt Line Key	default: fldr
Offset Key	Header key defining the location of the offset in the trace. default: offset
Shot X Header Key	The header key specifying where line source data is stored in the trace. default: sx
Shot Y Header Key	The header key specifying where crossline source data is stored in the trace. default: sy

continues on next page

Table 41. interpShot Header Keys Panel Fields–continued

Field	Description
Receiver X Header Key	The header key specifying where inline geophone data is stored in the trace. default: gx
Receiver Y Header Key	The header key specifying where crossline geophone data is stored in the trace. default: gy
Shot X Header Key	default: sdel
Shot Y Header Key	default: swdep
Receiver X Header Key	default: gdel
Receiver Y Header Key	default: gwdep

kdm Module

The kdm module is Panorama Technologies' version of Kirchhoff depth migration. This is a full-featured, fault-tolerant, restartable depth migration algorithm which can use parallel processing over both input and output. The major difference between the km and kdm modules is that km calculates the traveltime information it needs internally, while kdm requires that the traveltimes come from the data.

A typical migration job has the following job flow: diskRead ⇒ kdm ⇒ collect

For faster restarts, the Mode option in the diskRead module should be set to Shot Migration (see diskRead Module).

Note:

You should be sure the Restart File parameter is in sync with the kdm module. If you edit the parameter in kdm, the parameter in diskRead will be updated.

The collect module is designed to stack output from migrations. By default, it does this first-come, first-served, and the output files will be unsorted. Choose the Preallocate Volume option in the collect module to avoid this behavior (see collect Module). As with the Restart File option in the diskRead module, make sure the output parameters to collect are in sync with those in kdm.

See also, km Module.

kdm Main Panel

There are two forms of the kdm Main panel depending on the Output Mode you select: Stack (Figure 61), or Offsets (Figure 62). The fields are described in Table 42.

Figure 61. kdm Main Panel, Stack Output

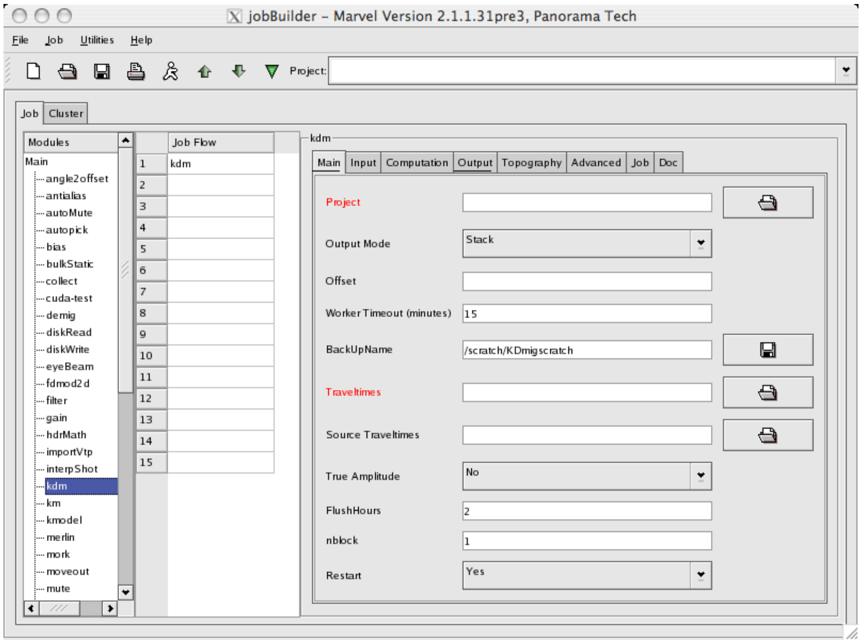

Figure 62. kdm Main Panel, Offsets Output

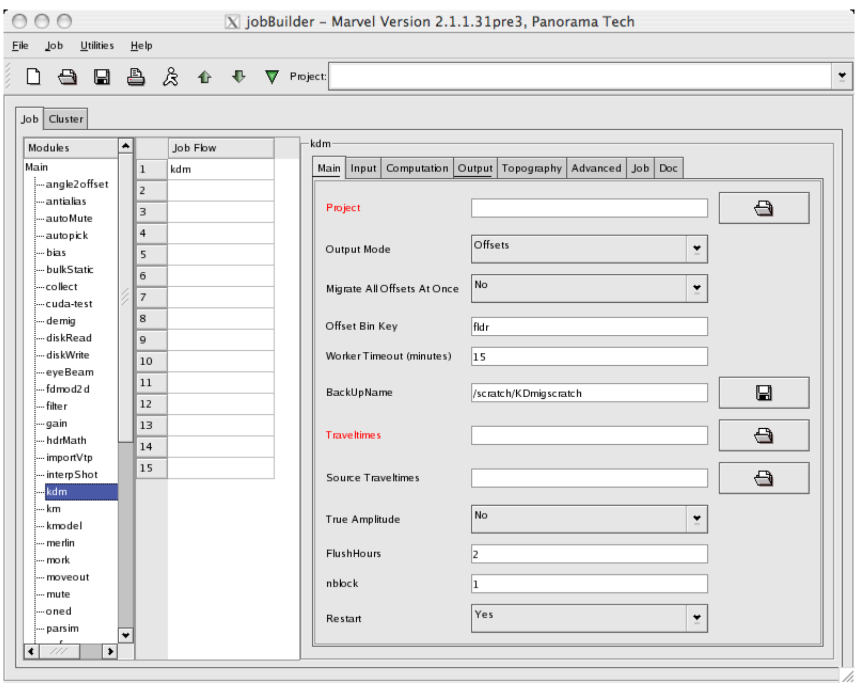

Table 42. kdm Panel Fields

Field	Description
Stacks Output Mode	
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **Note: This is a REQUIRED entry.**
Output Mode	The kind of output: Offset gathers or Stack. default: Stack
Offset	Defines the bin of the run to be used for the output header.
BackUpName	The name of the file to contain backup data if a restart becomes necessary. default: */scratch/KDmigscratch* **Note: This file is not deleted when a job finishes successfully. You must delete the file manually.**
BaseTmapName	Base name of the required traveltime data. This name is the tmap file name without the `.tmap` extension. **Note: This is a REQUIRED entry.**
FlushHours	The time, in hours, between backups. default: 2
nblock	The size of the trace block. default: 1
Master is Worker	Flag that controls whether the master I/O controller is also used for migrating data. default: Yes
Offsets Output Mode	
Offset Bin Key	The header key for the offset bin parameter. default: fldr

kdm Input Panel

The kdm Module Input Panel, Figure 63 defines the header keys that provide surface information to the module. The fields are described in Table 43.

Figure 63. kdm Input Panel

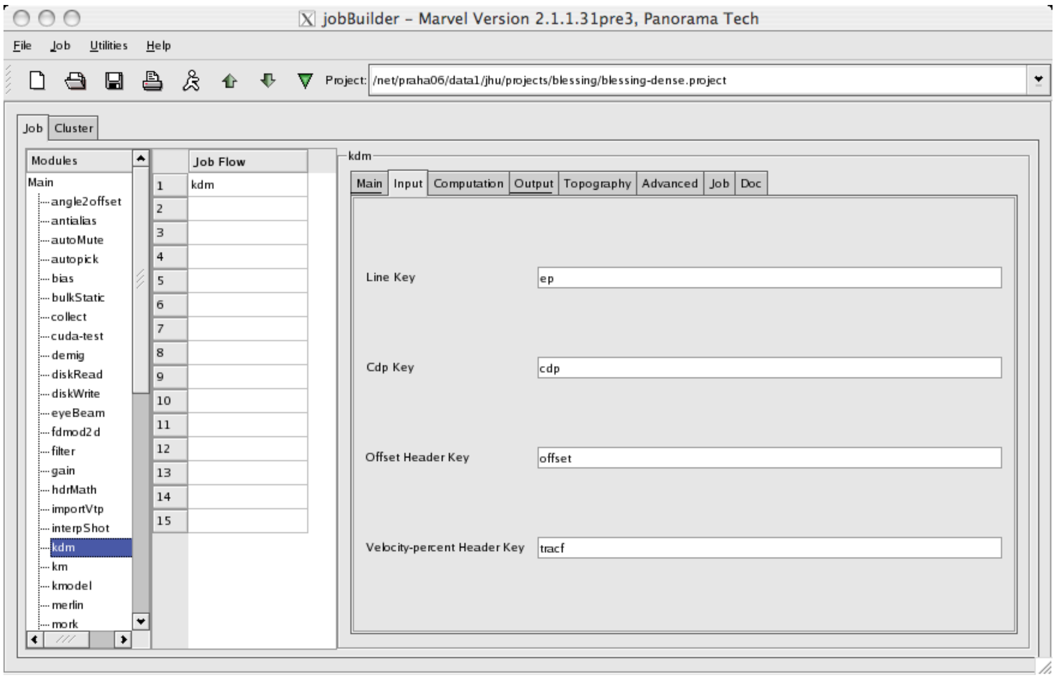

Table 43. kdm Input Panel Fields

Field	Description
Line Key	Header key for line designators. default: ep
Cdp Key	Header key for CDP designators. default: cdp
Offset Header Key	Header key for the offset parameter. default: offset
Velocity-percent Header Key	default: tracf

kdm Computation Panel

The kdm Computation Panel defines the x (line) and y (crossline) aperture limits.

The *LineAperture* is the length, in meters or feet, of the line direction aperture limit. The default is 0.

The *XLineAperture* is the length, in meters or feet, of the crossline (CDP) direction aperture limit. The default is 0.

kdm Output Panel

The kdm Output panel, Figure 64, defines the aliasing and output line and crossline dimensions. The fields are described in Table 44.

Figure 64. kdm Output Panel

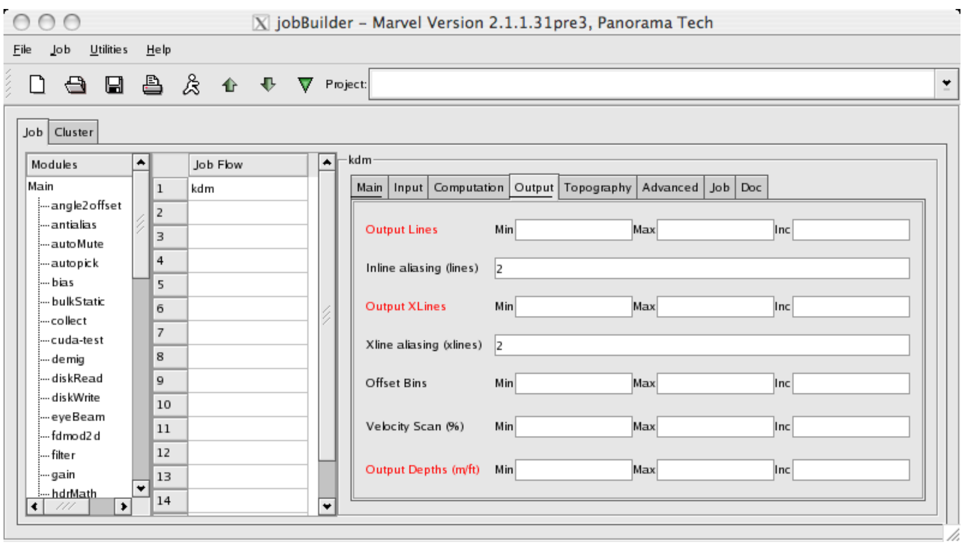

Table 44. kdm Output Panel Fields

Field	Description
Output Lines	The minimum, maximum, and increment values for output lines. **This is a REQUIRED field.**
Inline aliasing	The inline anti-aliasing distance, in units of lines. **Note: This can be a costly operation.** **default: 2**

continues on next page

Table 44. kdm Output Panel Fields–continued

Field	Description
Output XLines	The minimum, maximum, and increment values for output crosslines. **This is a REQUIRED field.**
Xline aliasing	The crossline anti-aliasing distance, in units of lines. **Note: This can be a costly operation.** **default: 2**
Velocity scan (%)	
Output Depths	The minimum, maximum, and increment values for output depths. **This is a REQUIRED field.**

kdm Topography Panel

The kdm Topography Panel defines the surface topography for the project. There are two variables on the panel.

Figure 65. kdm Topography Panel

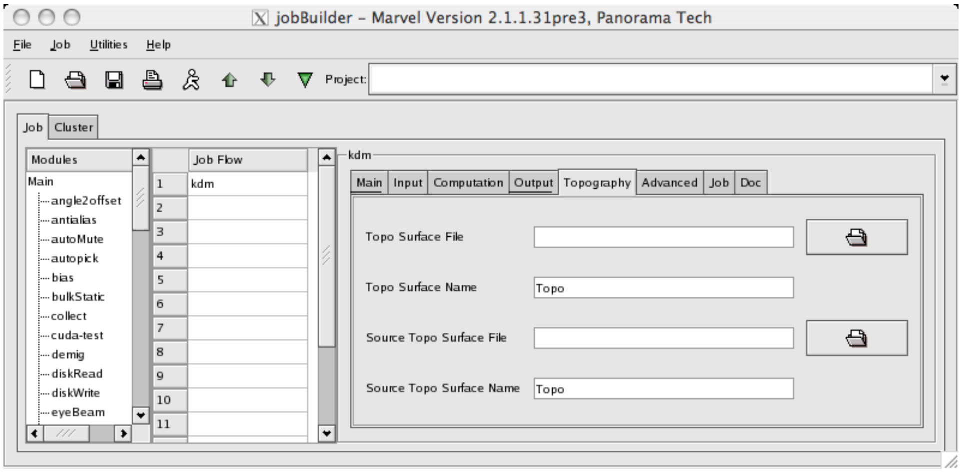

Table 45. kdm Topography Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values,, for example: ep=100 cdp=500 z=20.
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo
Source Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values,, for example: ep=100 cdp=500 z=20.
Source Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

kdm Advanced Panel

The kdm Advanced panel, Figure 66, enables you to define several advanced usage parameters. The parameters are defined in Table 46.

Figure 66. kdm Advanced Panel

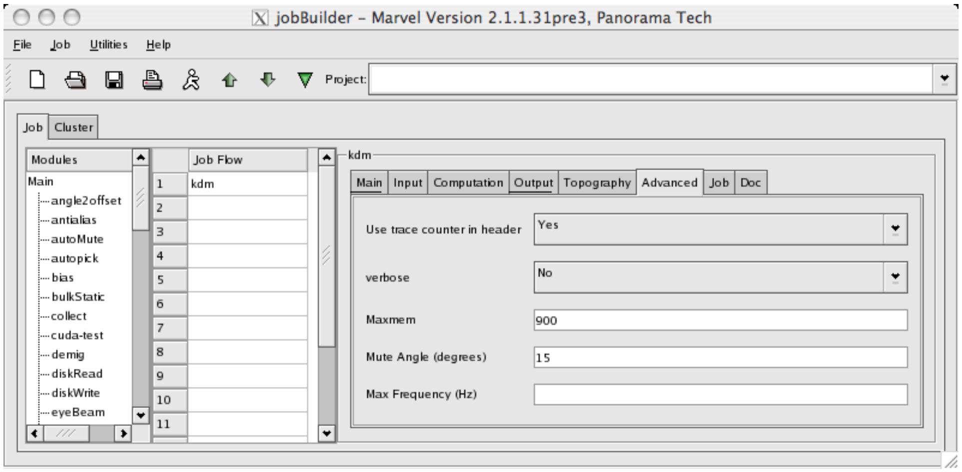

Table 46. kdm Advanced Panel Fields

Field	Description
Use trace counter in header	Flag indicating whether or not the trace counter that diskRead puts in the trace header will be used. default: Yes
verbose	Switch for turning debug printing on and off. default: No
Maxmem	Maximum amount of memory to be used by MARVEL per kdm instance. default: 900
Mute Angle	The angle, in degrees, measured down from the surface defining a cone limiting the near surface aperture. default: 15
Max Frequency	The maximum frequency allowed by the filtering process. Default: 0, do not filter

kmodel Module

Figure 67. kmodel Main Panel

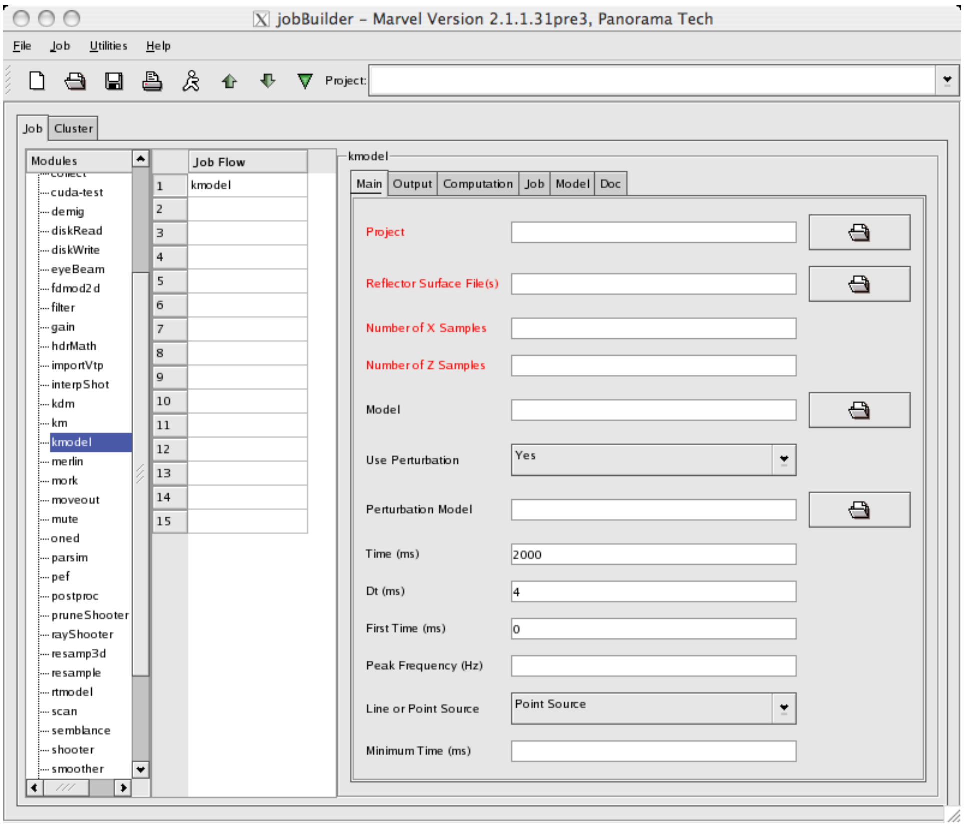

Table 47. kmodel Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a REQUIRED entry.**
Reflector Surface File(s)	**This is a REQUIRED entry.**
Number of X Samples	**This is a REQUIRED entry.**
Number of Z Samples	**This is a REQUIRED entry.**

continues on next page

Table 47. kmodel Main Panel Fields–continued

Field	Description
Model	
Use Perturbation	
Perturbation Model	
Time (ms)	(default: 2000)
Dt (ms)	(default: 4)
First Time (ms)	(default: 0)
Peak Frequency (Hz)	
Line or Point Source	
Minimum Time	default: offset

kmodel Output Panel

Figure 68. kmodel Output Panel

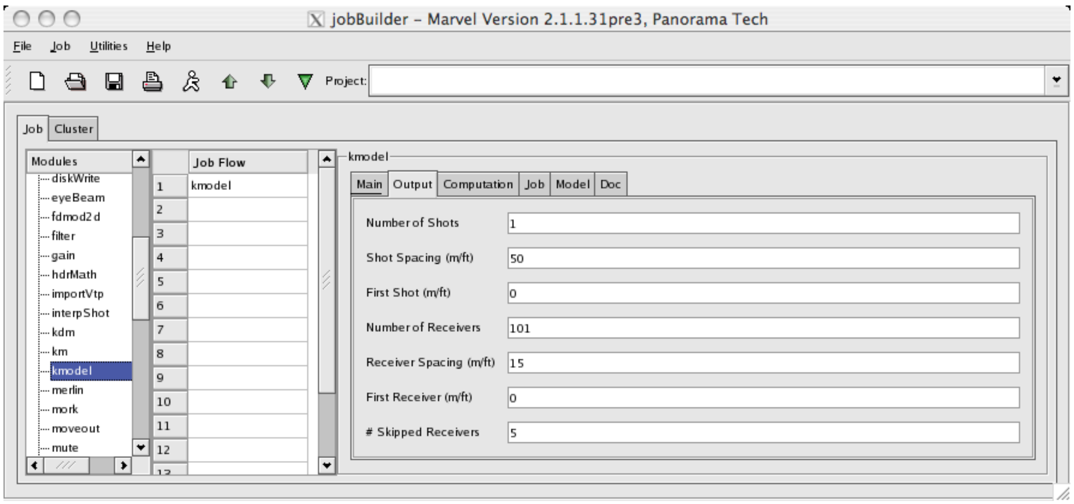

Table 48. kmodel Output Panel Fields

Field	Description
Number of Shots	
Shot Spacing (m/ft)	
First Shot (m/ft)	
Number of Receivers	
Receiver Spacing (m/ft)	
First Receiver (m/ft)	
# Skipped Receivers	

kmodel Computation Panel

Figure 69. kmodel Computation Panel

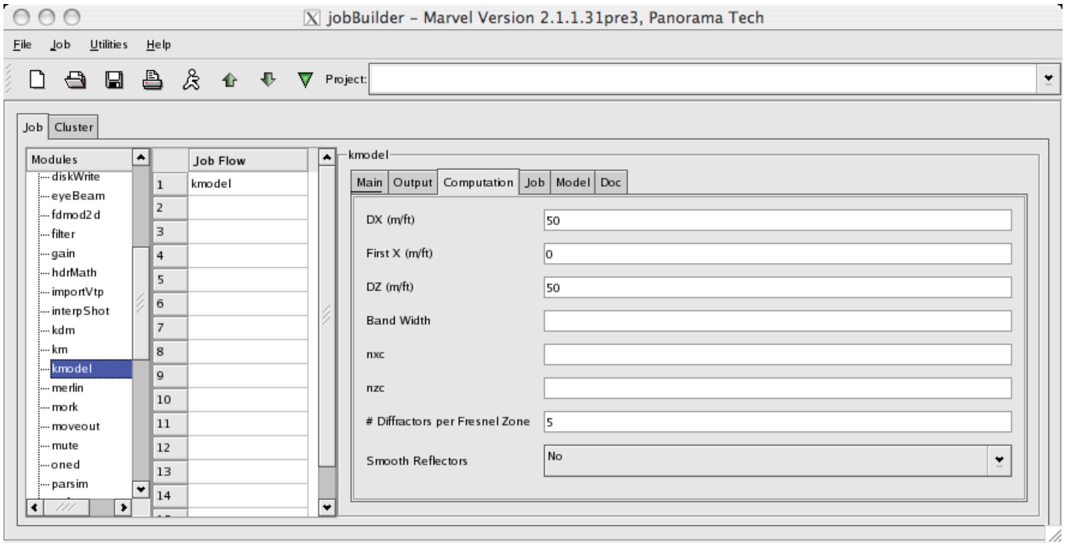

Table 49. kmodel Computation Panel Fields

Field	Description
DX (m/ft)	
First X (m/ft)	
DZ (m/ft)	
Band Width	
nxc	
nzc	
# Diffractors per Fresnel Zone	
Smooth Reflectors	

kmodel Job Panel

kmodel Model Panel

km Module

The km module is Panorama Technologies' version of Kirchhoff curved-ray time migration. This is a full featured, fault tolerant, restartable depth migration algorithm which can use parallel processing over both input and output. The parallelization scheme is identical to that used in the kdm module. The major difference between the km and kdm modules is that the km module calculates the traveltime information it needs internally, while the kdm module requires that the traveltime information be present in the data.

A typical migration job has the following job flow: diskRead ⇒ km ⇒ collect

For faster restarts, the Mode option in the diskRead module should be set to Shot Migration (see diskRead Module).

Note:

> You should be sure the Restart File parameter is in sync with the km module. If you edit the one in km, the one in diskRead will be updated.

The collect module is designed to stack output from migrations. By default, it does this on a first-come, first-served basis and the output files will be unsorted. Choose the Preallocate Volume option in the collect module to avoid this behavior (see collect Module). As with the Restart File option in the diskRead module, make sure the output parameters that you want to collect are in sync with those in the km module.

km Main Panel

This km Module main panel enables you to define the basic parameters for the module. There are two different versions of the panel depending on the output mode you use: Stack (Figure 70) or Offsets (Figure 71). Table 50 defines the terms used on both panels.

Figure 70. km Main Panel—Stack Output Mode

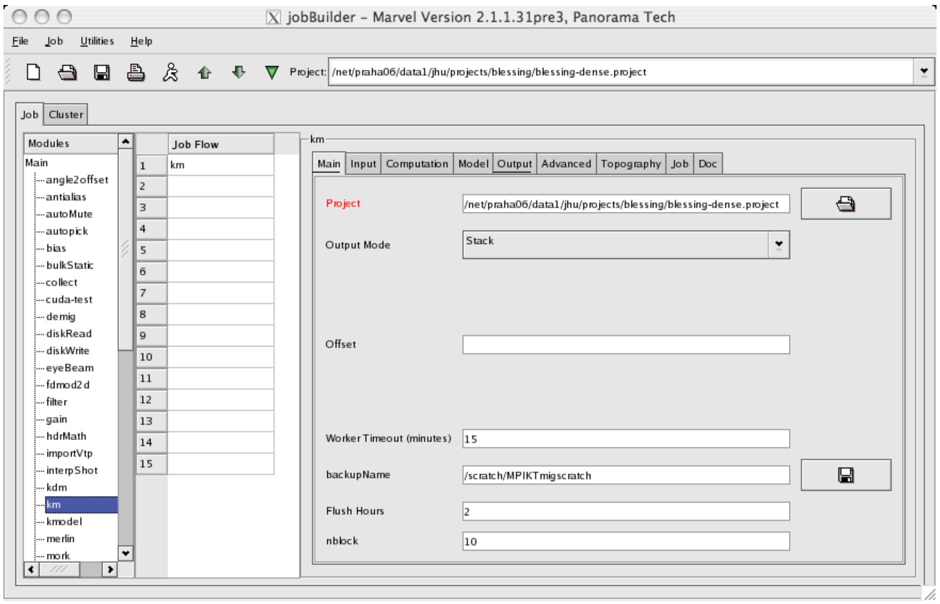

Figure 71. km Main Panel–Offsets Output Mode

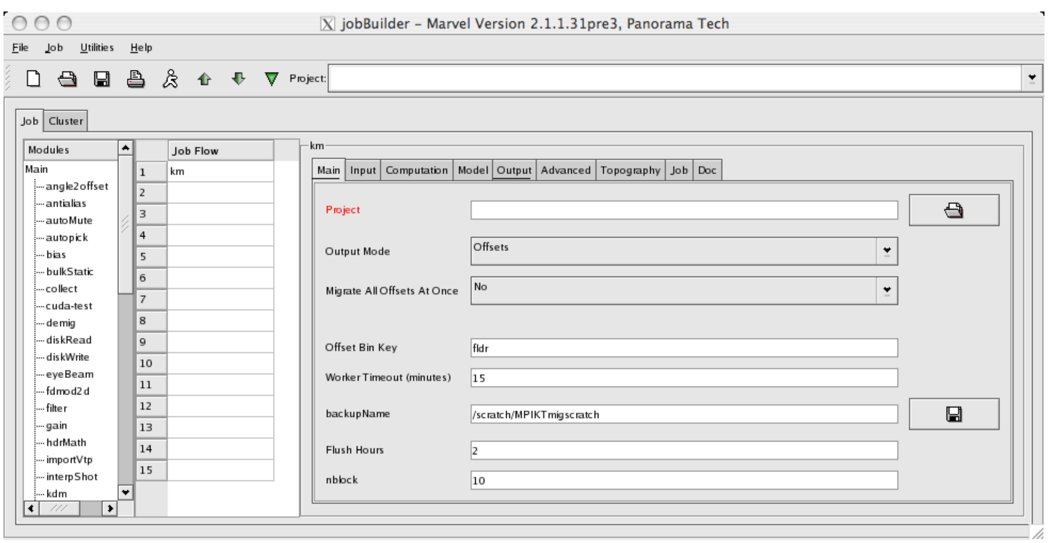

Table 50. km Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a REQUIRED entry.**
Output Mode	This is the kind of output: Stack or Offset gathers. default: Stack
Migrate All Offsets at Once	(Only visible for Output Mode Offsets.) Enables all offsets to be held in memory at one time. This is good for increasing I/O performance. default: No
Offset Bin Key	(Only visible for Output Mode Offsets.) The header key for the offset bin parameter. default: fldr
Offset	(Only visible for Output Mode Stack.) The bin for the run to be used for the output header.
Worker Timeout (minutes)	Worker components that have not responded in this amount of time are assumed to be dead. default: 15
backupName	The name of the file to contain backup data if a restart becomes necessary. default: */scratch/MPIKTmigscratch* **Note:** This file is not deleted when a job finishes successfully. You must delete the file manually.
Flush Hours	The time, in hours, between backups. default: 2
nblock	The size of the trace block. default: 10

km Input Panel

The km Input panel, Figure 72, defines the header keys that provide surface information to the module. The fields are defined in Table 51.

Figure 72. km Input Panel

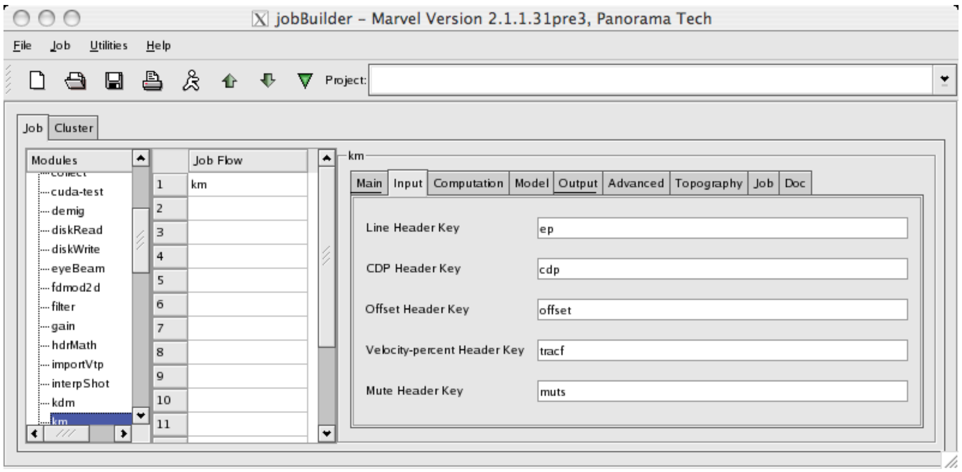

Table 51. km Input Panel Fields

Field	Description
Line Header Key	Header key with line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: ep
CDP Header Key	Header key containing CDP designators. MARVEL usually uses cdp, which is a 4-byte integer at location 21 in SEG-Y files. default: cdp
Offset Header Key	Header key for the offset parameter. default: offset
Velocity-percent Header Key	default: tracf
Mute Header Key	Header key for the mute parameter. default: muts

km Computation Panel

The km Computation panel, Figure 73, defines the x and y aperture limits to be used in the calculations. The fields are described in Table 52.

Figure 73. km Computation Panel

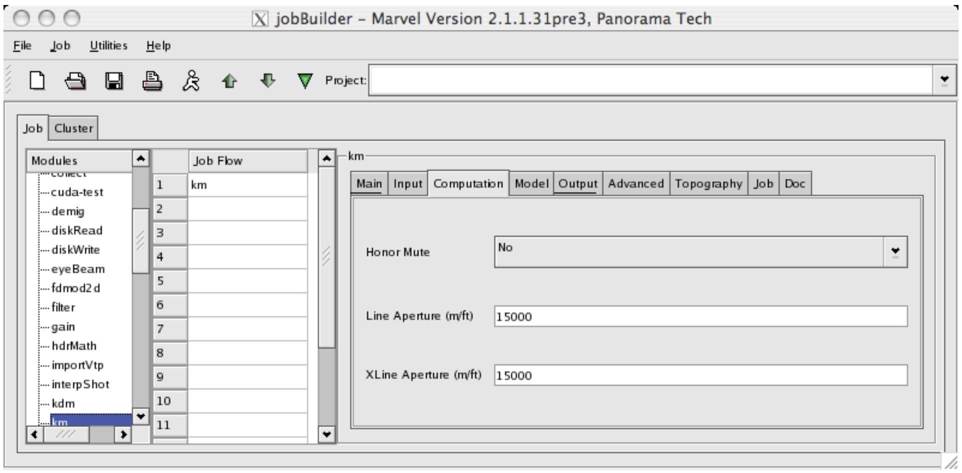

Table 52. km Computation Panel Fields

Field	Description
Honor Mute	Switch indicating whether or not the Kirchhoff migration calculation should use the mute setting.
Line Aperture	The length, in meters or feet, of the line direction aperture limit. default: 15000
XLine Aperture	The length in meters or feet of the crossline aperture limit. default: 15000

km Model Panel

The km model panel, Figure 74, defines the kind and type of input model to be used by MARVEL. The fields are described in Table 53.

> **Note:**
>
> All gridded models are assumed to be SEG-Y formatted.

Figure 74. km Model Panel

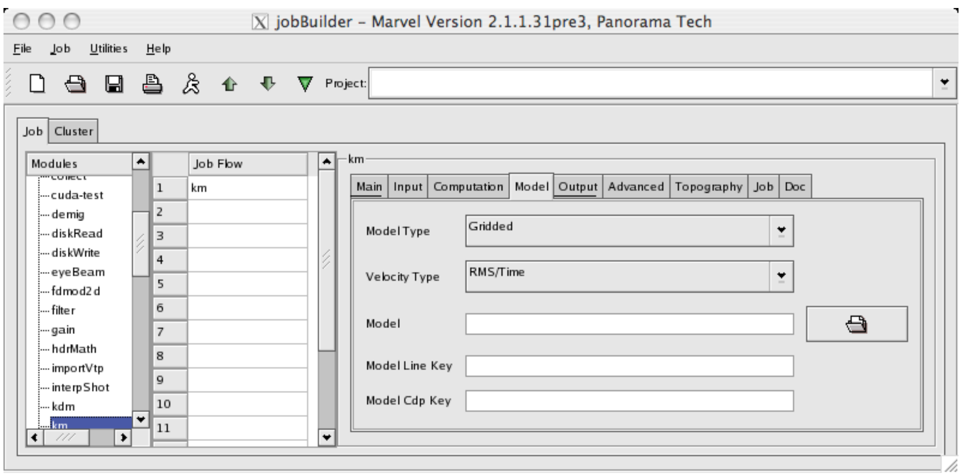

Table 53. km Model Panel Fields

Field	Description
Model Type	The type of input velocity model. Currently, only a Gridded model is allowed. In the future, models defined by time-velocity pairs will also be permitted. default: Gridded
Velocity Type	The velocity type used with this model: RMS/Time, Int/Depth, Int/Time. default: RMS/Time
Model	The file containing the model you want to use with the Kirchhoff migration. **Note:** All gridded models are assumed to be SEG-Y formatted.
Model Line Key	The header word key for line information when the model is gridded. Use if different from the data. default: same as data

continues on next page

Table 53. km Model Panel Fields–continued

Field	Description
Model Cdp Key	The header word key for CDP information when the model is gridded. Use if different from the data. default: same as data

km Output Panel

The km Output panel, Figure 75, defines the aliasing, output line and crossline dimensions. The fields are described in Table 54.

Figure 75. km Output Panel

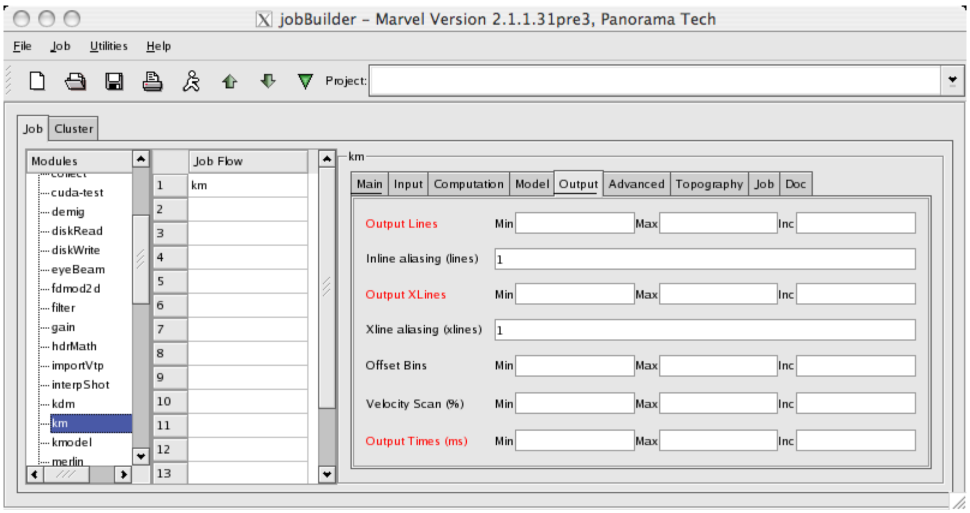

Table 54. km Output Panel Fields

Field	Description
Output Lines	The minimum, maximum, and increment values for output lines. **This is a REQUIRED entry.**
Inline aliasing	Defines the inline anti-aliasing distance, in units of lines. default: 1
Output XLines	Defines the minimum, maximum, and incremental crossline values. **This is a REQUIRED entry.**
Xline aliasing	Defines the crossline anti-aliasing distance, in units of lines. default: 1
Offset Bins	Defines the endpoints of the desired output offset bins. For example, the values 0, 20,000, and 1000, define output offsets ranging from 500 to 19,500. *This field is only visible if you have selected an Output Mode of Offsets in the Main panel.*
Velocity Scan (%)	Setting the minimum, maximum, and increment provide the percentage range over which migrations should be performed. For example, setting this range to 90, 110, 5 will produce output volumes using 90, 95, 100, 105, and 110 percent of the original velocity field.

continues on next page

Table 54. km Output Panel Fields–continued

Field	Description
Output Times	Defines the minimum, maximum, and incremental output time values, in milliseconds. **This is a REQUIRED entry.**

km Advanced Panel

The km Advanced panel, Figure 76, defines several advanced user parameters. The fields are described in Table 55.

Figure 76. km Advanced Panel

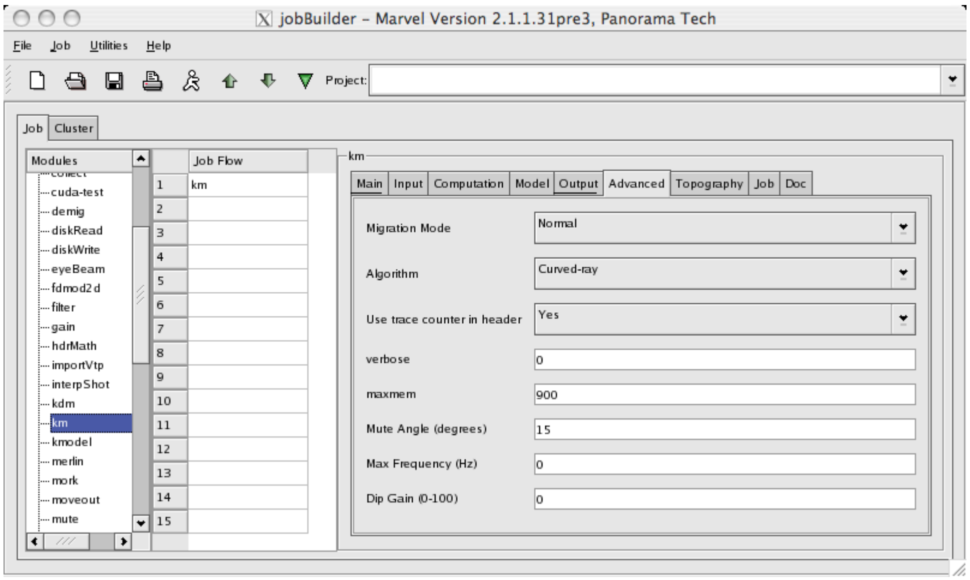

Table 55. km Advanced Panel Fields

Field	Description
Migration Mode	Specifies whether the migration is to be Normal, DoubleV, or from Topography. If the migration is from topography, you can enter data on the km Topography Panel. default: Normal
Algorithm	Specifies the algorithm to be used in the calculations: Curved-ray or Straight-ray. default: Curved-ray
Use trace counter in header	Flag indicating whether or not the trace counter that diskRead puts in the trace header is to be used. default: Yes
Verbose	Switch for turning debug printing on and off. default: 0
maxmem	Maximum amount of memory that MARVEL can use per kdm instance. default: 900

continues on next page

Table 55. km Advanced Panel Fields–continued

Field	Description
Mute Angle	Defines the angle, measured down from the surface, that defines a cone limiting the near surface aperture. default: 15
Max Frequency	The maximum frequency allowed by the filtering process. default: 0, do not filter
Dip Gain	Variable that enables you to control dip. The value can range from 0 through 100. default: 0, do not apply a gain

km Topography Panel

The km Topography panel, Figure 77, defines several topography user parameters. The fields are described in Table 56.

Note:

The fields on the panel are visible are only visible if you select From Topography for the Migration Mode on the km Advanced Panel.

Figure 77. km Topography Panel

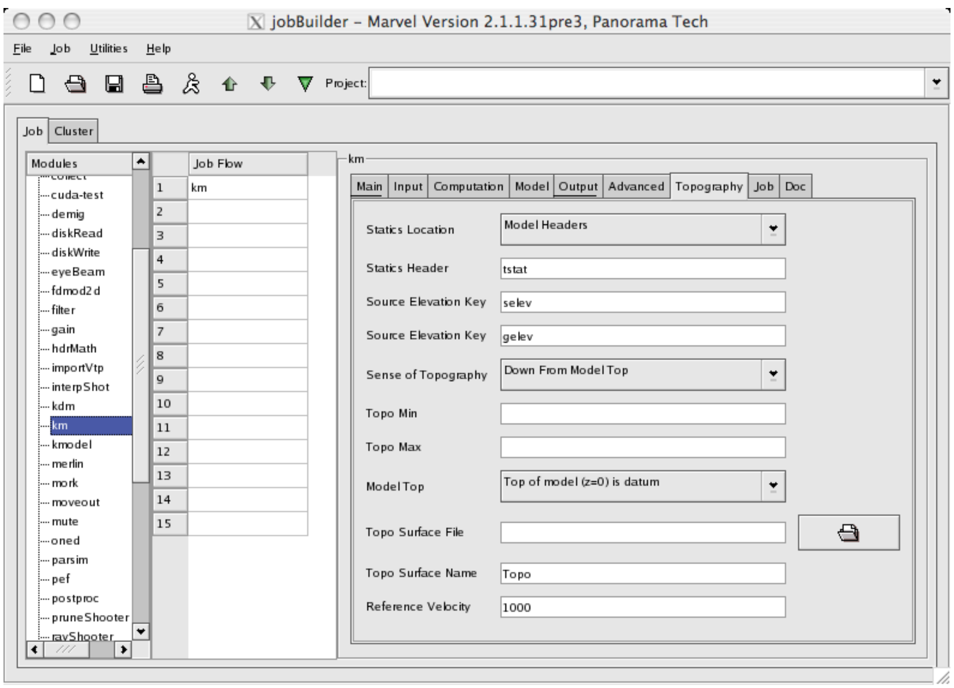

Table 56. km Topography Panel Fields

Field	Description
Statics Location	Model Headers, Data Headers, Surface File default: Model Headers
Statics Header	The header key for the total statics information. default: tstat
Source Elevation Key	The header key for the source elevation information. default: selev

continues on next page

Table 56. km Topography Panel Fields–continued

Field	Description
Source Elevation Key	The header key for the source elevation information. default: gelev
Sense of Topography	Down From Model Top, Up From Sea Level/Datum default: Down From Model Top
Topo Min	
Topo Max	
Model Top	Top of model (z=0) is datum, Top of model (z=0) is topo surface default: Top of model (z=0) is datum
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo
Reference Velocity	default: 1000

MERLIN Module

Two-way wave equation program for modeling, velocity analysis and depth imaging.

Note:

You should use MERLIN® to perform migrations instead of **rtmodel**.

Figure 78. MERLIN Main Panel, Model Mode

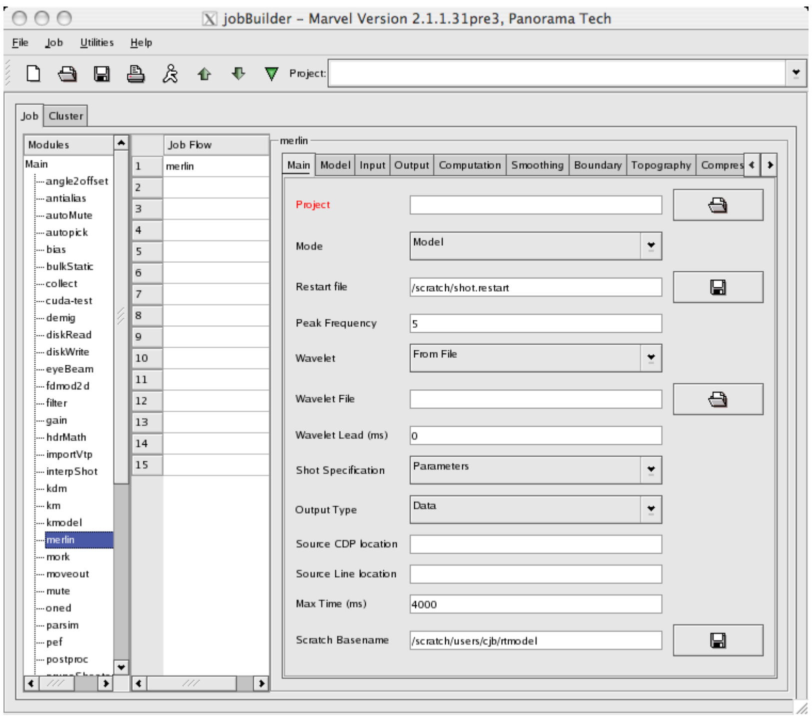

Figure 79. MERLIN Main Panel, Migrate Mode

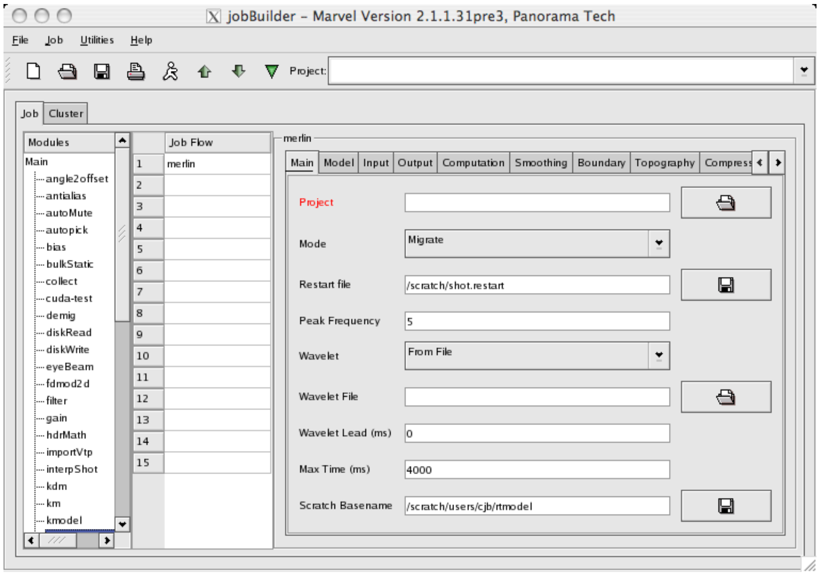

Table 57. MERLIN Main Panel Fields

Field	Description
VTI/TTI Model Type	
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a REQUIRED entry.**
Mode	Model or Migrate
Restart File	The application keeps information about shots already processed in this file. It is usually best to put it in the same directory where your output files are located and to give it a similar name. default: */scratch/shot.restart*
Peak Frequency	This field has a somewhat historical definition in units of Hz. The value is based on the definition of the default Ricker wavelet, and refers to the peak frequency of the defining Gaussian pulse (since the Ricker wavelet is the second derivative of the Gaussian pulse, its peak frequency is actually higher than the Gaussian pulse itself). The maximum produced frequency will be roughly 2.8 times this number. default: 5

continues on next page

Table 57. MERLIN Main Panel Fields–continued

Field	Description
Wavelet	The name of the wavelet convolved with a reflectivity trace to generate a synthetic seismogram: Ricker (zero-phase) or Spike (which is mostly useful for migration), or From File (where you specify your own wavelet). If you specify a wavelet, you must then specify two additional parameters: Wavelet File and Wavelet Lead. • Ricker • Spike • From File default: Ricker
Wavelet File	When you have specified that the wavelet is From File, this field allows a single trace to be read from a seismic input file to define the source wavelet.
Wavelet Lead (ms)	When you have specified that the wavelet is From File, the specified wavelet will be centered at this point. default: 0
Shot Specifications	Parameters or From Data (This field is only displayed for the Model Mode.) default: Parameters
Output Type	Data or Residual (This field is only displayed for the Model Mode.) default: Data
Source CDP Location	(This field is only displayed for the Model Mode.)
Source Line Location	(This field is only displayed for the Model Mode.)
Max Time (ms)	default: 4000
Scratch Basename	The application needs temporary storage for acquired data, accumulated image, and others. All of these filenames will start with this prefix.

MERLIN Model Panels

Figure 80. MERLIN Model Panel, VTI/TTI Model Type

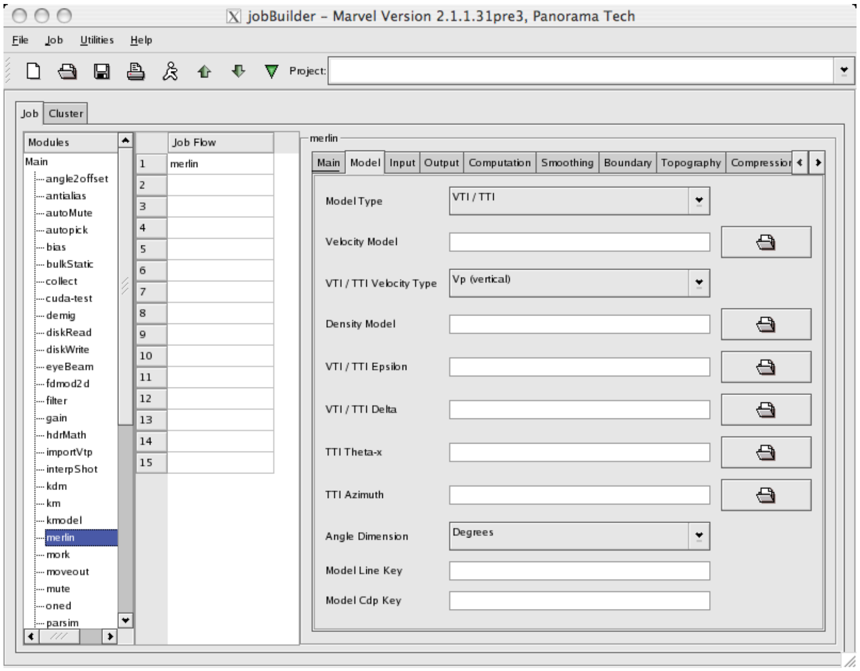

Figure 81. MERLIN Model Panel, Constant-Density Acoustic Model Type

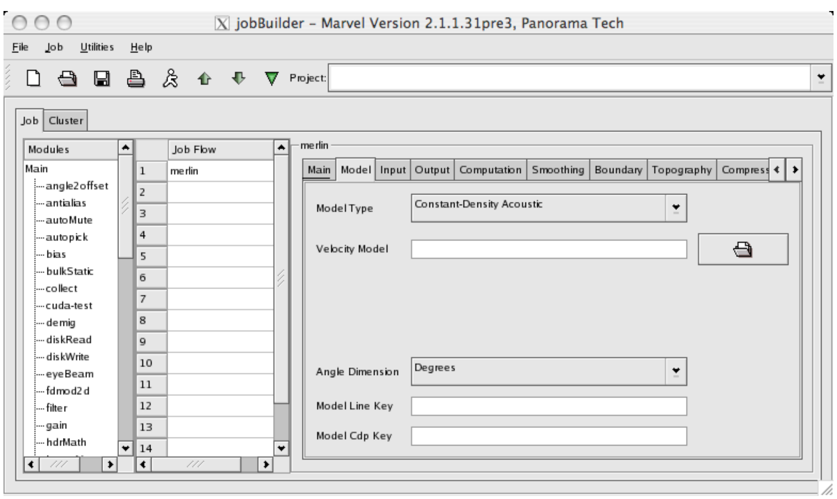

Figure 82. MERLIN Model Panel, Variable-Density Acoustic Model Type

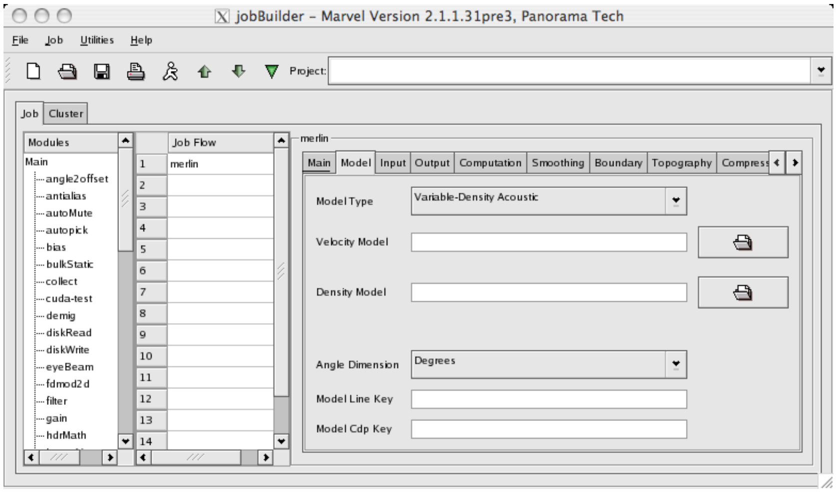

Table 58. MERLIN Model Panel Fields

Field	Description
VTI/TTI Model Type	
Model Type	• VTI/TTI • Constant-Density Acoustic • Variable-Density Acoustic default: VTI/TTI
Velocity Model	The path and filename of the velocity model to be used in the calculations. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data.
VTI/TTI Velocity Type	Vp (vertical) or VNMO (vertical) default: Vp (vertical)
VTI/TTI Epsilon	
VTI/TTI Delta	
TTI Theta-x	
TTI Azimuth	
Angle Dimension	Degrees or Radians default: Degrees

continues on next page

Table 58. MERLIN Model Panel Fields–continued

Field	Description
Model Line Key	The header word key for line information when the model is gridded. Use if different from the data.
Model Cdp Key	The header word key for CDP information when the model is gridded. Use if different from the data.
Source Line Location	
Max Time (ms)	default: 4000
Scratch Basename	The application needs temporary storage for acquired data, accumulated image, and others. All of these filenames will start with this prefix.
Constant-Density Acoustic Model Type	
There are no fields specific just to this model.	
Variable-Density Acoustic Model Type	
Density Model	

MERLIN Input Panel

Figure 83. MERLIN Input Panel

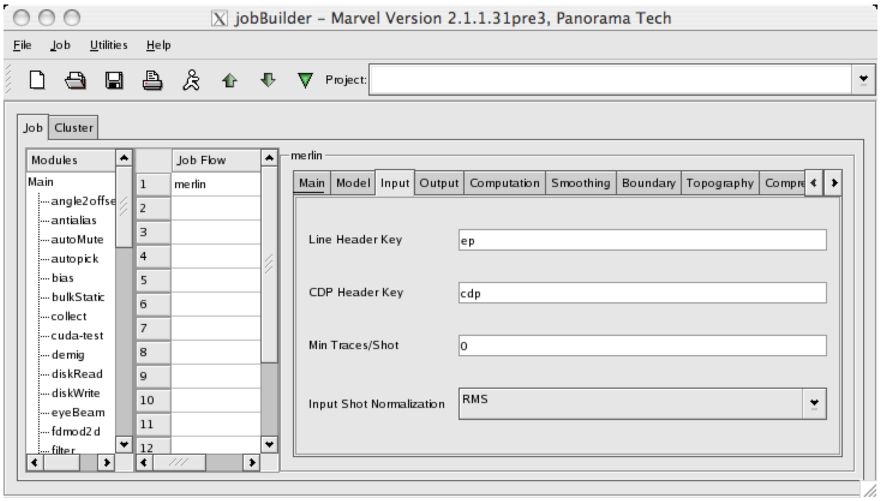

Table 59. MERLIN Input Panel Fields

Field	Description
Line Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: ep
CDP Header Key	Header key containing CDP designators. MARVEL usually uses cdp, which is a 4-byte integer at location 21 in SEG-Y files. default: cdp
Min Traces/Shot	default: 0
Input Shot Normalization	None or RMS. **This field is only visible if MERLIN is performing a migrate operation, as selected on the Main panel.** default: None

MERLIN Output Panels

Figure 84. MERLIN Output Panel, Model Mode

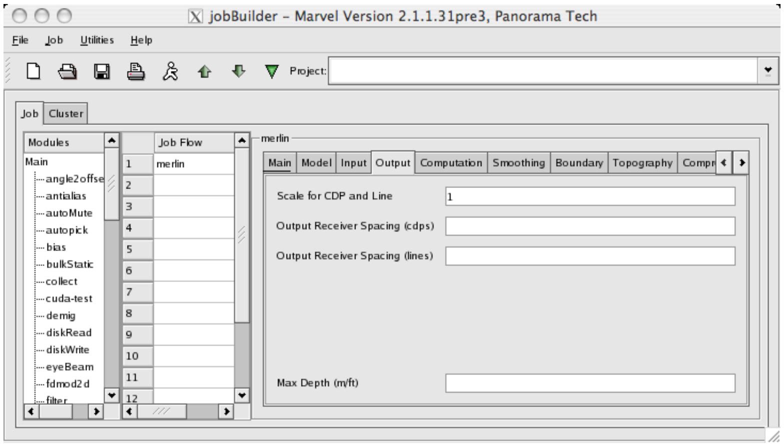

Figure 85. MERLIN Output Panel, Migrate Mode

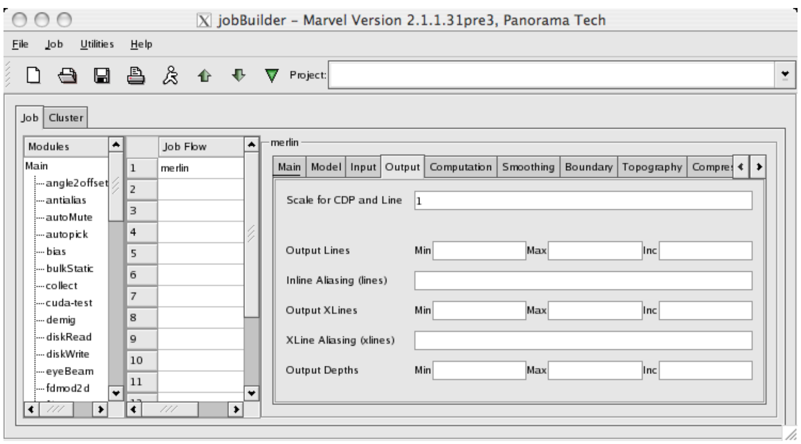

Table 60. MERLIN Output Panel Fields

Field	Description
MERLIN Model Mode	
Scale for CDP and Line	default: 1
Output Receiver Spacing (cdps)	Data will be acquired on a grid centered on the shot point, with this spacing along the CDP axis.

continues on next page

Table 60. MERLIN Output Panel Fields–continued

Field	Description
Output Receiver Spacing (lines)	Data will be acquired on a grid centered on the shot point, with this spacing along the line axis.
Max Depth (m/ft)	
MERLIN Migrate Mode	
Output Lines	The number of lines to be contained in the output data.
Input Aliasing (lines)	
Output XLines	The number of crosslines to be contained in the output data.
XLine Aliasing (xlines)	Attempt to compensate for aliasing in the crossline direction (units: lines). **Note:** This can be a costly operation.
Output Depths	Defines the minimum, maximum, and increment for the each output trace.

MERLIN Computation Panels

Figure 86. MERLIN Computation Panel, Model Mode

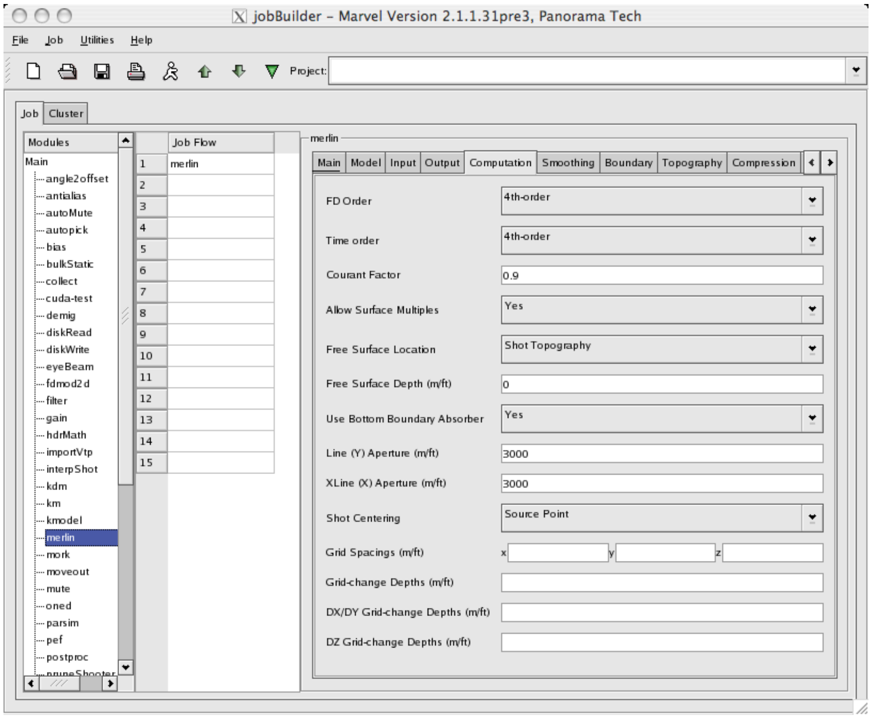

Figure 87. MERLIN Computation Panel, Migrate Mode

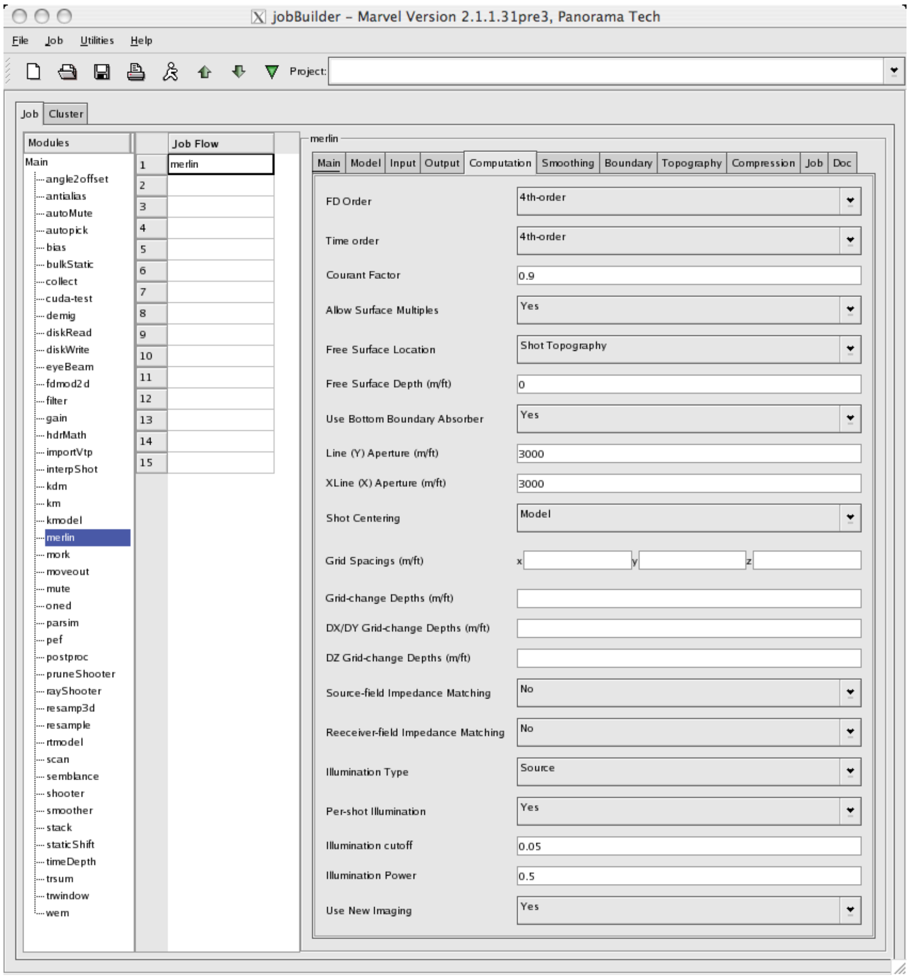

Table 61. MERLIN Computation Panel Fields

Field	Description
Both Migrate and Model Panels	
FD Order	This determines the order of accuracy of the spatial derivatives used in the simulation. For second-order, a second derivative is computed using 3 grid points. For 8^{th}-order,9 grid points are used, with 5 unique coefficients. This is usually the ideal combination for speed and accuracy. Possible values are 2nd, 4th, 6th, 8th, 10, 12th, 14th order. default: 4th order
Time order	2^{nd}-order time uses a three-point stepping algorithm. 4^{th}-order uses the wave equation to compensate for errors in the former approach (usually referred to in the industry as 'the Dablain trick').

continues on next page

Table 61. MERLIN Computation Panel Fields–continued

Field	Description
Courant Factor	The internal time step is determined by the Courant stability condition, involving the grid spacing and the maximum velocity. For the default 4^{th}-order time, this code is stable with a factor of .9; for 2^{nd}-order time, a value of .85 is recommended. Slightly smaller values *may* result in slightly better output, but probably will not help.
Allow Surface Multiples	If this field is set to Yes, a free surface is modeled, and the wave field will reflect off the top, leading to multiples in the data. If the field is set to No, an absorbing zone will be placed at the top. default: Yes
Free Surface Location	There are three options to this field: Shot Topography—Reflections occur at the topography defined for shots (see below). Receiver Topography—Reflections occur at the topography defined for receivers (see below). Fixed Depth—Free surface is at user-specified depth.
Free Surface Depth (m/ft)	User-specified free-surface depth, when 'Fixed Depth' is chosen for 'Free Surface Location'.
Use Bottom Boundary Absorber	This field has two options: Yes—Waves are absorbed at the bottom. No—Waves can reflect off the bottom. This generally does little harm, and costs a bit less. default: Yes
Line (Y) Aperture (m/ft)	The computation for each shot is limited along the y axis to a range above and below the center of the shot. default: 3000
XLine (X) Aperture (m/ft)	The computation for each shot is limited along the x axis to a range above and below the center of the shot. default: 3000
Shot Centering	• Source Point • Shot + Receiver Box • Avg Midpoint • Model default: Source Point

continues on next page

Table 61. MERLIN Computation Panel Fields–continued

Field	Description
Grid Spacings	If left blank, these will be determined by the 'Output Receiver Spacings' (see above). Otherwise, these specify the spacings of the computation grid.
Grid-change Depths (m/ft)	
DX/DY Grid-change Depths (m/ft)	
DZ Grid-change Depths (m/ft)	
Migrate Panel Only	
Source Field Impedance Matching	Use 'non-reflecting' wave equation for source propagation, and is an attempt to reduce artifacts. Costly, and not very effective. Default: No
Receiver-field Impedance Matching	Use 'non-reflecting' wave equation for receiver back-propagation in an attempt to reduce artifacts. Costly and not very effective. default: No
Illumination Type	An illumination is produced. Generally, the default value of 'Source' should be used. In this case, the illumination is just the sum of the squared source fields at each image point. • Source Point • Shot + Receiver Box • Avg Midpoint • Model default: Source.Receiver
Per-Shot Illumination	Each shot image can be divided by the illumination separately. This tends to be noisier, but can help to image steep dips in some cases.
Illumination cutoff	This field is only available if Per-Shot illumination is set to Yes. default: 0.05
Illumination Power	For a value of '1', the illumination is the squared source. This field is only available if Per-Shot Illumination is set to Yes. default: 0.5

continues on next page

Table 61. MERLIN Computation Panel Fields–continued

Field	Description
Use New Imaging	default: Yes

MERLIN Smoothing Panel

The Smoothing Panel does not display any fields if the the MERLIN Main Panel Mode Type is set to Model.

Figure 88. MERLIN Smoothing Panel

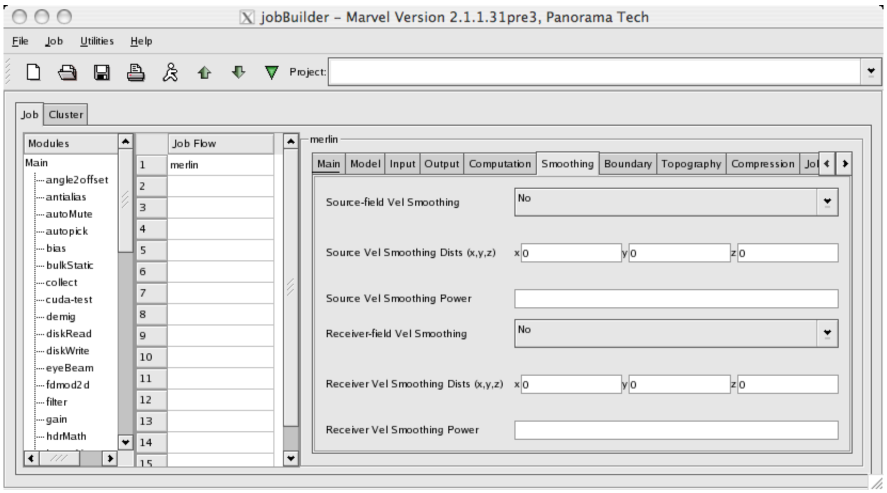

Table 62. MERLIN Smoothing Panel Fields

Field	Description
Source-field Vel Smoothing	Flag controlling the smoothing of the source-field velocity (slowness) field used to propagate the source term. This process can be useful for reducing artifacts.
Source Vel Smoothing Dists (x,y,z)	Gaussian widths for smoothing slowness in each direction for the source. defaults: 0, 0, 0
Source Vel Smoothing Power	The number of times to smooth the source volume.
Receiver-field Vel Smoothing	Turn the smoothing of the receiver-field velocity (slowness) field used to propagate the source term *on* or *off*. This process can be useful for reducing artifacts.
Receiver Vel Smoothing Dists (x,y,z)	Gaussian widths for smoothing slowness in each direction for the receiver. defaults: 0, 0, 0
Receiver Vel Smoothing Power	The number of times to smooth the receiver volume.

MERLIN Boundary Panel

Figure 89. MERLIN Boundary Panel

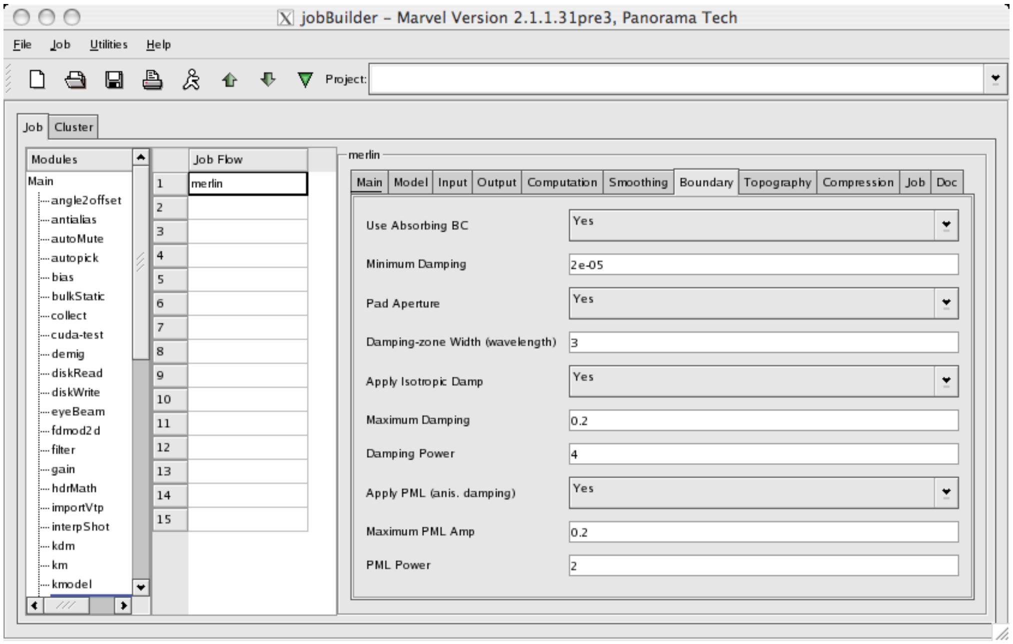

Table 63. MERLIN Boundary Panel Fields

Field	Description
Use Absorbing BC	default: Yes
Minimum Damping	This is an isotropic damping factor applied everywhere, regardless of other settings. The default of $2 \cdot 10^{-5}$ should not produce much noticeable effect, but helps when other damping is used to avoid reflections.
Pad Aperture	This field has two possible values: *Yes*—Computation aperture is increased and damping is done outside the output zone. *No*—Damping is included in the output aperture.
Damping-zone Width (wavelength)	The damping thickness will be this number of wavelengths for the ‘Peak Frequency’ at the maximum velocity. The default of 3 should eliminate reflections sufficiently.
Apply Isotropic Damping	If ‘Yes’, use Isotropic damping in the damping zones.

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Table 63. MERLIN Boundary Panel Fields–continued

Field	Description
Maximum Damping	The maximum damping factor to use. The default of 0.2 should be safe, while anything over 0.5 may be unstable, and anything over 1 is **very** unstable. (This field is only visible if Apply Isotropic Damping is set to Yes.)
Damping Power	Damping is varied from 0 to 'Maximum Damping' over the pad length, with a formula like $d = d_{max}(x/L)^p$, where d_{max} is *MaximumDamping*, x is the distance into the pad, L is the pad length, and p is this parameter. The default of 4 is a good choice to avoid reflections caused by damping. (This field is only visible if Apply Isotropic Damping is set to Yes.)
Apply PML (anis. damping)	PML, or 'Perfectly-Matched Layers' is designed to absorb one direction of propagation. **Note: This approach of anisotropic damping is much more costly than isotropic damping, and Panorama Technologies believes it does not work as well.**
Maximum PML Amp	This is analogous to *MaximumDamping*. This field is only visible if Apply PML is set to Yes.
PML Power	This is analogous to *DampingPower*. This field is only visible if Apply Isotropic Damping is set to Yes.

MERLIN Topography Panel

Figure 90. MERLIN Topography Panel

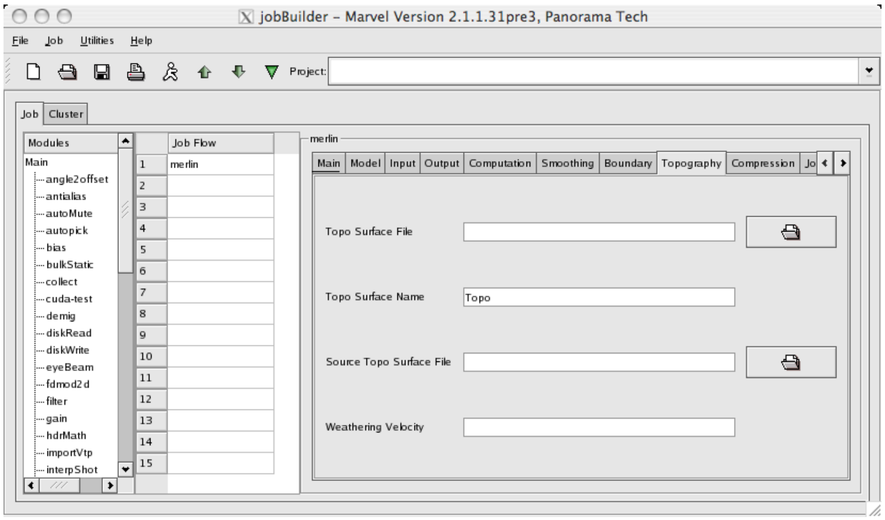


Table 64. MERLIN Topography Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep = 100 cdp = 500 z = 20
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo
Source Topo Surface File	The path and name of the source topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep = 100 cdp = 500 z = 20
Weathering Velocity	The weathering velocity to use in the calculations.

MERLIN Compression Panel

Figure 91. MERLIN Compression Panel

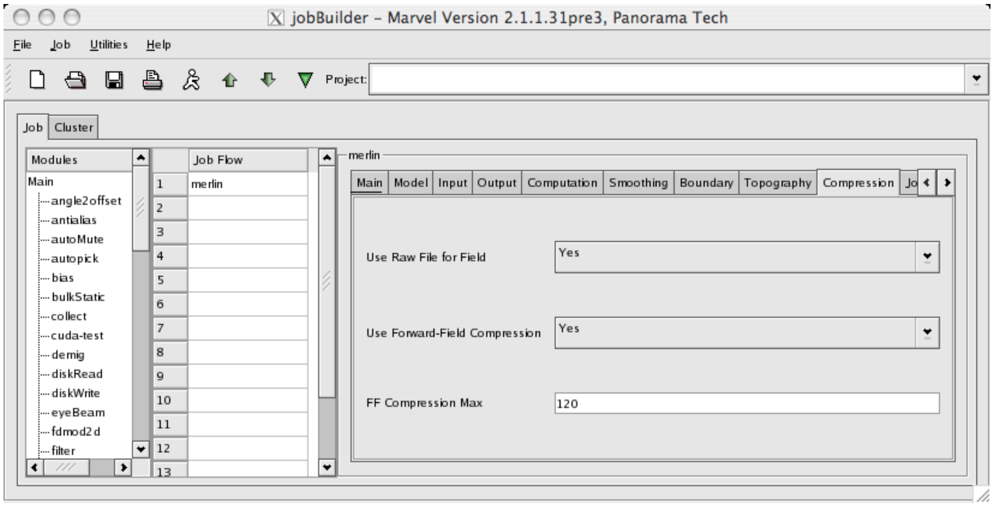


Table 65. MERLIN Compression Panel Fields

Field	Description
Use Raw File for Field	Necessary for compression. If No, stored source term is stored in SEG-Y files (SLOW).
Use Forward Field Compression	Turns compression for the source term on or off. **Note:** This field is only available if the Mode field on the rtmodel Main panel is set to Migrate.
FF Compression Max	As part of the compression, this specifies the amplitude range used to store the samples. For most projects, the default of 120 produces good results, but for some projects, a more dynamic range may be needed. **Note:** This field is only available if the Mode field on the rtmodel Main panel is set to Migrate. default: 120

MERLIN Job Panel

Figure 92. MERLIN Job Panel

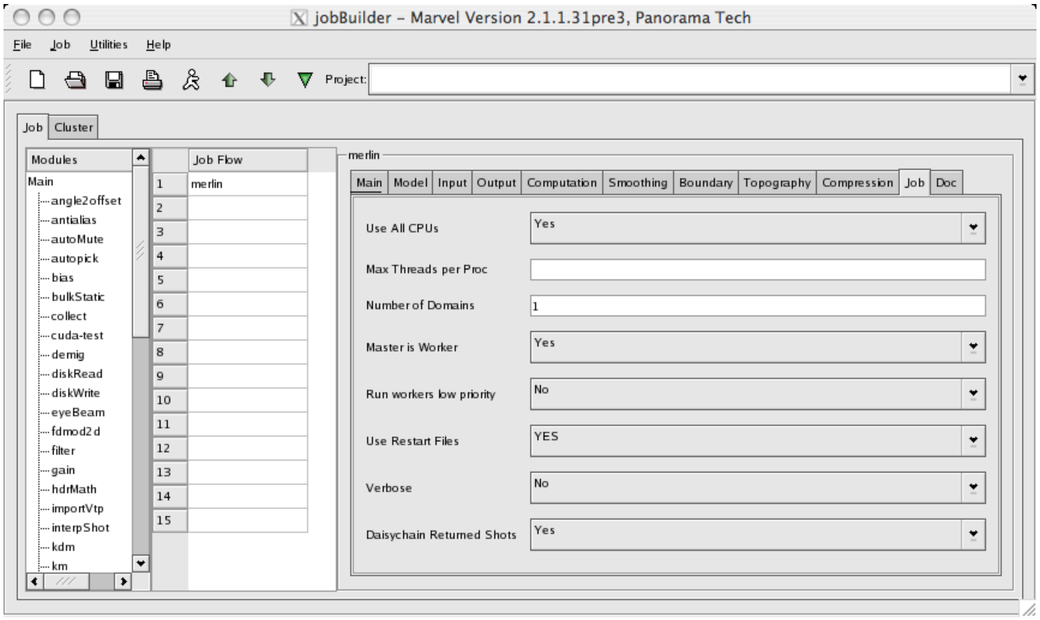


Table 66. MERLIN Job Panel Fields

Field	Description
Use All CPUs	This really means that each worker should use multiple threads. If No, then there will be one independent worker spawned for each CPU (or core) in the cluster. default: Yes
Max Threads per Proc	
Number of Domains	default: 1
Master is Worker	Flag that controls whether the master I/O controller is also used for performing calculations. default: Yes
Run workers low priority	If Yes, workers will be spawned with reduced priority, although the master process will remain at high priority. This can be useful, especially when *MasterIsWorker* is set, so that one worker does not slow down collection or submission of shots for all of the others. default: No

continues on next page

Table 66. MERLIN Panel Fields–continued

Field	Description
Use Restart Files	If NO, the job will ignore restart information and start from the beginning. default: Yes
Verbose	Switch for turning debug printing on and off. default: No

MORK Module

This is Panorama Technologies' one-way migration module. When a seismic section is migrated, reflection events are repositioned so they are below their correct surface locations and have the proper corrected vertical reflection times.

MORK Main Panel

This panel, Figure 93, enables you to define the basic parameters for the module. Table 67 describes the terms used on both panels.

Figure 93. MORK Module Main Panel

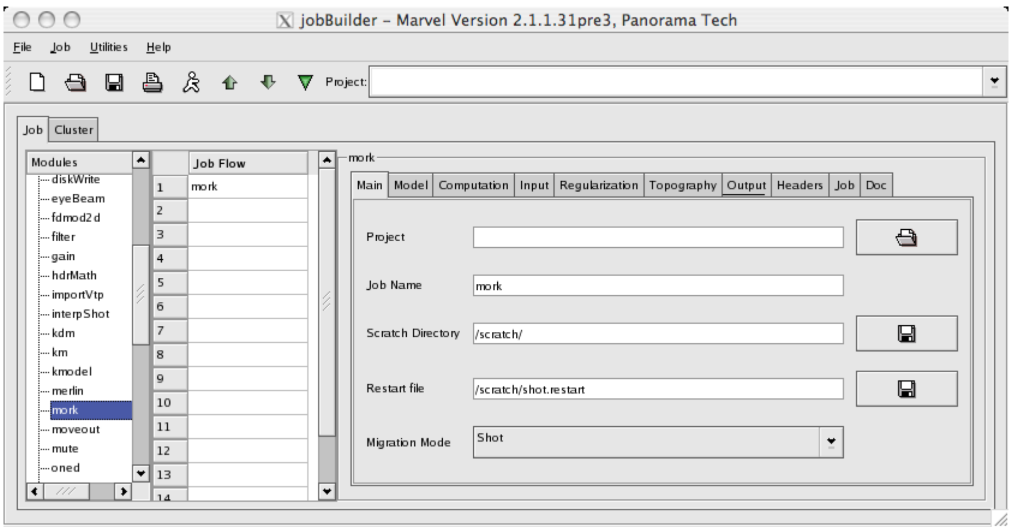


Table 67. MORK Module Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Job Name	The name for this job. default: MORK
Scratch Directory	Name of the directory used for temporary files. default: */scratch/*

continues on next page

Table 67. MORK Module Main Panel Fields–continued

Field	Description
Restart File	The application keeps information about shots already processed in this file. It is usually best to put it in the same directory where your output files are located and to give it a similar name. default: */scratch/shot.restart*
Migration Mode	• Shot • Common Azimuth • Post-stack • Data Regularization (common azimuth) default: Shot

MORK Model Panel

This panel, Figure 94, enables you to define the basic parameters for the module. Table 68 describes the terms used on both panels.

Figure 94. MORK Model Panel

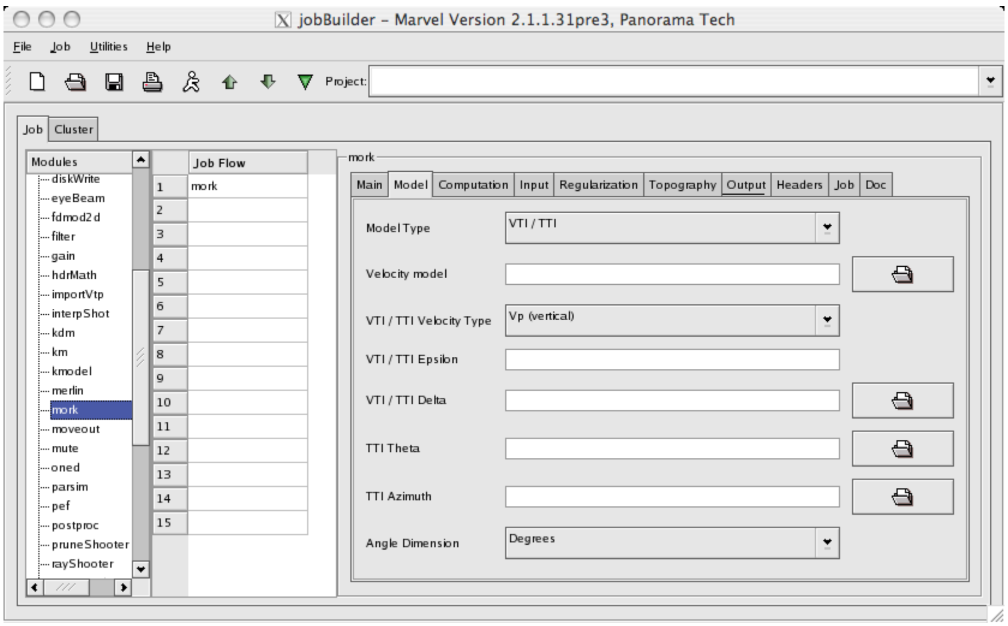


Table 68. MORK Model Panel Fields

Field	Description
Model Type	Constant-density Acoustic or VTI/TTI default: Constant-Density Acoustic
Velocity Model	The path and filename of the velocity model to be used in the calculations. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data.
VTI/TTI Velocity Type	Vp (vertical) or VNMO (vertical) (This field is only visible for VTI/TTI model types.) default: Vp (vertical)
VTI/TTI Epsilon	(This field is only visible for VTI/TTI model types.)
VTI/TTI Delta	(This field is only visible for VTI/TTI model types.)
TTI Theta	(This field is only visible for VTI/TTI model types.)

continues on next page

Table 68. MORK Model Panel Fields–continued

Field	Description
TTI Azimuth	(This field is only visible for VTI/TTI model types.)
Angle Dimension	Degrees or Radians (This field is only visible for VTI/TTI model types.) default: Degrees

MORK Computation Panel

This panel, Figure 95, enables you to define the parameters used in the computations for the module. Table 69 describes the terms used on both panels.

Figure 95. MORK Computation Panel

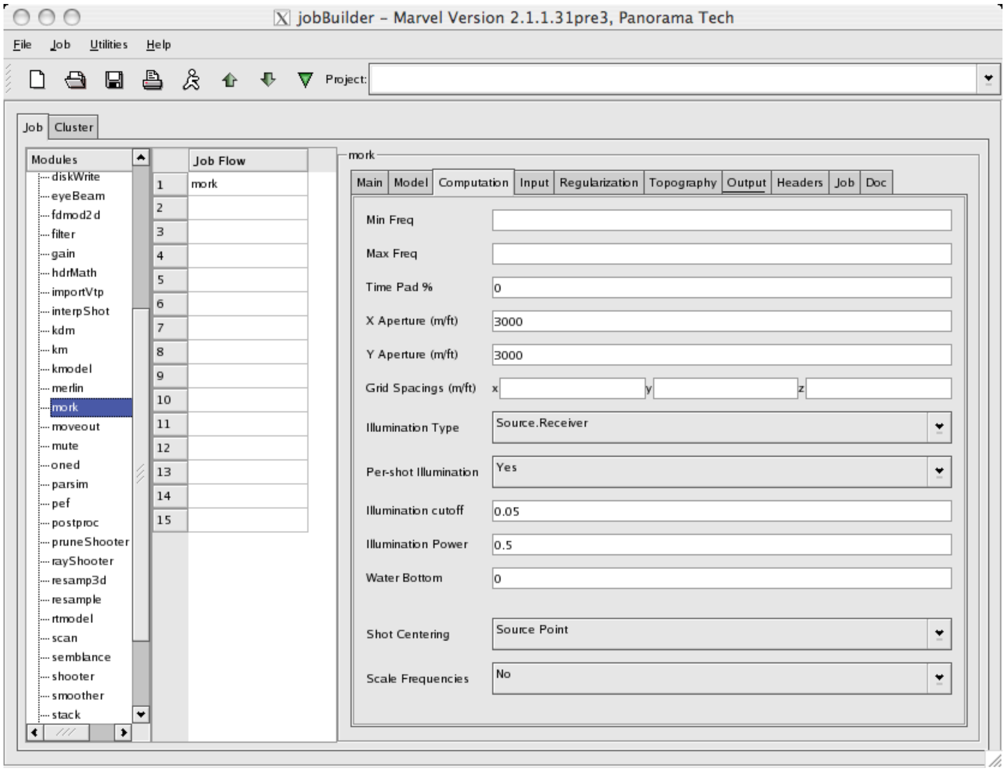


Table 69. MORK Computation Panel Fields

Field	Description
Min Freq	The minimum frequency to be allowed by filtering.
Max Freq	The maximum frequency to be allowed by filtering.
Time Pad	The percent padding to apply to input traces. default: 0
X Aperture (m/ft)	The length, in meters or feet, of the line direction aperture limit. default: 3000
Y Aperture (m/ft)	The length, in meters or feet, of the crossline (CDP) direction aperture limit. default: 3000

continues on next page

Table 69. MORK Computation Panel Fields–continued

Field	Description
Grid Spacings	If left blank, these will be determined by the 'Output Receiver Spacings'. Otherwise, these specify the spacings of the computation grid.
Illumination Type	An illumination is produced. Generally, the default value of 'Source' should be used. In this case, the illumination is just the sum of the squared source field at each image point. default: Source.Receiver
Per Shot Illumination	Each shot image can be divided by the illumination separately. This tends to be noisier, but can help to image steep dips in some cases. default: No
Illumination cutoff	This field is only available if Per-Shot illumination is Yes. default: 0.05
Illumination Power	For a value of '1', the illumination is the squared source. This field is only available if Per-Shot illumination is Yes. default: 0.5
Water Bottom	
Shot Centering	For modeling, the only generally useful choices are: Source Point - computation aperture is centered on the source. Model - computation aperture is centered at the center of the model. Generally, the apertures should be at least half the dimensions of the model in this case. default: Source Point
Scale Frequencies	default: No

MORK Input Panel

This MORK Input panel enables you to set one parameter, *InputShotNormalization*, and this field is only displayed if you have selected *Shot* as the *MigrationMode* on the MORK Main panel, Figure 93.

InputShotNormalization: Normalization corrects for the amplitude effects of wavefront divergence and damping. It is also used when you apply a subsequent filter for eliminating the surface waves. If RMS, each input shot is divided by its RMS value before processing. Possible values: None, RMS; default: None

MORK Regularization Panel

Figure 96. MORK Regularization Panel

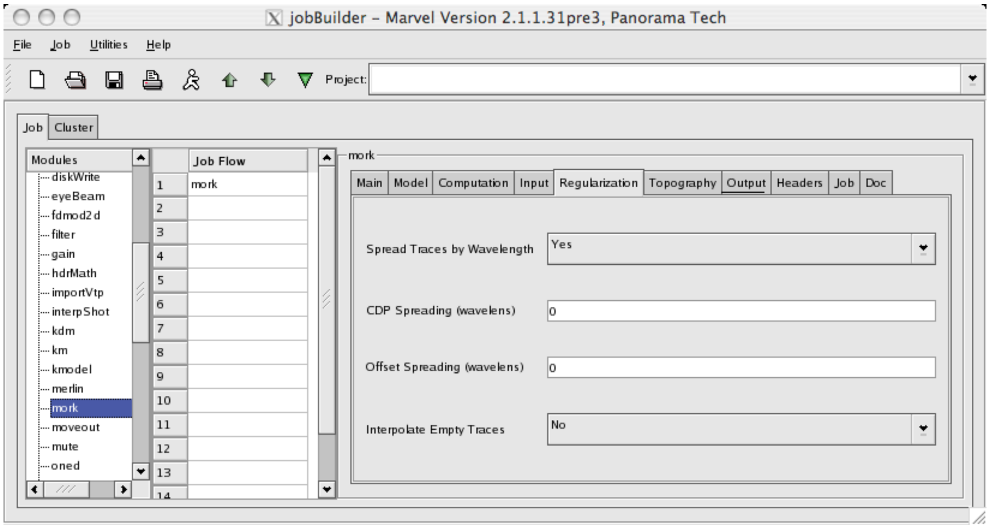


Table 70. MORK Regularization Panel Fields

Field	Description
Spread Traces by Wavelength	
CDP Spreading (wavelens)	
Offset Spreading (wavelens)	
Interpolate Empty Traces	

MORK Topography Panel

This panel enables you to define the basic topographic parameters for the module. There are only two parameters on the panel:

- Topo Surface File: The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20.

- Topo Surface Name: The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

MORK Output Panel

This panel, Figure 97, enables you to define the basic parameters for the module. Table 71 describes the terms used on the panels.

Figure 97. MORK Output Panel

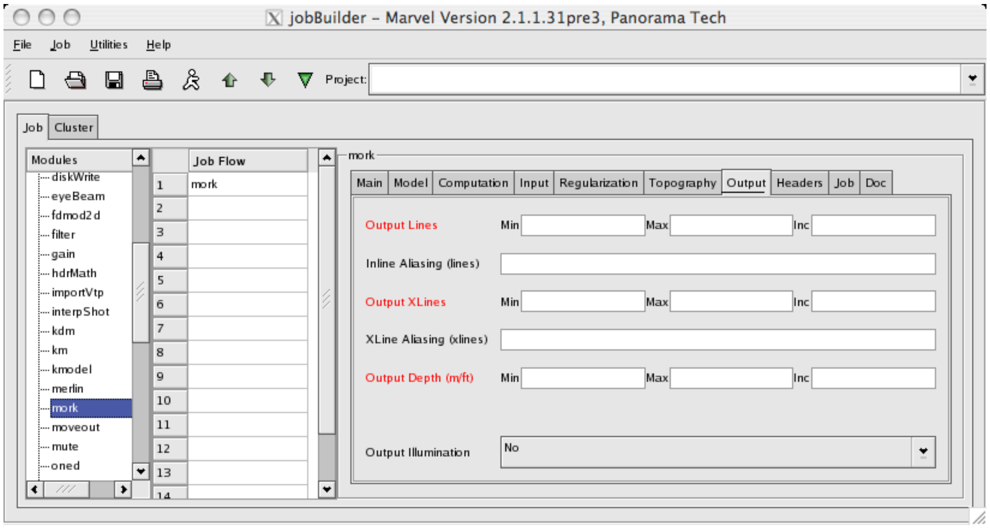


Table 71. MORK Output Panel Fields

Field	Description
Output Lines	The minimum, maximum and increment values for the output lines. **This is a REQUIRED entry.**
Inline Aliasing (lines)	Attempt to compensate for aliasing in the inline direction (units: lines). **Note:** This can be a costly operation.
Output XLines	The minimum, maximum and increment values for the output crosslines. **This is a REQUIRED entry.**
XLine Aliasing (xlines)	Attempt to compensate for aliasing in the crossline direction (units: lines). **Note:** This can be a costly operation.
Output Depth (m/ft)	Minimum, Maximum, Increment for output depths. **This is a REQUIRED entry.**
Output Illumination	Default: No

MORK Headers Panel

This panel, Figure 98, enables you to define the basic parameters for the module. Table 72 describes the terms used on both panels.

Figure 98. MORK Headers Panel

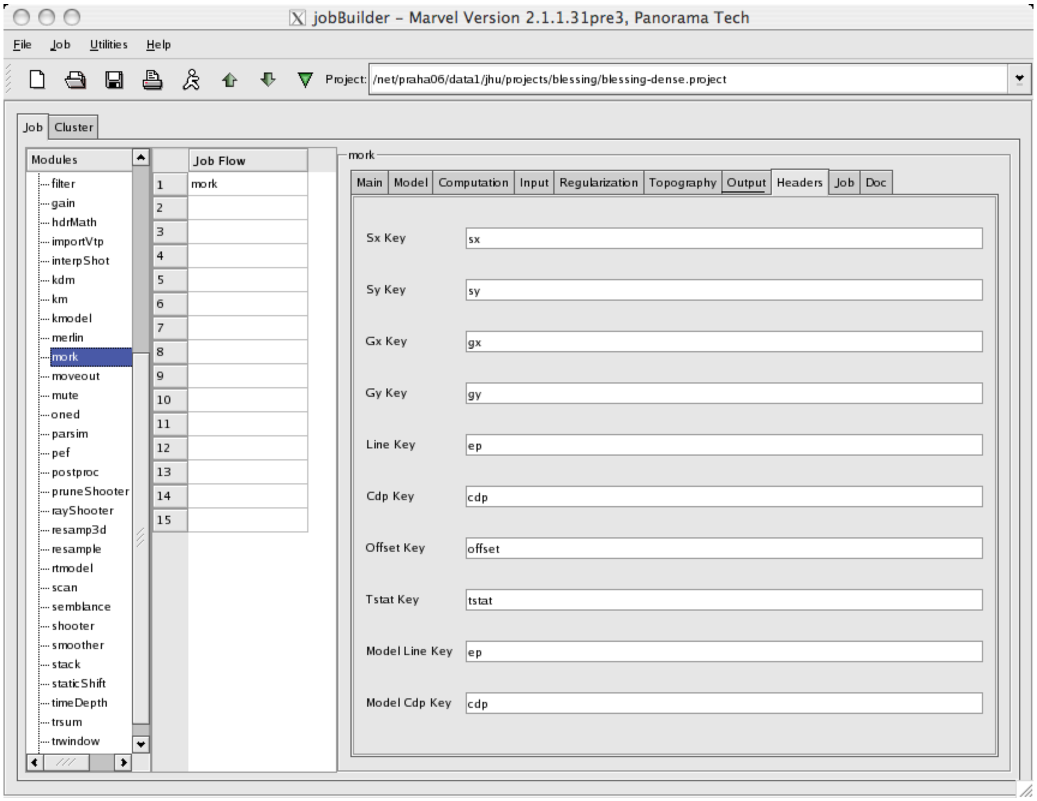


Table 72. MORK Headers Panel Fields

Field	Description
Sx Key	The header key specifying where line source data is stored in the trace. default: sx
Sy Key	The header key specifying where crossline source data is stored in the trace. default: sy
Gx Key	The header key specifying where inline geophone data is stored in the trace. default: gx

continues on next page

Table 72. MORK Headers Panel Fields–continued

Field	Description
Gy Key	The header key specifying where crossline geophone data is stored in the trace. default: gy
Line Key	The header key specifying where line data is stored in the trace. default: ep
Cdp Key	The header key specifying where CDP data is stored in the trace. default: cdp
Offset Key	The header key defining the offset field of the stacked trace. default: offset
Tstat Key	The header key for the total statics information. default: tstat
Model Line Key	The header word key for line information when the model is gridded. Use if different from the data. default: ep
Model Cdp Key	The header word key for CDP information when the model is gridded. Use if different from the data. default: cdp

MORK Job Panel

This panel, Figure 93, enables you to define the basic parameters for the module. Table 67 describes the terms used on both panels.

Figure 99. MORK Job Panel

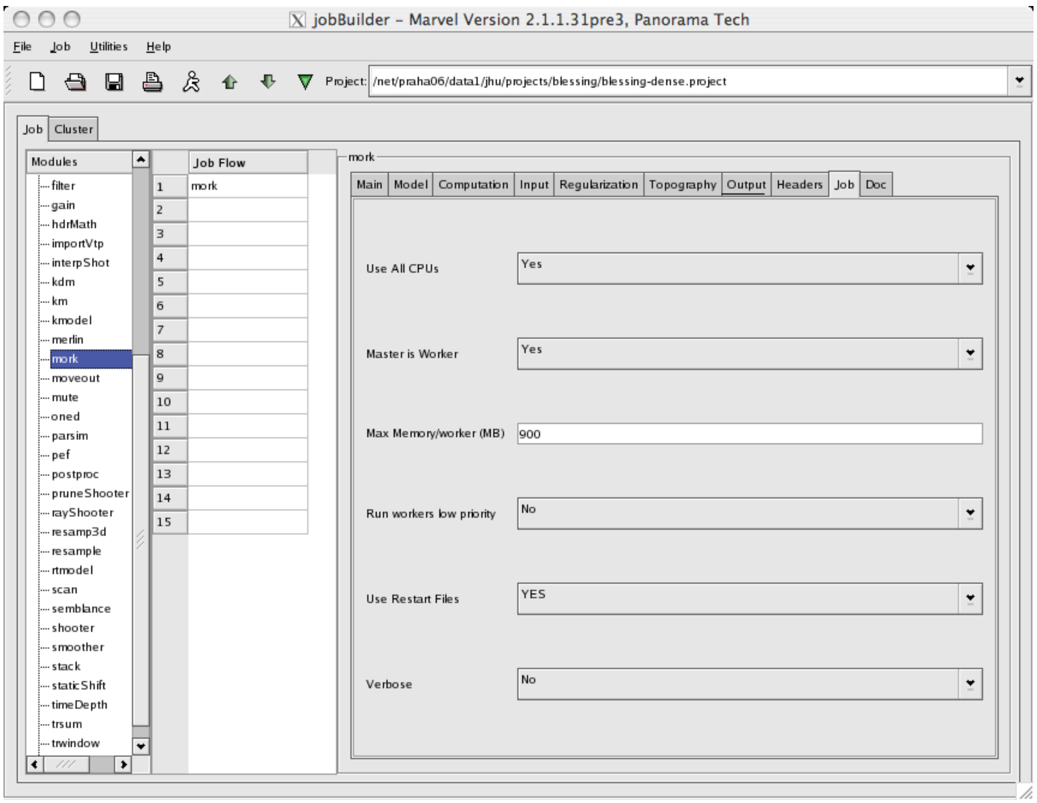


Table 73. MORK Job Panel Fields

Field	Description
Use All CPUs	This really means that each worker should use multiple threads. If No, then there will be one independent worker spawned for each CPU (or core) in the cluster. default: Yes
Master is Worker	Flag that controls whether the master I/O controller is also used for performing calculations. default: Yes
Max Memory/worker (MB)	default: 900

continues on next page

Table 73. MORK Job Panel Fields–continued

Field	Description
Run workers low priority	If Yes, workers will be spawned with reduced priority, although the master process will remain at high priority. This can be useful, especially when *MasterIsWorker* is set, so that one worker does not slow down collection or submission of shots for all of the others. default: No
Use Restart Files	If No, the job will ignore restart information and start from the beginning. default: Yes
Verbose	Switch for turning debug printing on and off. default: No

moveout Module

The moveout module either applies normal moveout (NMO) or the inverse of NMO to input traces.

moveout Main Panel

This panel enables you to define the basic parameters for the moveout module. There are two different versions of the panel depending on the model type you use, Gridded (Figure 100) or RMS Picks. Table 74 describes the terms used on both panels.

Figure 100. moveout Main Panel–Model Type, Gridded

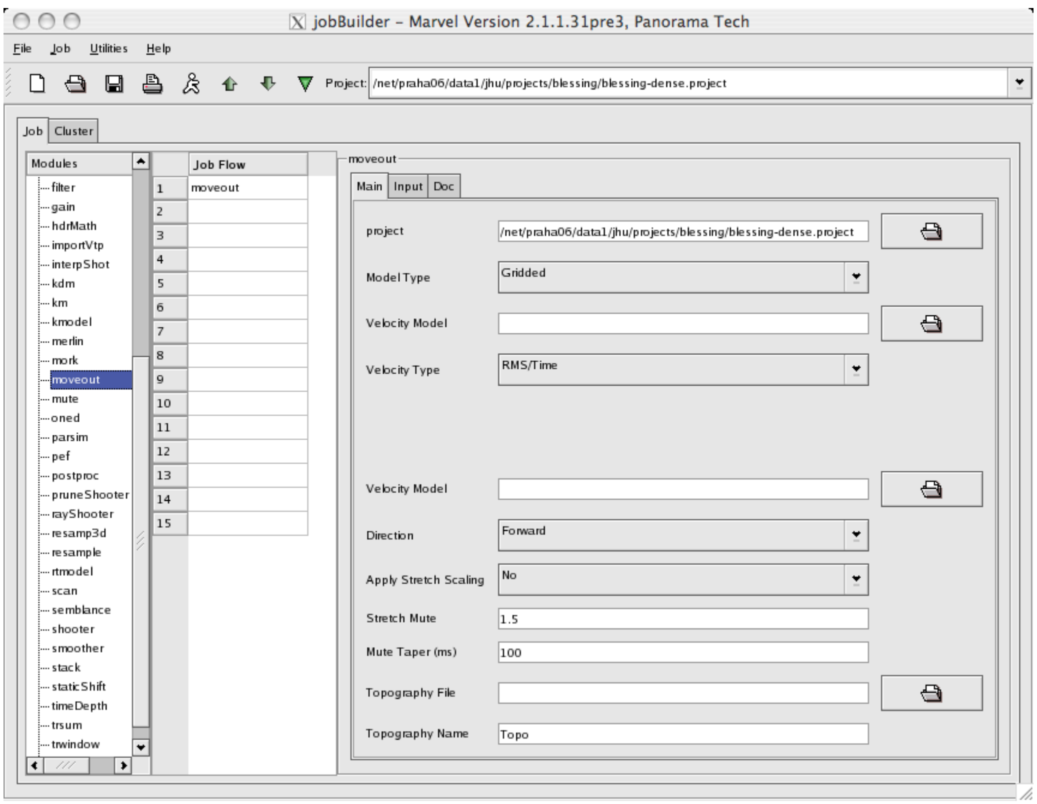


Table 74. moveout Module Main Panel Fields

Field	Description
project	The name of the project. The project file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.

continues on next page

Table 74. moveout Main Panel Fields–continued

Field	Description
Model Type	The model type to be used for this run: Gridded or RMS Picks. default: Gridded
Velocity Model	The path and filename of the velocity model to be used in the calculations. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data. **This field is only displayed for a Gridded Model Type.**
Velocity Type	The type of velocity being used, that is, interval time, interval depth, or RMS/Time. **This field is only displayed for a Gridded Model Type.** default: RMS/Time
Picks	**This field is only displayed for the RMS Picks Model Type.**
Direction	Specifies whether NMO or inverse NMO is used in the calculations. default: Inverse
Apply Stretch Scaling	If yes, divide output samples by stretch factor. default: No
Stretch Mute	The time, in seconds, defining when the stretch mute is applied. Samples that are larger than the stretch factor are muted. default: 1.5
Mute Taper	The length of the mute taper, in milliseconds, where the mute taper avoids edge artifacts produced in any frequency domain processing due to abrupt start of data at the mute. default: 100
Topography File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20
Topography Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

moveout Input Panel

The moveout Input panel, Figure 101, enables you to define several data keys used in the input data. The fields are described in Table 75.

Figure 101. moveout Input Panel

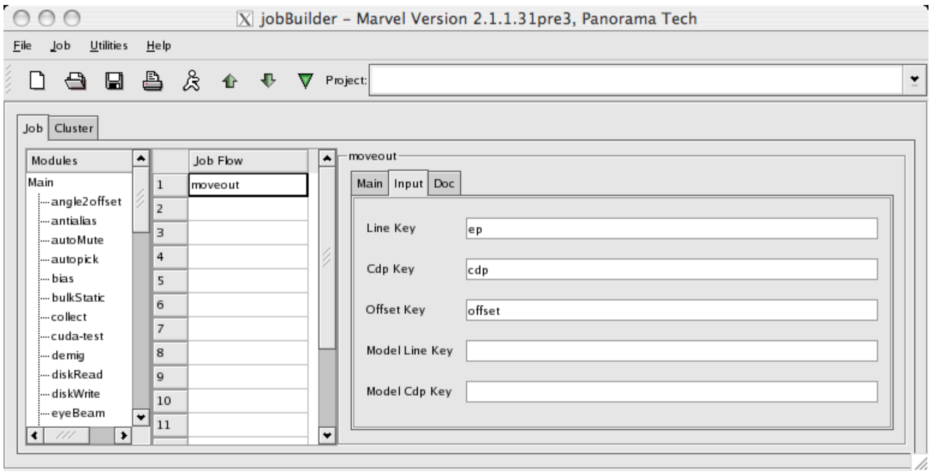


Table 75. moveout Input Panel Fields

Field	Description
Line Key	The header key specifying where line data is stored in the trace. default: ep
Cdp Key	Header key defining the location of the CDP data in the trace. default: cdp
Offset Key	Header key defining the location of the offset in the trace. default: offset
Model Line Key	The header word key for line information when the model is gridded. Use if different from the data. default: same as data
Model Cdp Key	The header word key for CDP information when the model is gridded. Use if different from the data. default: same as data

mute Module

The mute module mutes above, below, or along a linearly-interpolated curve whose width is defined by the times in the mute file, or by the mute X and T values. Mute values are extrapolated to the left by the smallest time sample on the trace, and they are extrapolated to the right by the last value given in the various mute arrays. (For the purposes of this program, above means shorter time and below means longer time, as would normally be seen on a seismic section.) The linear option allows you to define a corridor around a central line to remove air-blasts or other linear events from the gather. In this case, the mute is defined by the linear velocity parameter.

mute Main Panel

There are three mute Main panels that enable you to set parameter values used in the mute module depending on the location of the Mute Source, Figure 102, Figure 103 and Figure 104. The parameter fields are described in Table 76.

Figure 102. mute Main Panel, From Pickfile

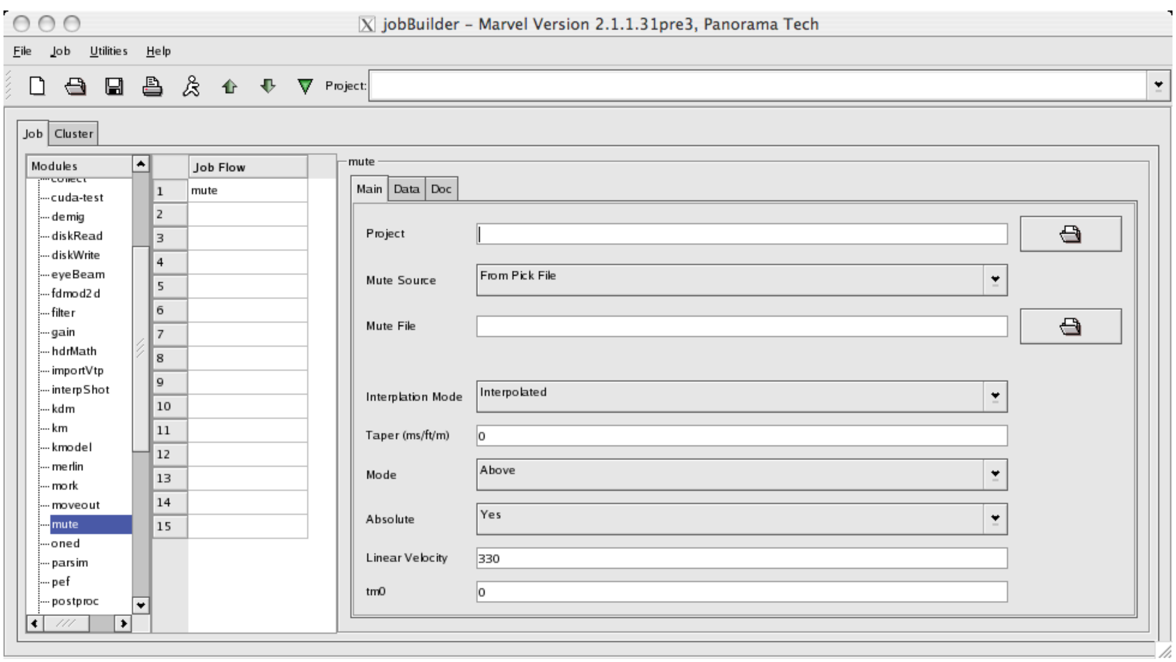


Figure 103. mute Main Panel, From Data Headers

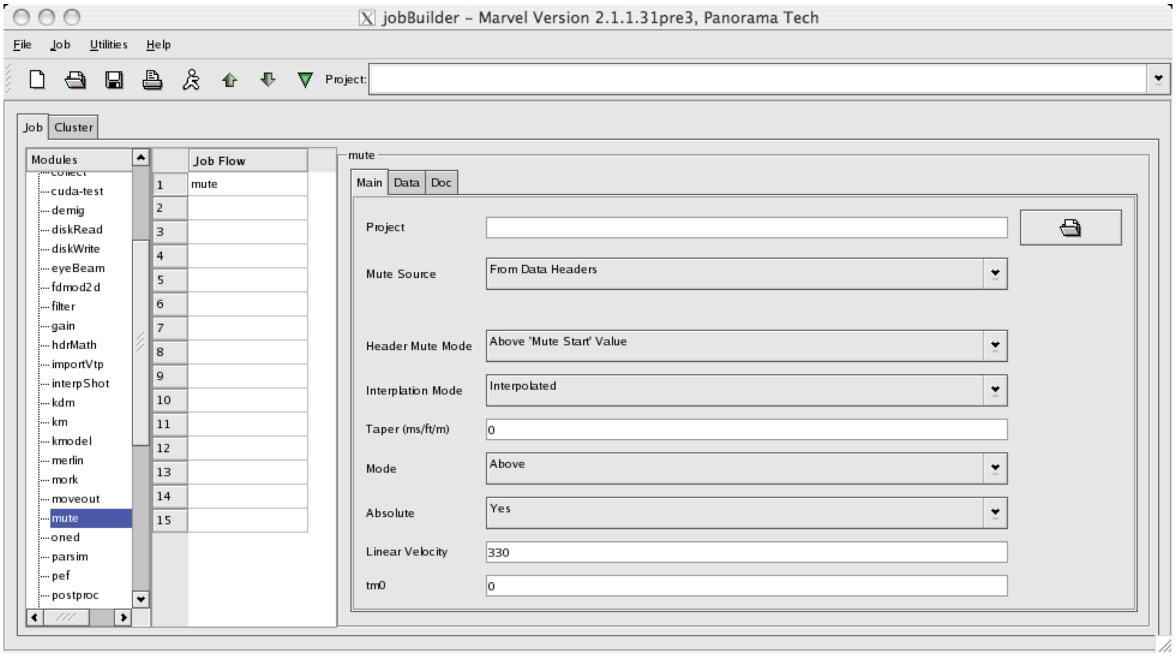


Figure 104. mute Main Panel, From Parameters

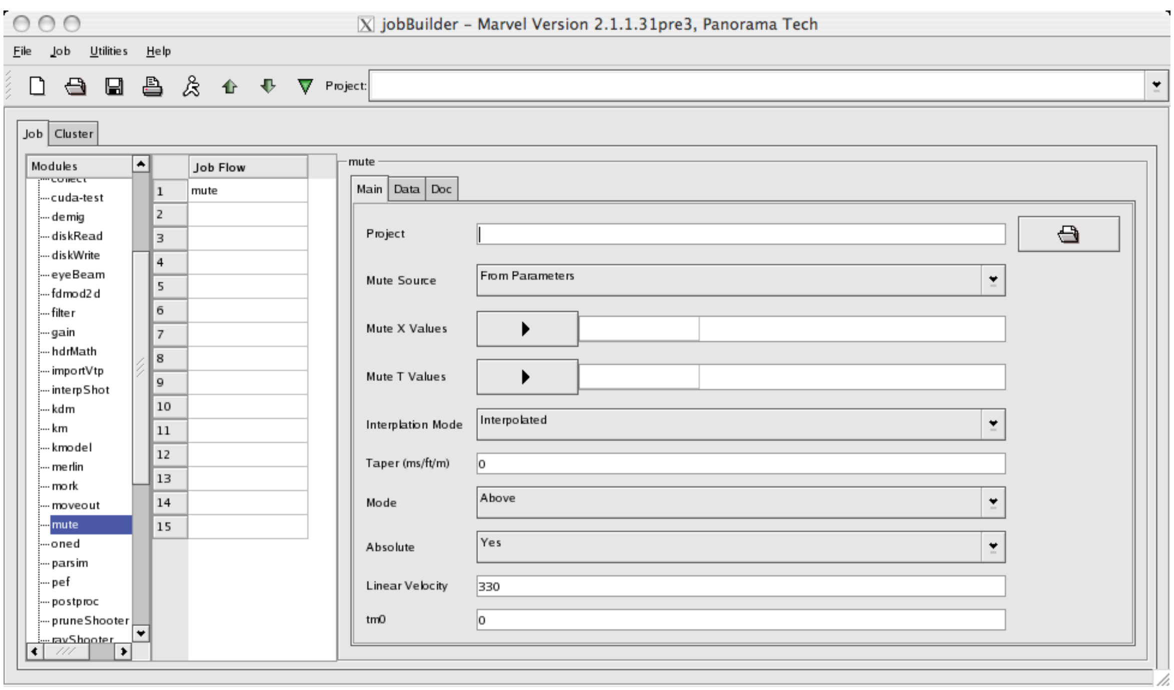


Table 76. mute Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Mute Source	Identifies the source of mute information: From Pick File, From Data Headers, or From Parameters.
Mute File	A *.pick* file picked in the gathers program. This file can contain a large number of time-mute or depth-mute pairs for use in the muting process. **This field is only displayed if the Mute Source is From Pick File.**
Header Mute Mode	**This field is only displayed if the Mute Source is From Data Headers.** default: Above Mute Start Value
Mute X Values	**This field is only displayed if the Mute Source is From Parameters.**
Mute T Values	**This field is only displayed if the Mute Source is From Parameters.**
Interpolation Mode	Interpolation mode that is to be used: Interpolated or Exclusive, where exclusive means that traces without mutes are not passed. default: Interpolated
Taper	The number of samples to taper (using a sine-squared taper) before a hard mute. default: 0
Mode	Mute above, below, or along a linearly-interpolated curve whose width is defined by the times in the mute file. default: Above
Absolute	Defines whether or not the module uses the absolute value of the offset parameter. default: Yes
Linear Velocity	The linear or apparent velocity defining the arrival times of the air-blast when muting linear events. default: 330
tm0	The start time for the mute process. default: 0

mute Data Panel

The mute data panel, Figure 105, enables you to specify the keys used with the data. The key fields are described in Table 77.

Figure 105. mute Data Panel

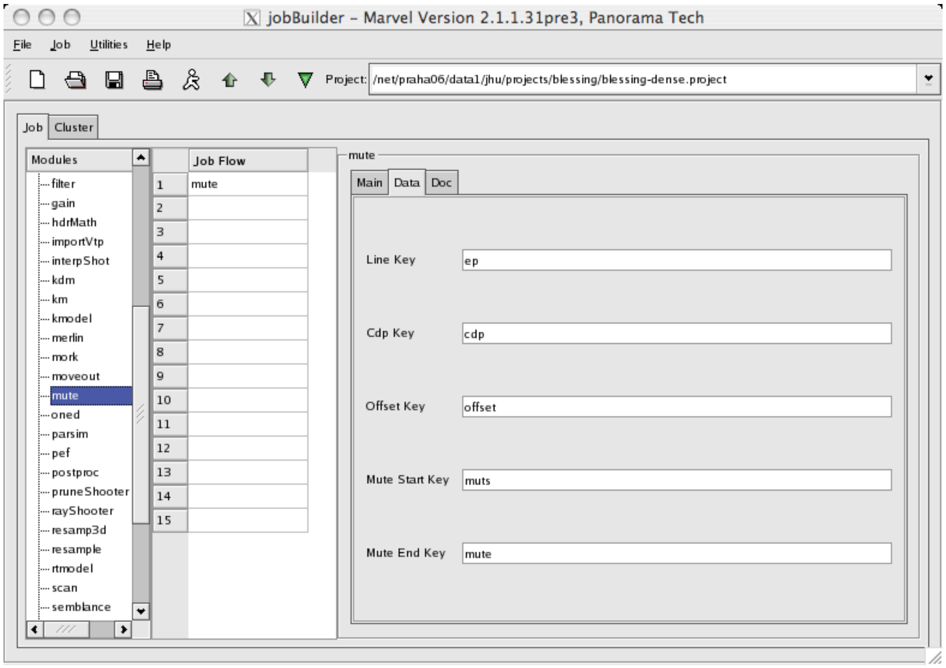


Table 77. mute Data Panel Fields

Field	Description
Line Key	Header key for the line number. default: ep
Cdp Key	Header key for the CDP number. default: cdp
Offset Key	Header key for the offset value. default: offset
Mute Start Key	Header key signifying the start of the mute values. default: muts
Mute End Key	Header key signifying the end of the mute values. default: mute

oned Module

Figure 106. oned Main Panel

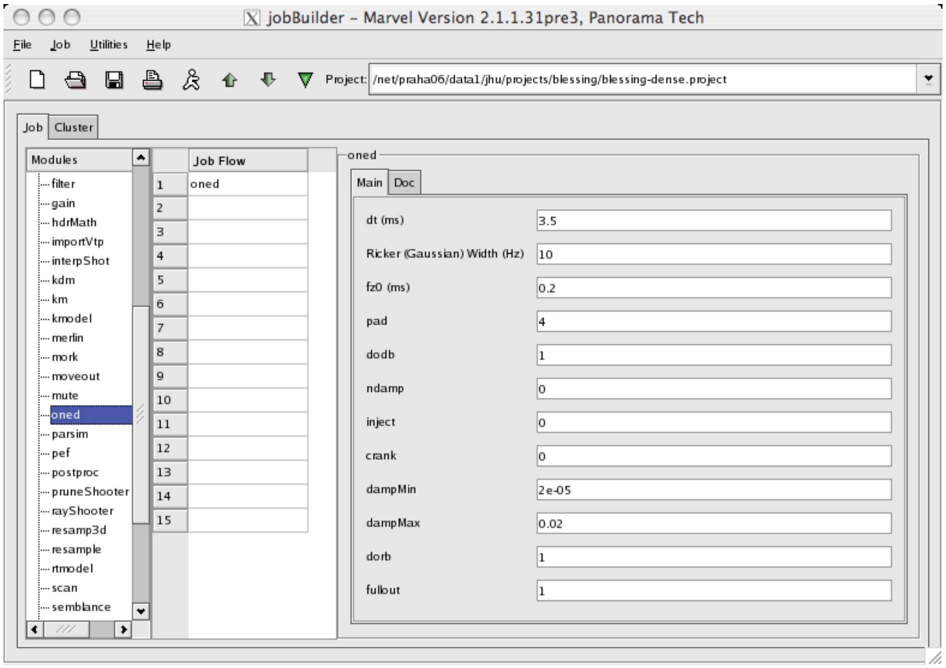


Table 78. oned Panel Fields

Field	Description
dt	default: 3.5
Ricker (Gaussian) Width (Hz)	default: 10
fz0 (ms)	default: 0.2
pad	default: 4
dodb	default: 1
ndamp	default: 0

continues on next page

Table 78. oned Panel Fields–continued

Field	Description
inject	default: 0
crank	default: 0
dampMin	default: 2e-05
dampMax	default: 0.02
dorb	default: 1
fullout	default: 1

parsim Module

Figure 107. parsim Main Panel, Stack Output Mode

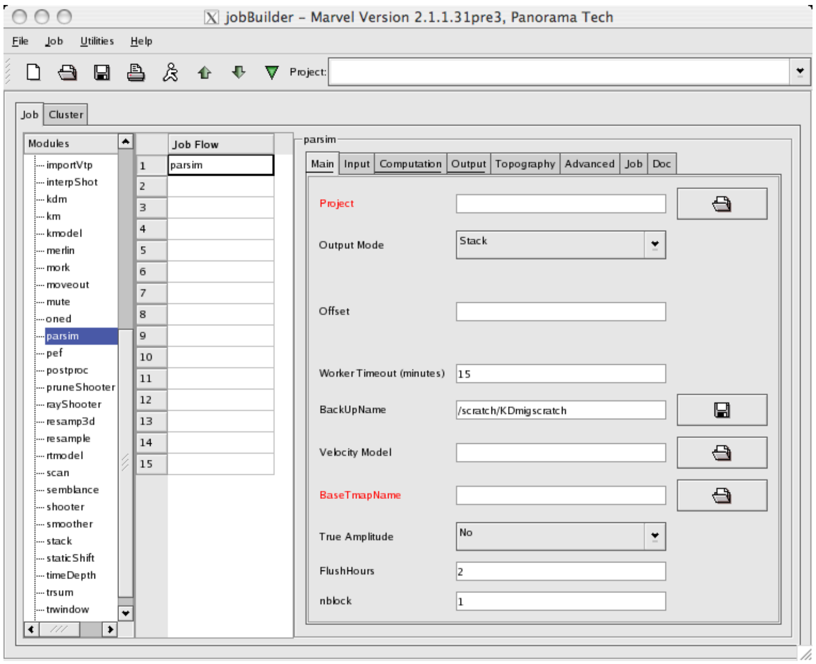


Figure 108. parsim Main Panel, Offsets Output Mode

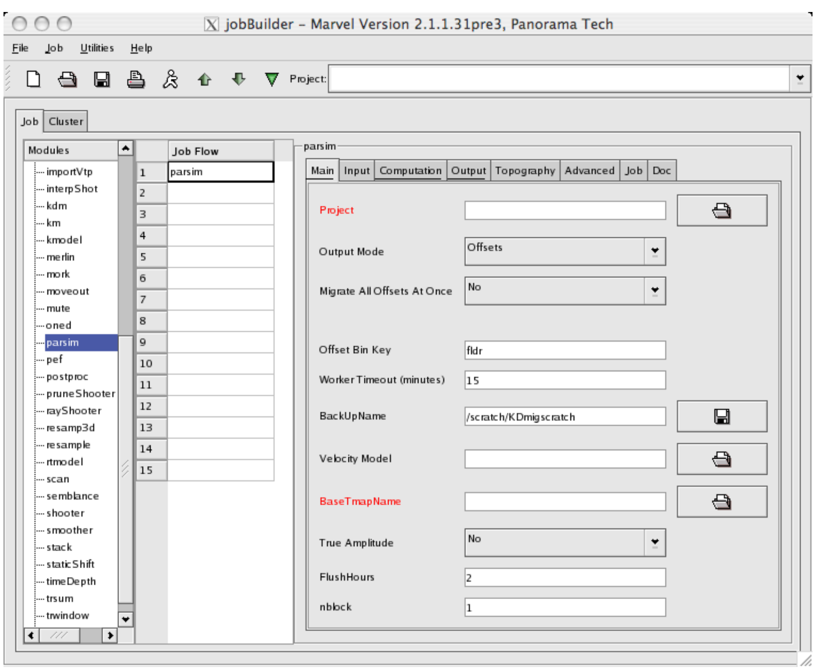


Table 79. parsim Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a REQUIRED entry.**
Output Mode	The mode to write the files: Stack or Offsets.
Offset	
Migrate All Offsets At Once	Enables all offsets to be held in memory at one time. This is good for increasing I/O performance. **This field is only visible for Offsets Output Mode.** default: No
Offset Bin Key	The header key for the offset bin parameter. **This field is only visible for Offsets Output Mode.** default: fldr
Worker timeout (minutes)	Worker components that have not responded in this amount of time are assumed to be dead. default: 15
BackupName	The name of the file to contain backup data if a restart becomes necessary. default: */scratch/KDmigscratch* **Note: This file is not deleted when a job finishes successfully. You must delete the file manually.**
Velocity Model	The path and filename of the velocity model to be used in the calculations. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data.
BaseTmapName	Base name of the required traveltime data. This name is the tmap file name without the `.tmap` extension. **Note: This is a REQUIRED entry.**
True Amplitude	If set, apply true-amplitude calculation. Yes or No.
Flush Hours	The time, in hours, between backups. default: 2
nblock	The size of the trace block. default: 1

parsim Input Panel

Figure 109. parsim Input Panel

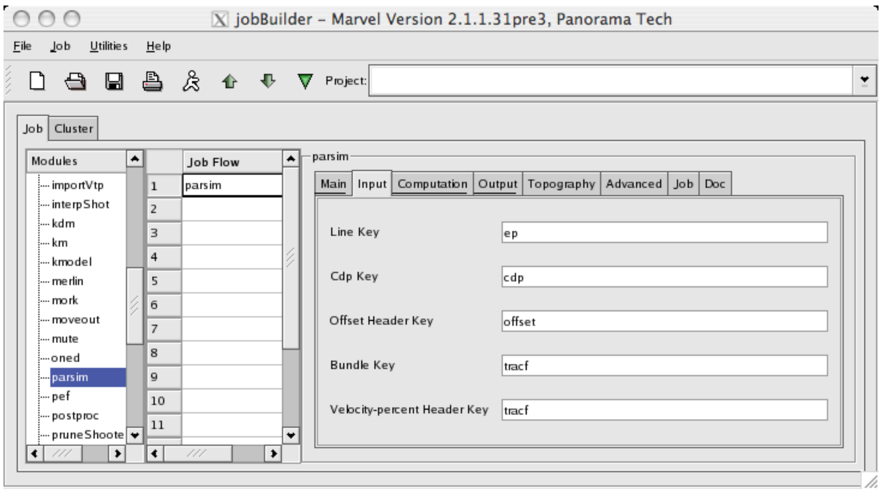


Table 80. parsim Input Fields

Field	Description
Line Key	Header key for the line number. default: ep
Cdp Key	Header key for the CDP number. default: cdp
Offset Header Key	The header key defining the offset field of the stacked trace. default: offset
Bundle Key	default: tracf
Velocity-percent Header Key	default: tracf

parsim Computation Panel

Figure 110. parsim Computation Panel

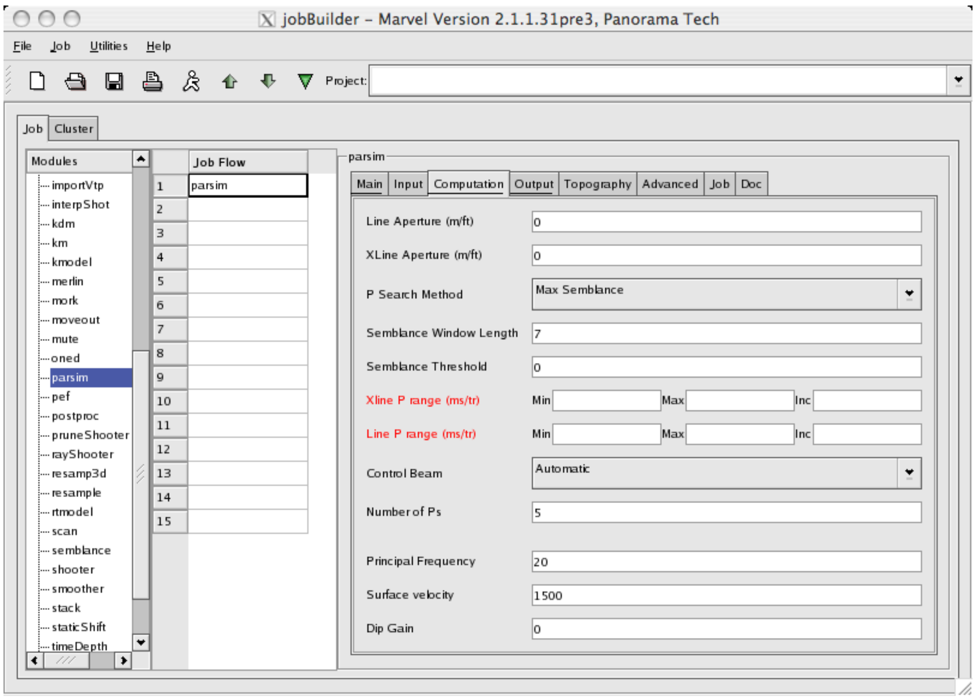


Table 81. parsim Computation Panel Fields

Field	Description
Line Aperture (m/ft)	default: 0
XLine Aperture (m/ft)	default: 0
P Search Method	Max Semblance or Max Stack
Semblance Window Length	**This field is only visible for a P Search Method of Max Semblance.** default: 7
Semblance Threshold	**This field is only visible for a P Search Method of Max Semblance.** default: 0
Xline P range (ms/tr)	**This field is a REQUIRED entry.**

continues on next page

Table 81. parsim Computation Panel Fields–continued

Field	Description
Line P range (ms/tr)	**This field is a REQUIRED entry.**
Control Beam	• No Control • Fixed P Range • Automatic
Number of P's	default: 5
P spring range	**This field is only visible for a Fixed P Range value for the Control Beam.** default: 0.5
Principal Frequency	**This field is only visible for an Automatic value for the Control Beam.** default: 20
Surface Velocity	The near surface velocity in Equation 2 on page 25. **This field is only visible for an Automatic value for the Control Beam.** default: 1500
Dip Gain	Variable that enables you to control dip. The value can range from 0 through 100. default: 0, do not apply a gain

parsim Output Panel

Figure 111. parsim Output Panel

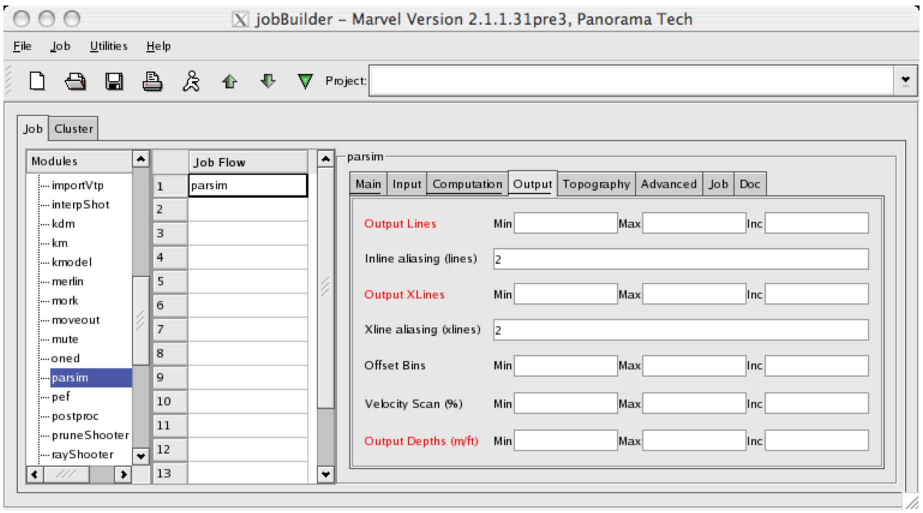


Table 82. parsim Output Panel Fields

Field	Description
Output Lines	Minimum, Maximum and Increment **This is a REQUIRED entry.**
Inline Aliasing (lines)	Attempt to compensate for aliasing in the inline direction (units: lines). **Note: This can be a costly operation.** **default: 2**
Output XLines	Minimum, Maximum and Increment **This is a REQUIRED entry.**
Xline Aliasing (xlines)	Attempt to compensate for aliasing in the crossline direction (units: lines). **Note: This can be a costly operation.** **default: 2**
Offset Bins	Specifies the offset bins in which to read the data. Enter the Minimum, Maximum and Increment values.
Velocity Scan (%)	Minimum, Maximum and Increment
Output Depths (m/ft)	Defines the minimum, maximum, and increment for the each output trace. **This is a REQUIRED entry.**

parsim Topography Panel

Figure 112. parsim Topography Panel

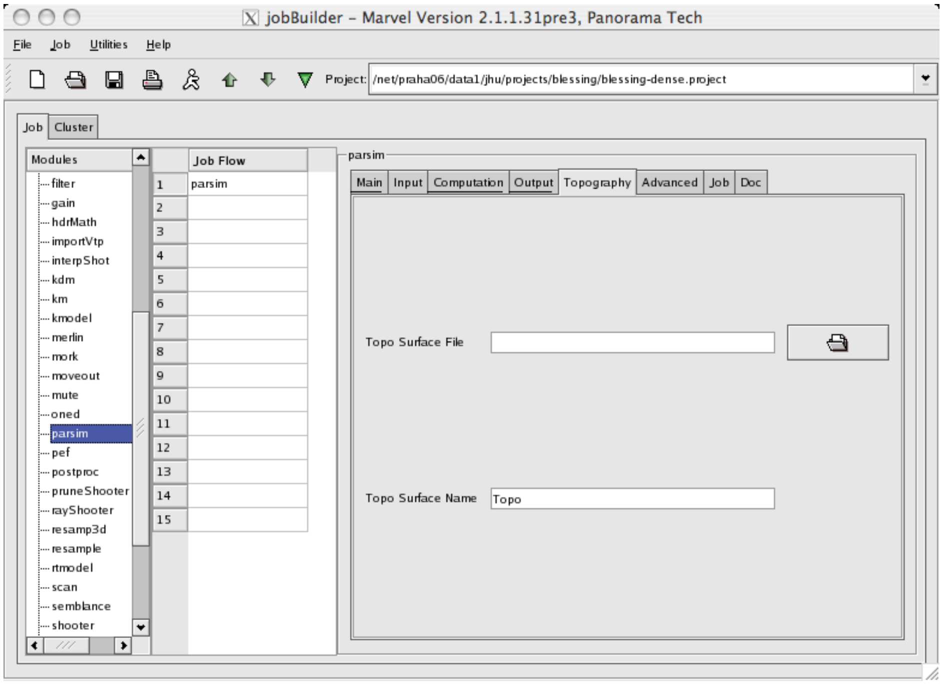


Table 83. parsim Topography Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

parsim Advanced Panel

Figure 113. parsim Advanced Panel

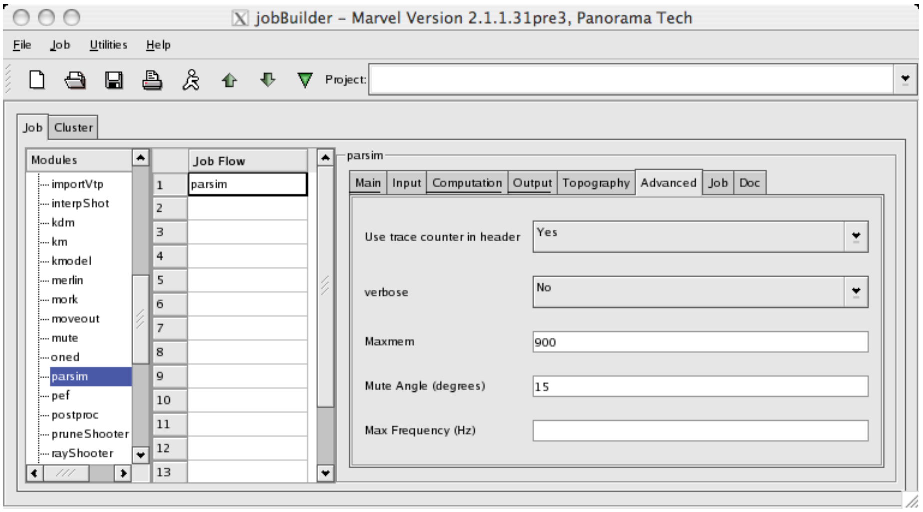


Table 84. parsim Advanced Panel Fields

Field	Description
Use trace counter in header	Flag indicating whether or not the trace counter that diskRead puts in the trace header will be used. default: Yes
verbose	Switch for turning debug printing on and off. default: No
Maxmem	Maximum amount of memory to be used by MARVEL per kdm instance. default: 900
Mute Angle	The angle, in degrees, measured down from the surface defining a cone limiting the near surface aperture. default: 15
Max Frequency	The maximum frequency allowed by the filtering process.

parsim Job Panel

Figure 114. parsim Job Panel

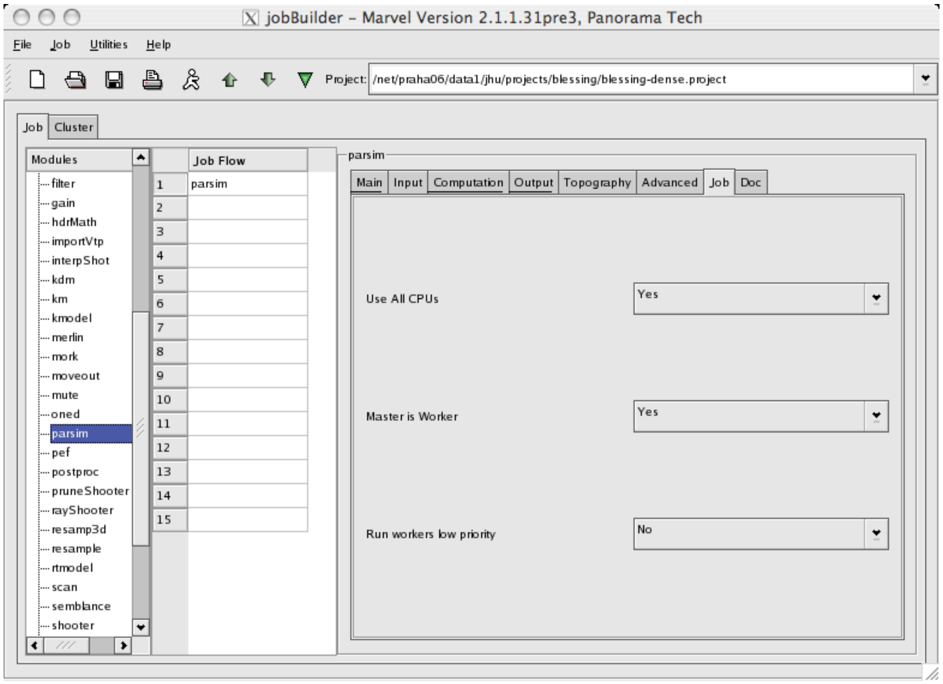


Table 85. parsim Job Panel Fields

Field	Description
Use All CPUs	This really means that each worker should use multiple threads. If *No*, then there will be one independent worker spawned for each CPU (or core) in the cluster.
Master is Worker	Yes—workers will be spawned on the master node of the job. No—workers will NOT be spawned on the master node of the job.
Run workers low priority	If *Yes*, workers will be spawned with reduced priority. although the master process will remain at high priority. This can be useful especially when *MasterIsWorker* is set to *Yes*, so that one worker does not slow down the collection or submission of shots for all of the others.

pef Module

Figure 115. pef Main Panel

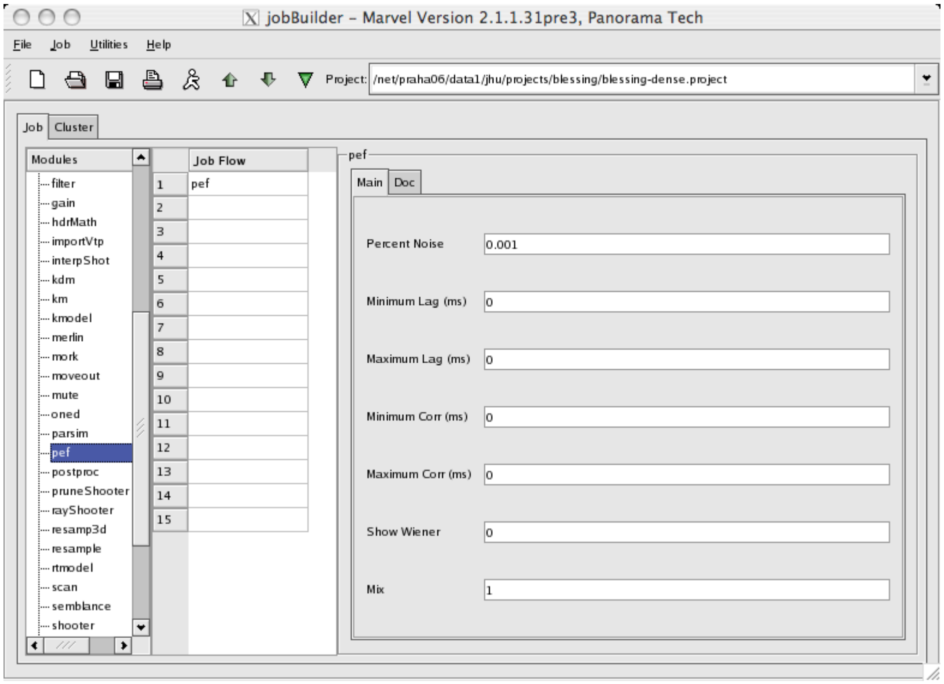


Table 86. pef Panel Fields

Field	Description
Percent Noise	default: 0.001
Minimum Lag (ms)	default: 0
Maximum Lag (ms)	default: 0
Minimum Corr (ms)	default: 0
Maximum Corr	default: 0
Show Wiener	default: 0

continues on next page

Table 86. pef Panel Fields–continued

Field	Description
Mix	default: 1

postproc Module

The postproc Module Main panel, Figure 116, enables you to set parameter values used in the postproc module. The parameter fields are described in Table 87.

Figure 116. postproc Module Main Panel

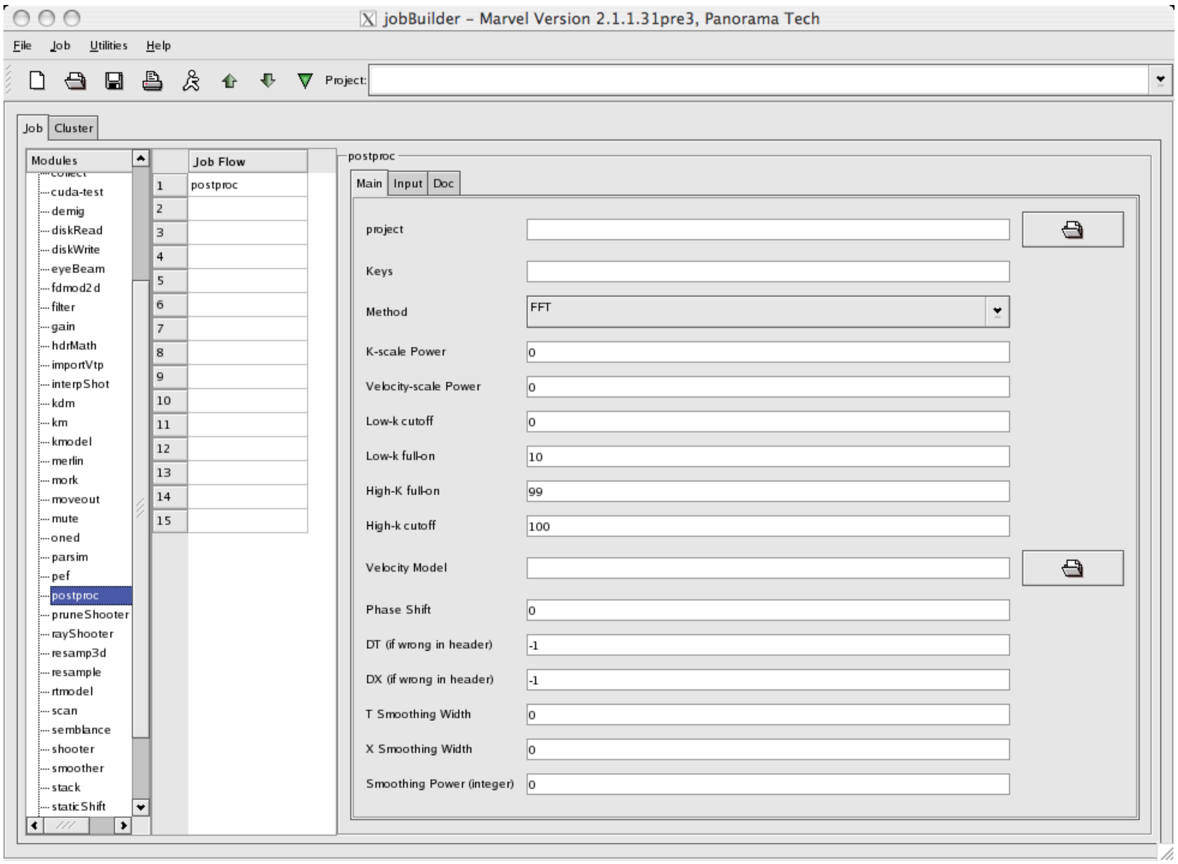


Table 87. postproc Module Main Panel Fields

Field	Description
project	The name of the project. The project file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Keys	
Method	Bias, Laplace, Bias 2, FFT, FFT Deriv, None default: Bias
K-scale Power	default: 0

continues on next page

Table 87. postproc Module Main Panel Fields–continued

Field	Description
Velocity-scale Power	default: 0
Low-k cutoff	default: 0
Low-k full-on	default: 10
High-k full-on	default: 99
High-k cutoff	default: 100
Velocity Model	The path and filename of the velocity model to be used in the calculations. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data.
Phase Shift	**This field is only visible for the FFT and FFT Deriv methods.** default: 0
DT (if wrong in header)	default: -1
DX (if wrong in header)	default: -1
T Smoothing Width	default: 0
X Smoothing Width	default: 0
Smoothing Power (integer)	default: 0

postproc Input Panel

The postproc Module Input panel, Figure 117, enables you to set parameter values used in the postproc module. The parameter fields are described in Table 88.

Figure 117. postproc Module Input Panel

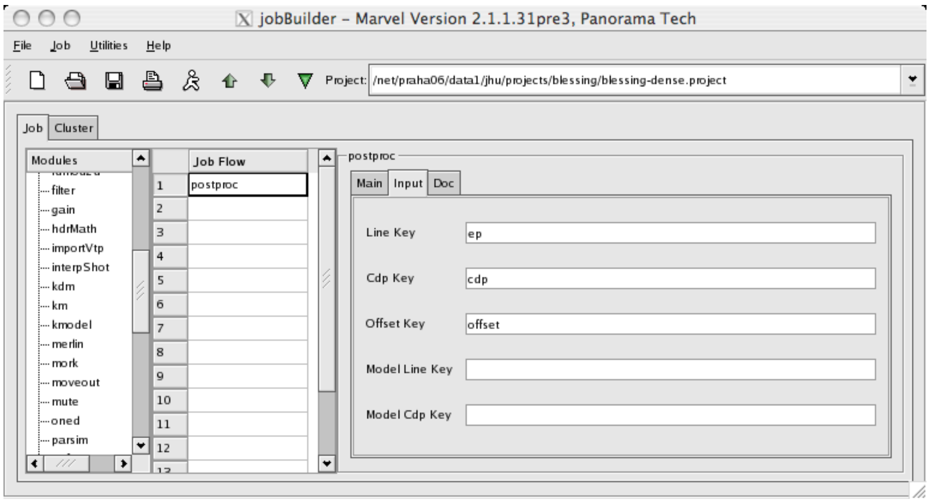


Table 88. postproc Module Input Panel Fields

Field	Description
Line Key	Header key for the line number. default: ep
Cdp Key	Header key for the CDP number. default: cdp
Offset Key	The header key defining the offset field of the stacked trace. default: offset
Model Line Key	The header word key for line information when the model is gridded. Use if different from the data.
Model Cdp Key	The header word key for CDP information when the model is gridded. Use if different from the data.

pruneShooter Module

The pruneShooter module is one of three MARVEL interfaces to a dynamic-anisotropic-maximum energy-travel-time generator. Although this module is still provided for compatibility purposes, its use has been deprecated. It is recommended that you now use the rayshooter module, instead, which combines both the pruneShooter and Shooter modules with more advanced features.

See also rayshooter Module.

pruneShooter Main Panel

Figure 118 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 89.

Note:

If the output range is smaller then the aperture range, the output range is used to limit the size of the traveltime table.

Figure 118. pruneShooter Module Main Panel

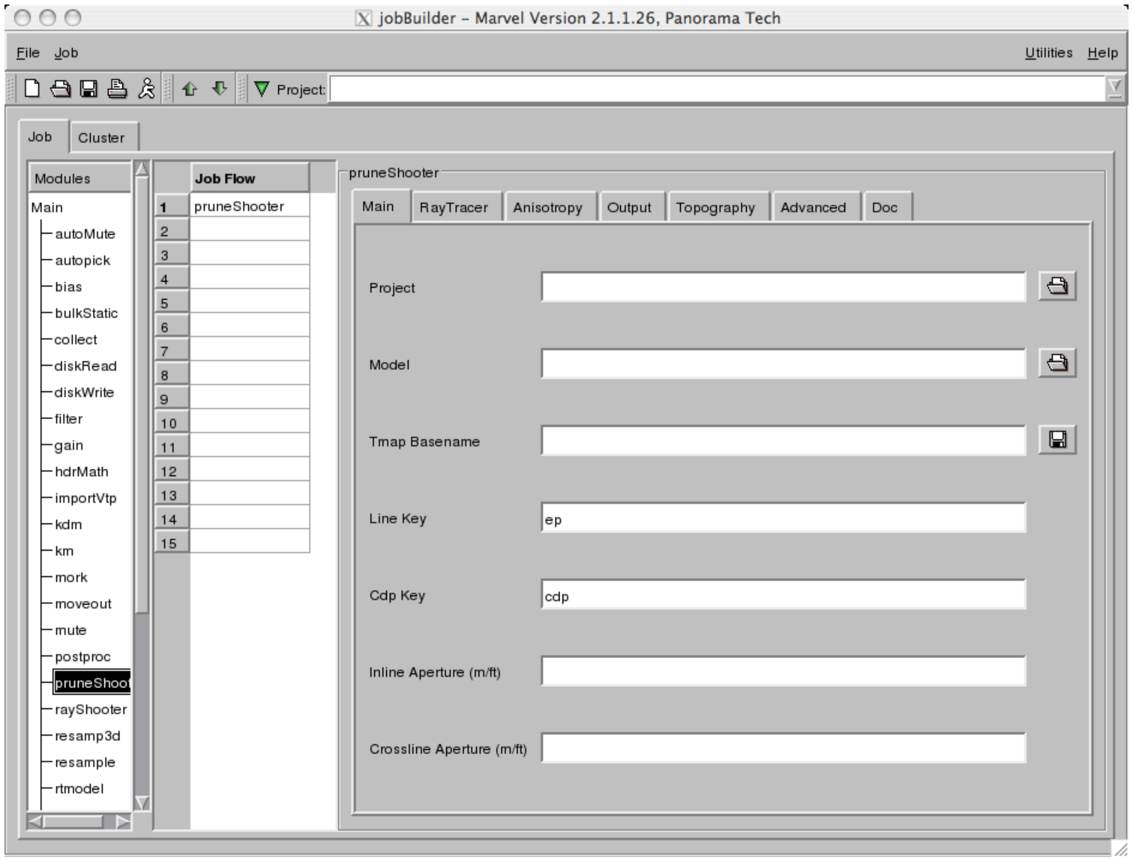


Table 89. pruneShooter Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Model	The name of the input model.
Tmap Basename	The prefix used to produce the traveltime output files with suffix *.tmap*.
Line Key	The header key for the line number in the model file. default: ep
Cdp Key	The header key for the CDP number in the model file. default: cdp
Inline Aperture	The output aperture in the line direction.

continues on next page

Table 89. pruneShooter Panel Fields–continued

Field	Description
Crossline Aperture	The output aperture, in meters or feet, of the crossline, or CDP, direction aperture limit.

pruneShooter RayTracer Panel

The pruneShooter module RayTracer panel, Figure 119, enables you to specify information that is to be used in ray tracing operations. The fields on the panel are described in Table 90.

Figure 119. pruneShooter Module RayTracer Panel

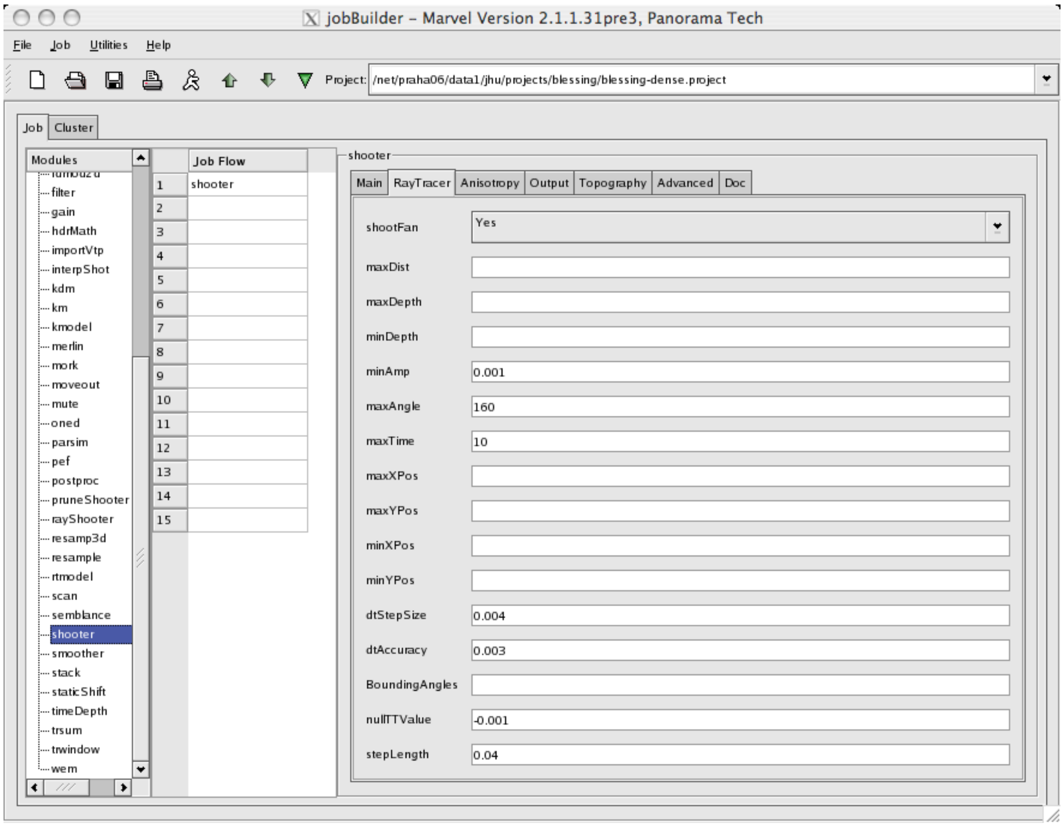


Table 90. pruneShooter Module RayTracer Panel Fields

Field	Description
shootFan	Selects the shooting direction: Yes causes rays to be shot toward deeper depths, while No causes rays to be shot upward toward shallower depths. default: Yes
maxDist	The maximum horizontal distance a ray can travel. If this parameter is defaulted to zero, the maximum distance a ray can travel is set to the maximum extent of the model.
maxDepth	The maximum depth a ray can travel. If this parameter is defaulted to 0, the maximum depth of a ray is set to the maximum depth of the model.

continues on next page

Table 90. pruneShooter Module RayTracer Panel Fields–continued

Field	Description
minDepth	The minimum depth a ray can travel. If this parameter is defaulted, the ray has no minimum depth.
minAmp	The cutoff amplitude of a ray. This value is in terms of $paraxialAmpxpathLengthxvelocity$. • In constant velocity, this value stays at 1.0 all along the ray. • For a linear velocity gradient starting with 5000 ft/sec at the surface and reaching 10000 ft/sec at a depth of 10000 feet, this value will be 0.66 at 10000 feet for a ray straight down. **Note: It is recommended that you set this value to about 0.10 so that only the very low amplitude rays are dropped. If you set the value to a large value, you will reduce run time at the expense of accuracy.** **default: 0.01**
maxAngle	The maximum angle a ray can attain. When set to 180 degrees, this can potentially cause the generation of turning rays and thus produce corresponding longer traveltimes. Generally, a reasonable compromise between speed and accuracy is to set this value in the neighborhood of 160 degrees. default: 160
maxTime	The maximum time a ray can travel. default: 10
maxXPos	The maximum line or crossline direction distance a ray end point can attain. This value can potentially override the maxDist parameter.
maxYPos	The maximum y or line direction distance a ray end point can attain. This value can potentially override the maxDist parameter.
minXPos	The minimum x or crossline direction distance a ray end point can attain. This value can potentially override the maxDist parameter.
minYPos	The minimum y or line direction distance a ray end point can attain. This value can potentially override the maxDist parameter.

continues on next page

Table 90. pruneShooter Module RayTracer Panel Fields–continued

Field	Description
dtStepSize	Ray tracing step length (in seconds) used for smoothing the velocity model. This is crucial for stability and for this routine to run quickly. The velocity is smoothed by $1.5 x averageVelocity x stepLength$. For a 60 Hz freq, the stepLength should be about 0.040 seconds. For velocities that average 7000 ft/sec, the smoothing is then 420 feet. **Note: Since ray tracing is adaptive, the smoothing value can actually be fairly small, but this is not recommended. In general, the velocity should be smoothed at least a few hundred feet and probably a few thousand.** **A value of 0.0 will turn off smoothing. If this value is not 0.0, but it is less than $2.5 x MIN(dx, dy)$, the value will be set to $2.5 x MIN(dx, dy)$.** **default: 0.004**
dtAccuracy	The desired accuracy of travel times. The recommended value is about $0.25 x 0.5/maxFrequency$. Therefore, for 60 Hz data, dtAccuracy is 0.002 sec. default: 0.003
BoundingAngles	The take-off angles anglex1, anglex2, angley1 and angley2 that bound the initial ray fan, and define the direction cosines off vertical. The four values define an initial cone and provide a convenient method for limiting near surface apertures during the migration process. These four angles usually have values of about 70, -70, 70, -70. Examples: • anglex1 = -90, angley1 = 0 means horizontal in the negative x direction • anglex2 = 0, angley2 = 90 means horizontal in the positive y direction • anglex1 = 0,angley1 = 0 means a vertical ray.
nullTTValue	The value that is set inside a given zone where no rays have penetrated. This is a marker that tells the migration module not to image in these zones. default: -0.001
stepLength	The length of a time step along a ray. Because this value is adaptive, there is little reason to change the default value of .04 second. default: 0.04

pruneShooter Anisotropy Panel

The parameters in the pruneShooter module Anisotropy panel, Figure 120, define the various velocity model input options available for the acoustic and anisotropic raytracer. The fields on the panel are described in Table 91.

Note:

You must enter these files in the proper order. What the raytracer requires is enough information to define the *vvelfile* and *eta*. Thus, one and only one of following combinations must be entered:

- *epsilonfile*, *delfile*
- *vvelfile*, *etafile*
- *vvelfile*, *epsilon*
- *vvelfile*, *delfile*

Figure 120. pruneShooter Module Anisotropy Panel

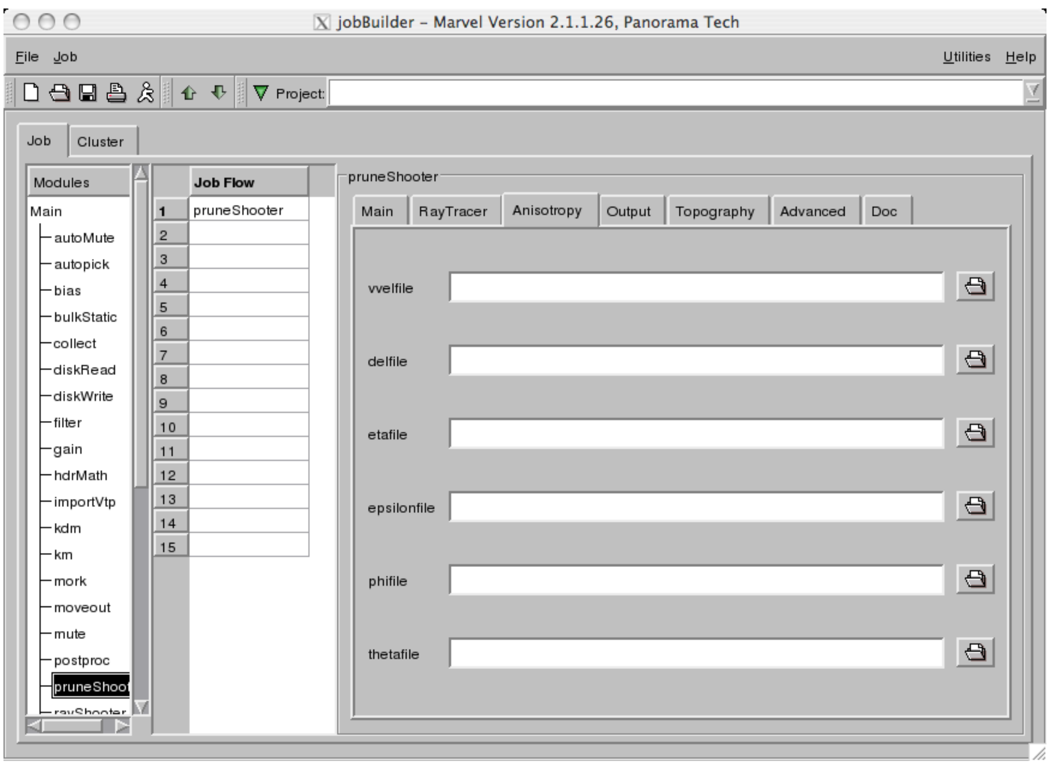


Table 91. pruneShooter Module Anisotropy Panel Fields

Field	Description
vvelfile	The name of the Vnmo file. This file is closely related to the vertical velocity field.
delfile	The name of the file containing Thomsen's delta.
etafile	The name of the file containing Thomsen's eta.
epsilonfile	The name of the file containing Thomsen's epsilon.
phifile	The name of the file containing Thomsen's phi.
thetafile	The name of the file containing Thomsen's theta.

pruneShooter Output Panel

This panel, Figure 121, enables you to control the output from the pruneShooter module. Table 92 describes the fields on the panel.

Figure 121. pruneShooter Module Output Panel

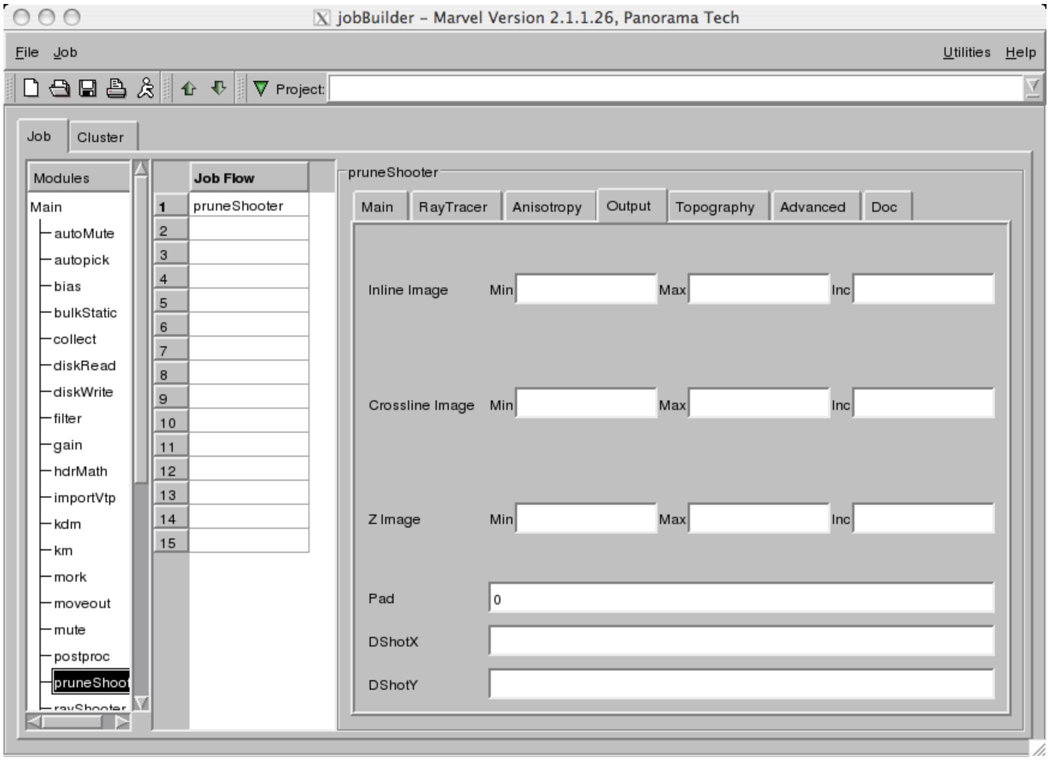


Table 92. pruneShooter Module Output Panel Fields

Field	Description
Inline Image	The minimum, maximum, and incremental line range of the shot locations of the output travel-time volumes.
Crossline Image	The minimum, maximum, and incremental CDP range of the shot locations of the output travel-time volumes.
Z Image	The minimum, maximum, and incremental depth of each travel-time volume.
Pad	The percent padding to apply to input traces. default: 0
DshotX	
DshotY	

pruneShooter Topography Panel

This panel, Figure 122, enables you to control the output from the shooter module. Table 93 describes the fields on the panel.

Figure 122. pruneShooter Module Topography Panel

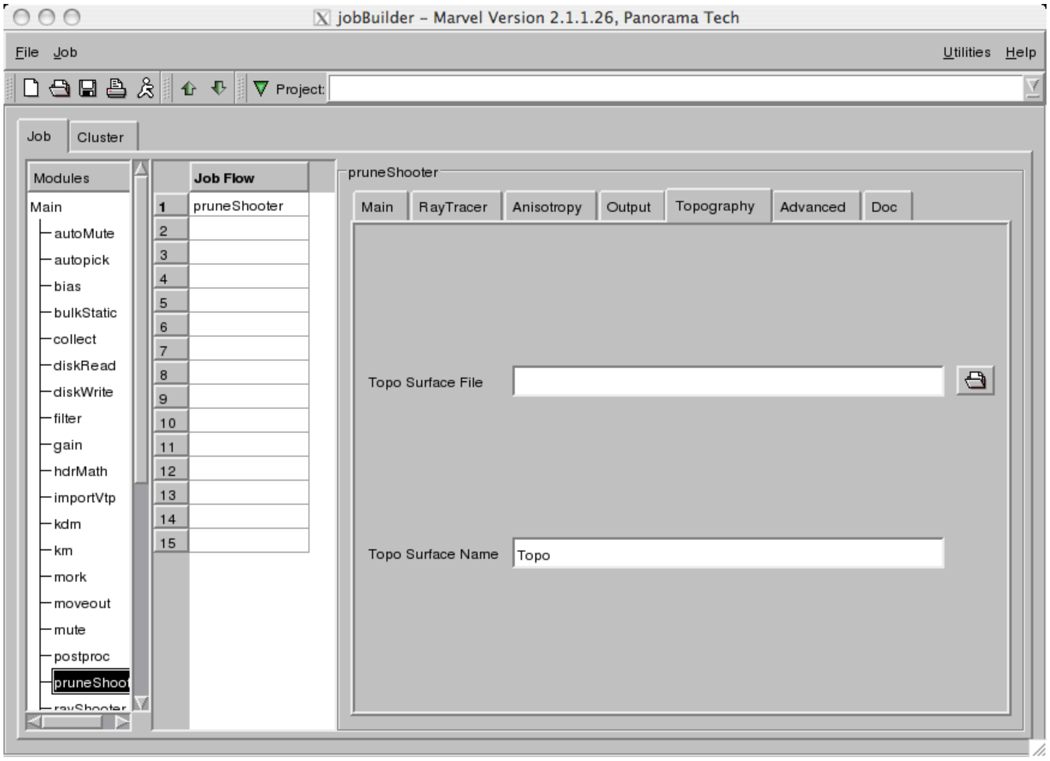


Table 93. pruneShooter Module Output Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep = 100 cdp = 500 z = 20
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

pruneShooter Advanced Panel

The pruneShooter module displays two versions of the Advanced panel depending on your Compress selection; all fields are shown in Figure 123. The field values are described in Table 94.

Figure 123. pruneShooter Module Advanced Panel–Compress, No

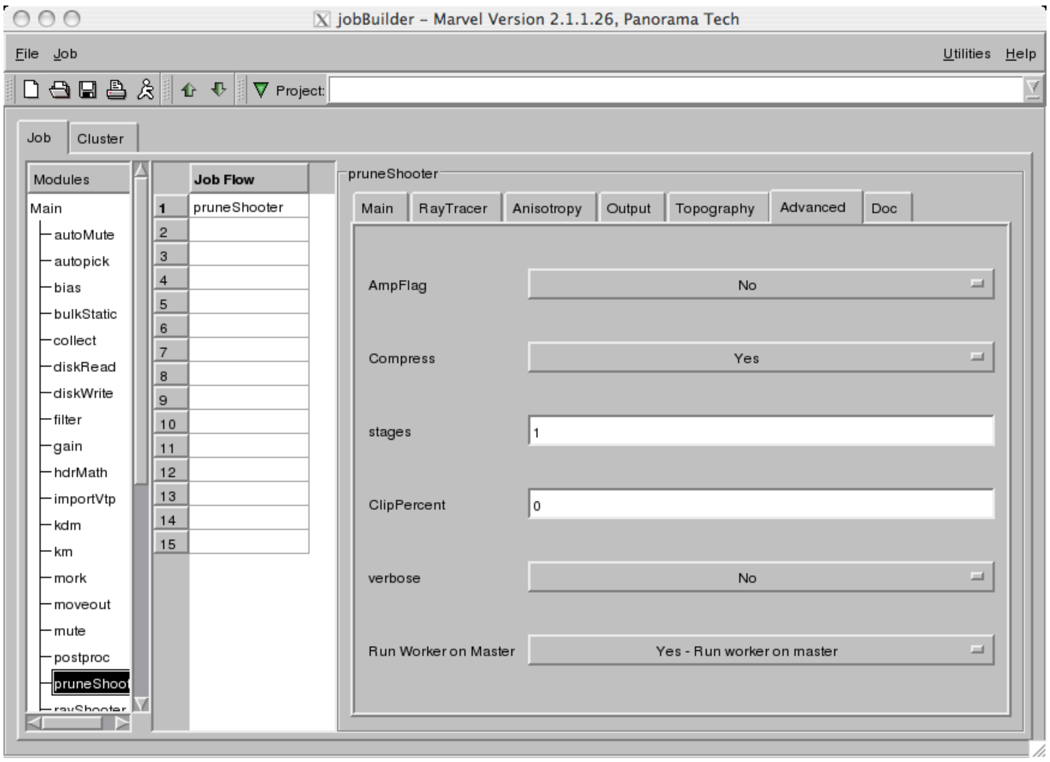


Table 94. pruneShooter Module Advanced Panel Fields

Field	Description
AmpFlag	Determines whether or not amplitudes are calculated and output. default: No
Compress	Determines whether or not traveltimes and amplitudes (if calculated) are compressed. default: Yes
stages	The number of stages to use in the wavelet-based compression scheme. This field is displayed only if *Compress* = *Yes* has been selected. default: 1

continues on next page

Table 94. pruneShooter Module Advanced Panel Fields–continued

Field	Description
ClipPercent	The percentage of the maximum amplitude defining the threshold in the wavelet domain below which amplitudes are zeroed. While clipping can increase compression efficiency, it can also seriously reduce accuracy. This field is displayed only if *Compress* = *Yes* has been selected. default: 0
verbose	Switch for turning debug printing on and off. default: No
Run Worker on Master	Determines whether or not the master is used in the computational process. default: Yes

rayshooter Module

The rayshooter module computes travel-time tables that are independent of output migration locations. Each such table or volume is centered on the shot location so when a sufficient number of shots have been computed, travel-time tables computed by this module are suitable for migrating to any output range. You should use this program when you expect to output a full volume, or when the targeted output may be arbitrarily defined. The rayshooter module combines the earlier pruneShooter and shooter modules together with more advanced features. Panorama Technologies recommends that you use the rayshooter module instead of either of the two other modules when possible.

rayshooter Main Panel

Figure 124 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 95.

Figure 124. rayshooter Module Main Panel

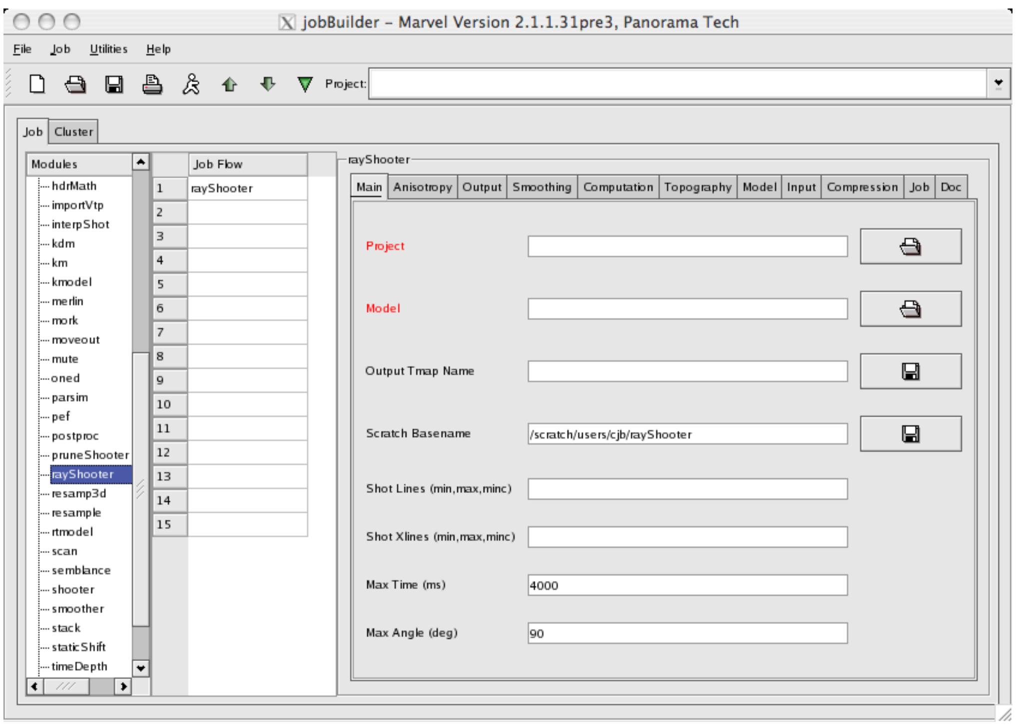


Table 95. rayshooter Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a required entry.**
Model	The name of the input model. **This is a required entry.**
Output Tmap Name	The name of the traveltime output file.
Scratch Basename	The application needs temporary storage for acquired data, accumulated image, and others. All of these filenames will start with this prefix. default: */scratch/rayShooter*
Shot Lines	minimum, maximum and minc
Shot Xlines	minimum, maximum and minc
Max Time (ms)	 default: 4000
Max Angle (deg)	 default: 90

rayshooter Anisotropy Panel

Figure 125 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 96.

Figure 125. rayshooter Anisotropy Panel

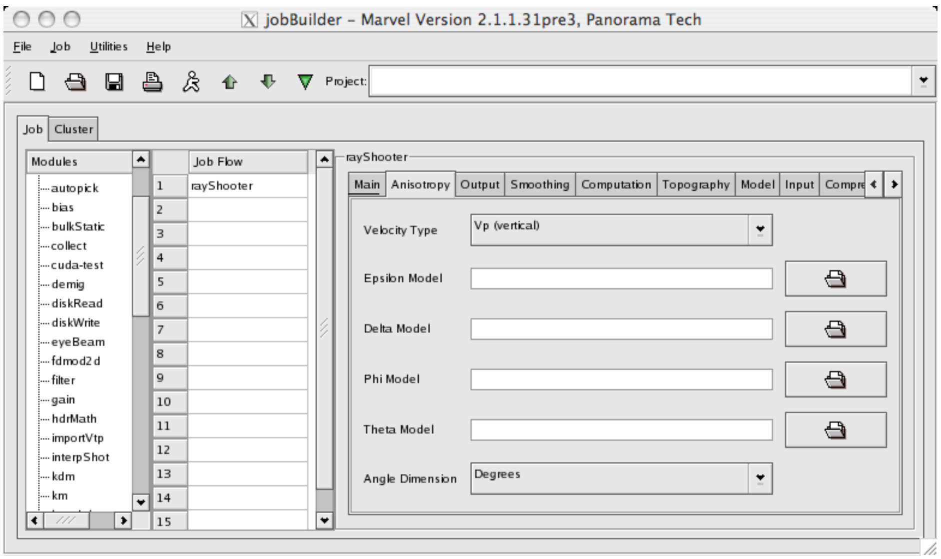


Table 96. rayshooter Anisotropy Panel Fields

Field	Description
Velocity Type	Vp (vertical) or VNMO (vertical)
Epsilon Model	
Delta Model	
Phi Model	
Theta Model	
Angle Dimension	Degrees or Radians

rayshooter Output Panel

Figure 126 and Figure 127 enable you to specify basic information to be used by the module. The fields on the panel are described in Table 97.

Figure 126. rayshooter Output Panel, Shot-Centered Mode

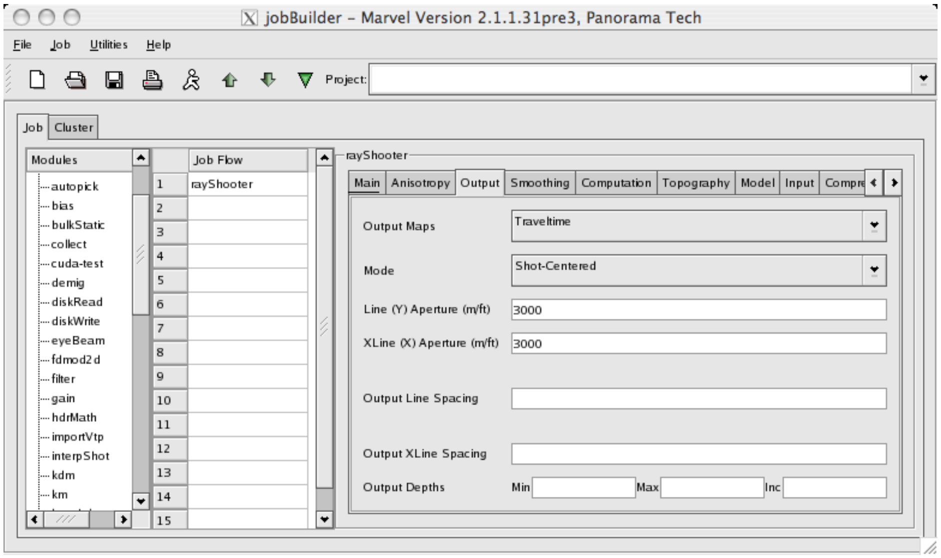


Figure 127. rayshooter Output Panel, Target-Volume Mode

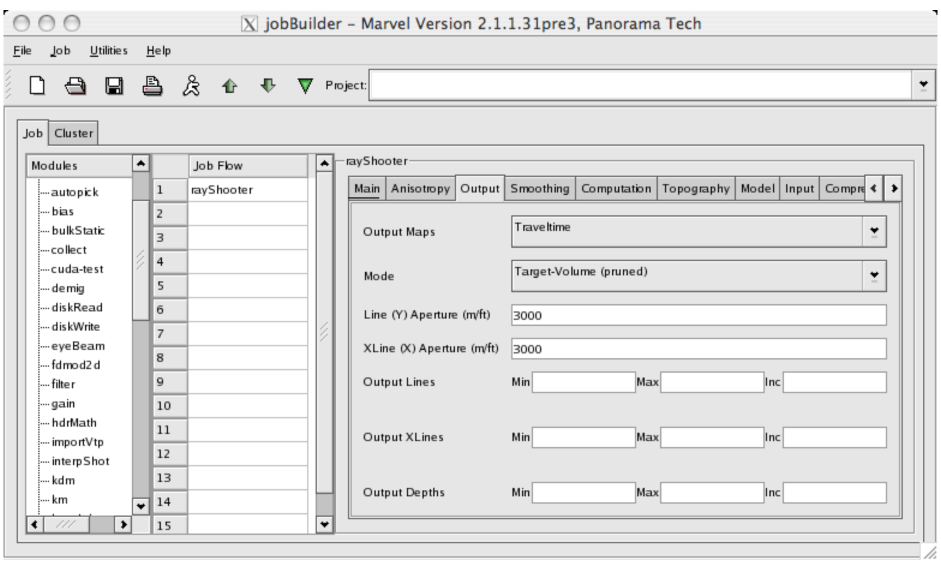


Table 97. rayshooter Output Panel Fields

Field	Description
Output Maps	• Traveltime • Traveltime/Amplitude • Traveltime/Takeoff Angle • Traveltime/Amplitude/Takeoff angle • Traveltime/Arrival Angle • Traveltime/Ampitude/Arrival angle • Traveltime/Takeoff/Arrival angle • Traveltime/Amplitude/Takeoff/Arrival angle default: Traveltime
Mode	Shot-Centered or Target Volume (pruned) default: Shot-Centered
Line (Y) Aperture (m/ft)	The length, in meters or feet, of the line direction aperture limit. default: 3000
XLine (X) Aperture (m/ft)	The length, in meters or feet, of the crossline (CDP) direction aperture limit. default: 3000
Output Lines	The Minimum, Maximum and Increment for the lines in the output. **This field is only displayed for Target-Volume Mode.**
Output XLines	The Minimum, Maximum and Increment for the crosslines in the output. **This field is only displayed for Target-Volume Mode.**
Output Line Spacing	The spacing for the output lines. **This field is only displayed for Shot-Centered Mode.**
Output XLine Spacing	The spacing for the output crosslines. **This field is only displayed for Shot-Centered Mode.**
Output Depths	Minimum, Maximum, Increment for output depths. Valid for both modes.

rayshooter Smoothing Panel

Figure 128 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 98.

Figure 128. rayshooter Smoothing Panel

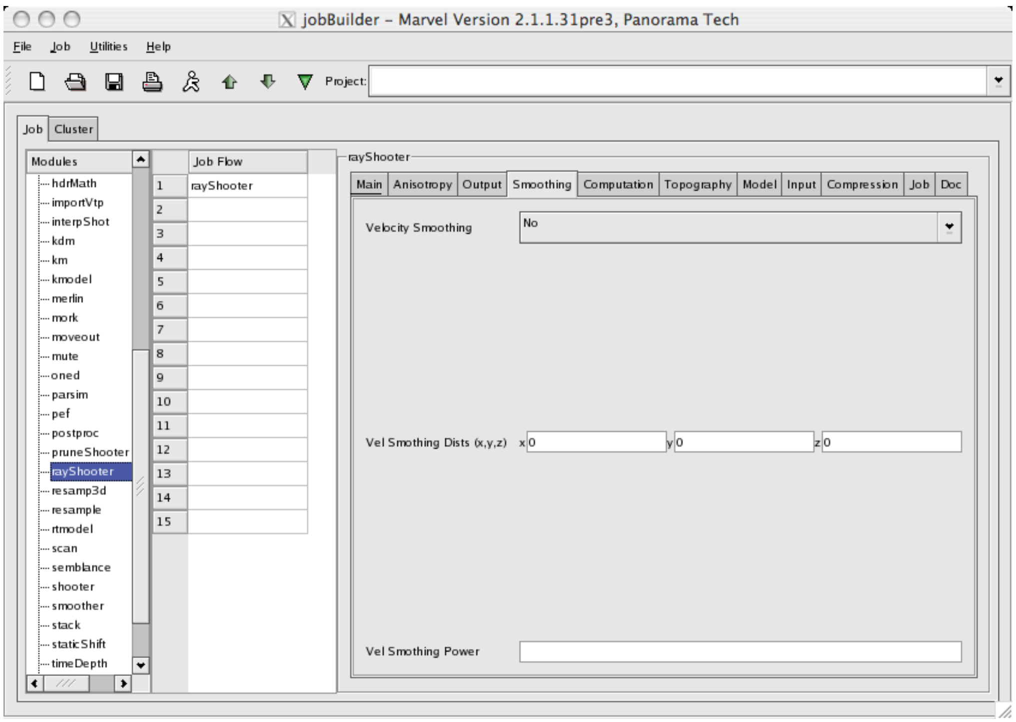


Table 98. rayshooter Smoothing Panel Fields

Field	Description
Velocity Smoothing	Turn the smoothing of the velocity (slowness) field used to propagate the source term *on* or *off*. This process can be useful for reducing artifacts.
Vel Smoothing Dists (x,y,z)	Gaussian widths for smoothing slowness in each direction. defaults: 0, 0, 0
Vel Smoothing Power	The number of times to smooth the volume.

rayshooter Computation Panel

Figure 129 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 99.

Figure 129. rayshooter Computation Panel

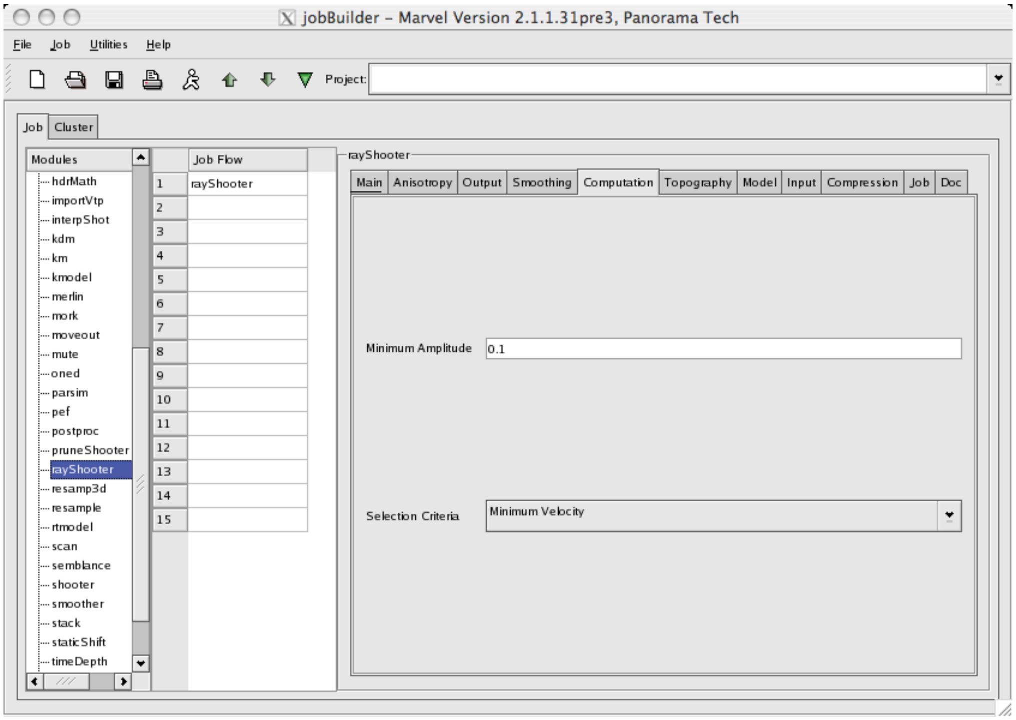


Table 99. rayshooter Computation Panel Fields

Field	Description
Minimum Amplitude	default: 0.1
Selection Criteria	Minimum Velocity, Minimum Distance, Maximum Amplitude default: Minimum Velocity

rayshooter Topography Panel

Figure 130 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 100.

Figure 130. rayshooter Topography Panel

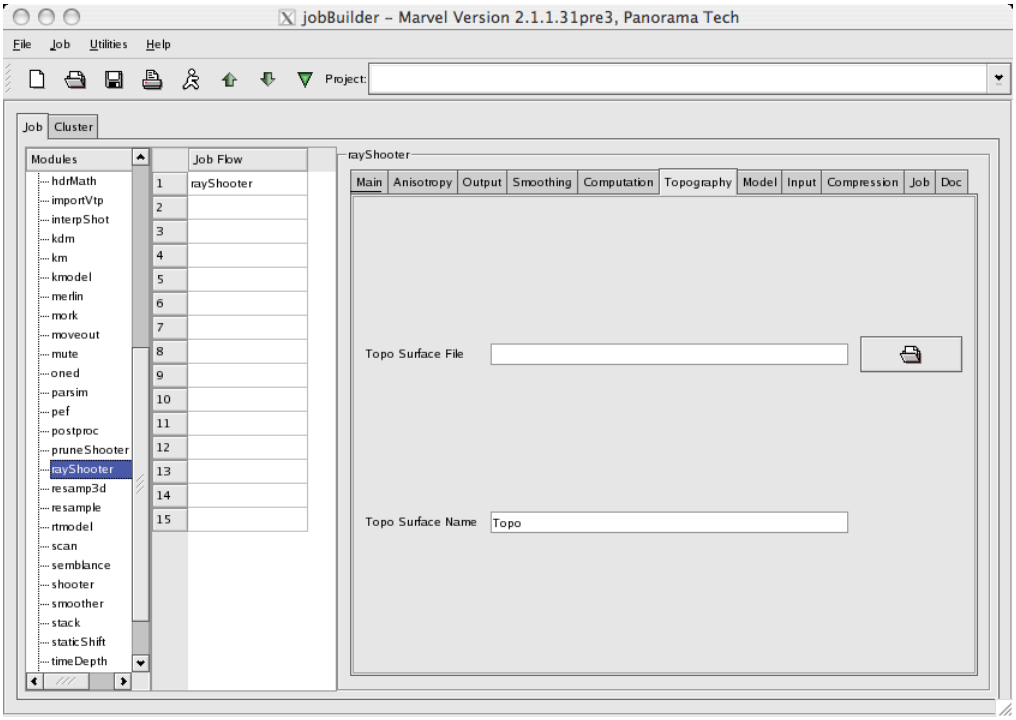


Table 100. rayshooter Topography Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. defaults: Topo

rayshooter Model Panel

Figure 131 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 101.

Figure 131. rayshooter Model Panel

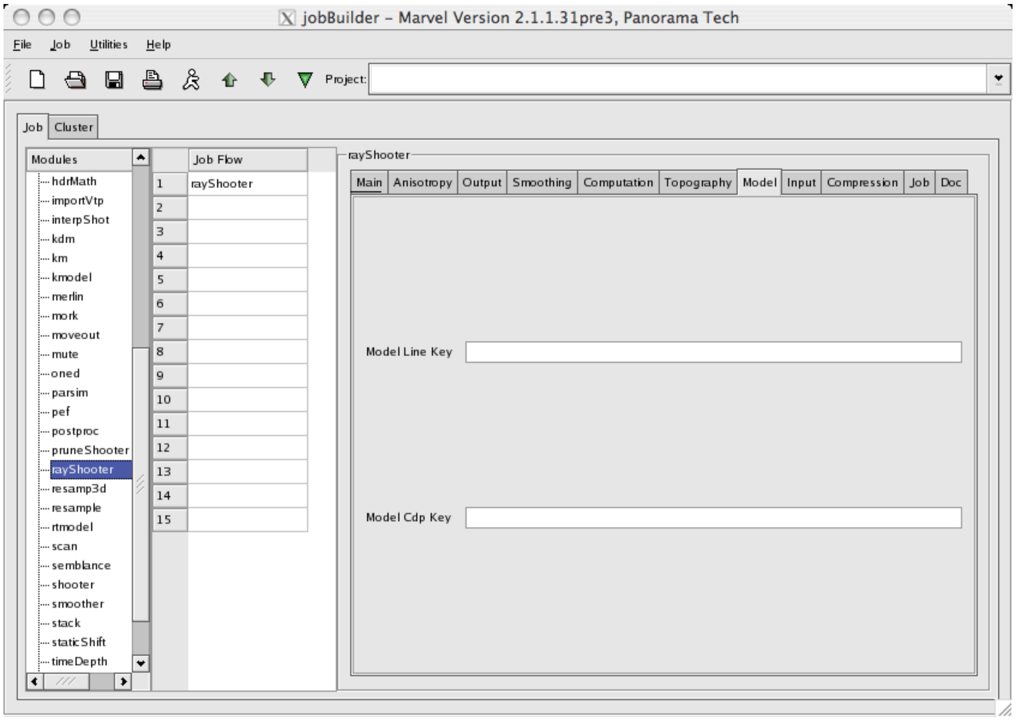


Table 101. rayshooter Model Panel Fields

Field	Description
Model Line Key	Header key for the line number in the model. Use if different from the data.
Model Cdp Key	Header key for the CDP number in the model. Use if different from the data.

rayshooter Input Panel

Figure 132 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 102.

Figure 132. rayshooter Input Panel

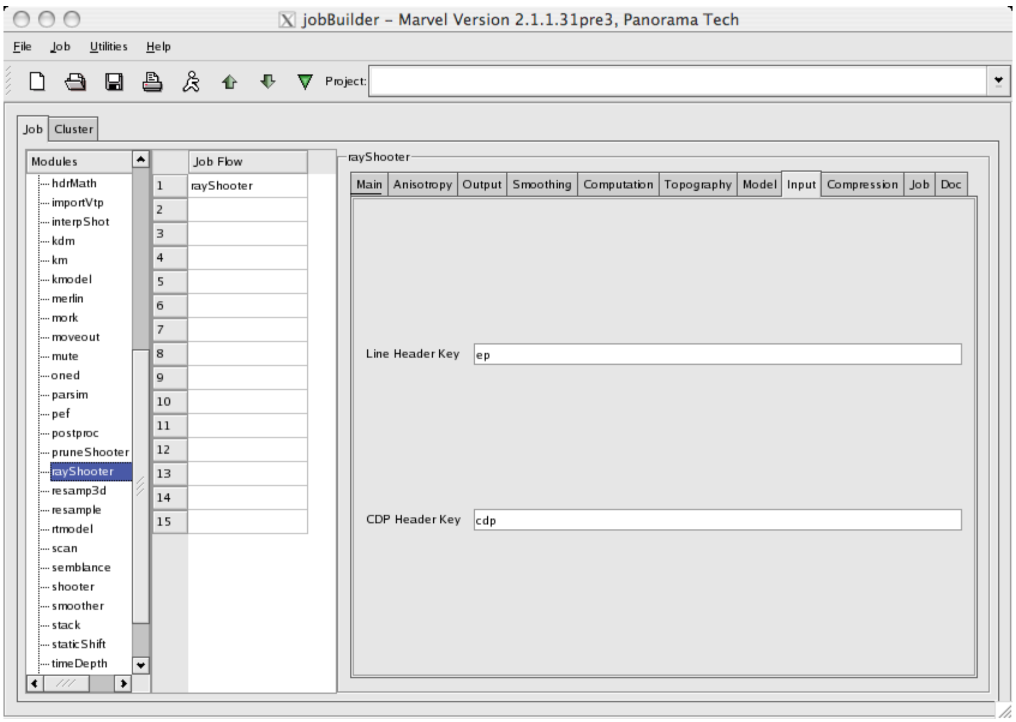


Table 102. rayshooter Input Panel Fields

Field	Description
Line Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: ep
CDP Header Key	Header key containing CDP (crossline) designators. MARVEL usually uses cdp, which is a 4-byte integer at location 21 in SEG-Y files. default: cdp

rayshooter Job Panel

Figure 133 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 103.

Figure 133. rayshooter Job Panel

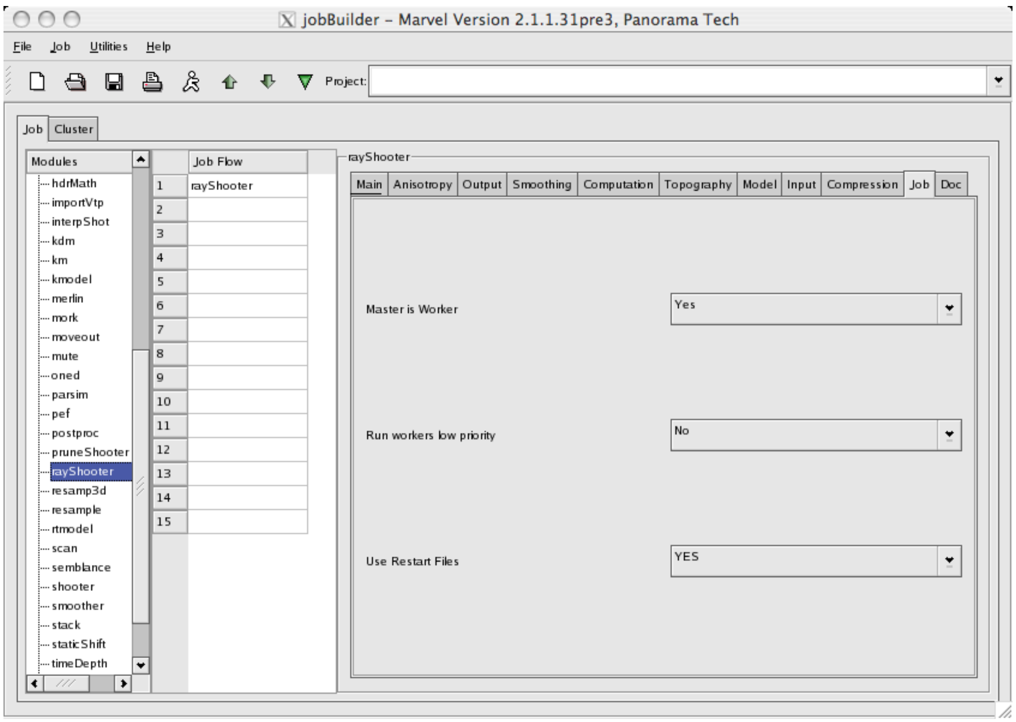


Table 103. rayshooter Job Panel Fields

Field	Description
Master is Worker	Flag that controls whether the master I/O controller is also used for performing calculations. default: Yes
Run Workers in Low Priority	If Yes, workers will be spawned with reduced priority. although the master process will remain at high priority. This can be useful especially when Master Is Worker is set, so that one worker does not slow down collection or submission of shots for all of the others. default: No
Use Restart Files	If NO, the job will ignore restart information and start from the beginning. default: Yes

resamp3d Module

Figure 134. resamp3d Panel

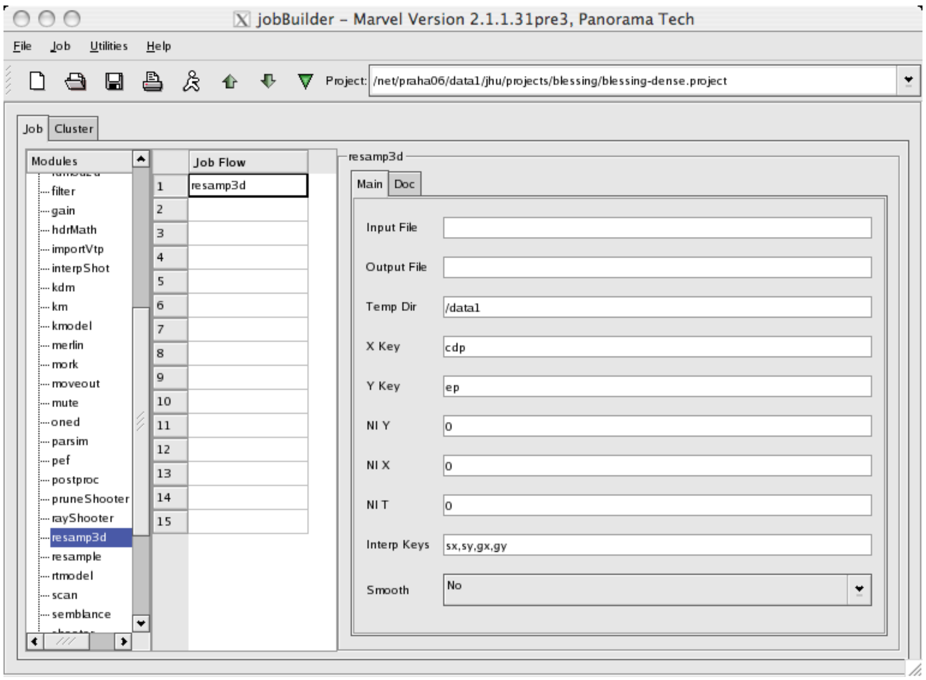


Table 104. resamp3d Panel Fields

Field	Description
Input File	
Output File	
Temp Dir	default: /data1
X Key	The header key specifying where CDP data is stored. default: cdp
Y Key	The header key specifying where line data is stored. default: ep
NI Y	default: 0
NI X	default: 0

continues on next page

Table 104. resamp3d Panel Fields–continued

Field	Description
NI T	default: 0
Interp Keys	The header keys specifying where source line and crossline data are stored, and where geophone line and geophone crossline data are stored. default: sx, sy, gx, gy
Smooth	default: No

resample Module

Figure 135. resample Panel

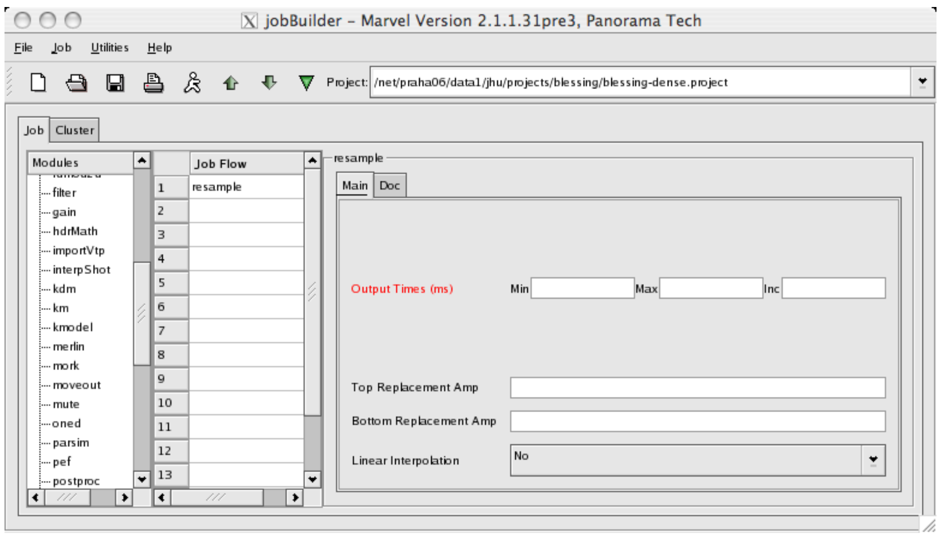


Table 105. resample Panel Fields

Field	Description
Output Times (ms)	Minimum, Maximum, Increment. **This is a REQUIRED entry.**
Top Replacement Amp	
Bottom Replacement Amp	
Linear Interpolation	default: No

rtmodel Module

The rtmodel provides an interface to the reverse time modeling module.

Note:

Although migration can be performed by the application called **rtmodel**, this module has been replaced by a separate application, called MERLIN®.

Note:

Although modeling is currently performed by the application called **rtmodel**, this will eventually be a separate application, tentatively called MINDY™.

All the technologies in the module are based on propagation with the acoustic wave equation, Equation 6, where u is the wave field, c is the velocity, and ρ is the density.

Equation 6:

$$\partial_t^2 u(\mathbf{x}, t) = c^2 \rho \nabla \cdot \frac{1}{\rho} \nabla u$$

Normally, for migration, the density is treated as constant, and the reduced equation, Equation 7, is used. Another version, for anisotropic velocity, will be covered later.

Equation 7:

$$\partial_t^2 u(\mathbf{x}, t) = c^2 \nabla^2 u$$

The equation of motion for the field Equation 6 is solved in these applications using a high-order, centered-grid finite-difference time-domain (FDTD) approach. Boundaries are handled by a choice of tunable isotropic or anisotropic (PML) absorbers.

Typically, a modeling job will involve only this application and the diskWrite module to write the output to disk.

Note:

You will probably want to use the *Append* setting of the diskWrite module *Mode* parameter, so that restart jobs will not overwrite previous work (see diskWrite Module).

Modeling

A source wavelet is inserted at the specified location, and the field is recorded as traces specified locations.

Migration

This is a 'Reverse-Time' algorithm; the source field is a synthetic modeled shot, cross-correlated with back-propagated data.

rtmodel Main Panel

Figure 136 and Figure 137 enable you to specify basic information to be used by the module. The fields on the panel are described in Table 106.

Figure 136. rtmodel Module Main Panel

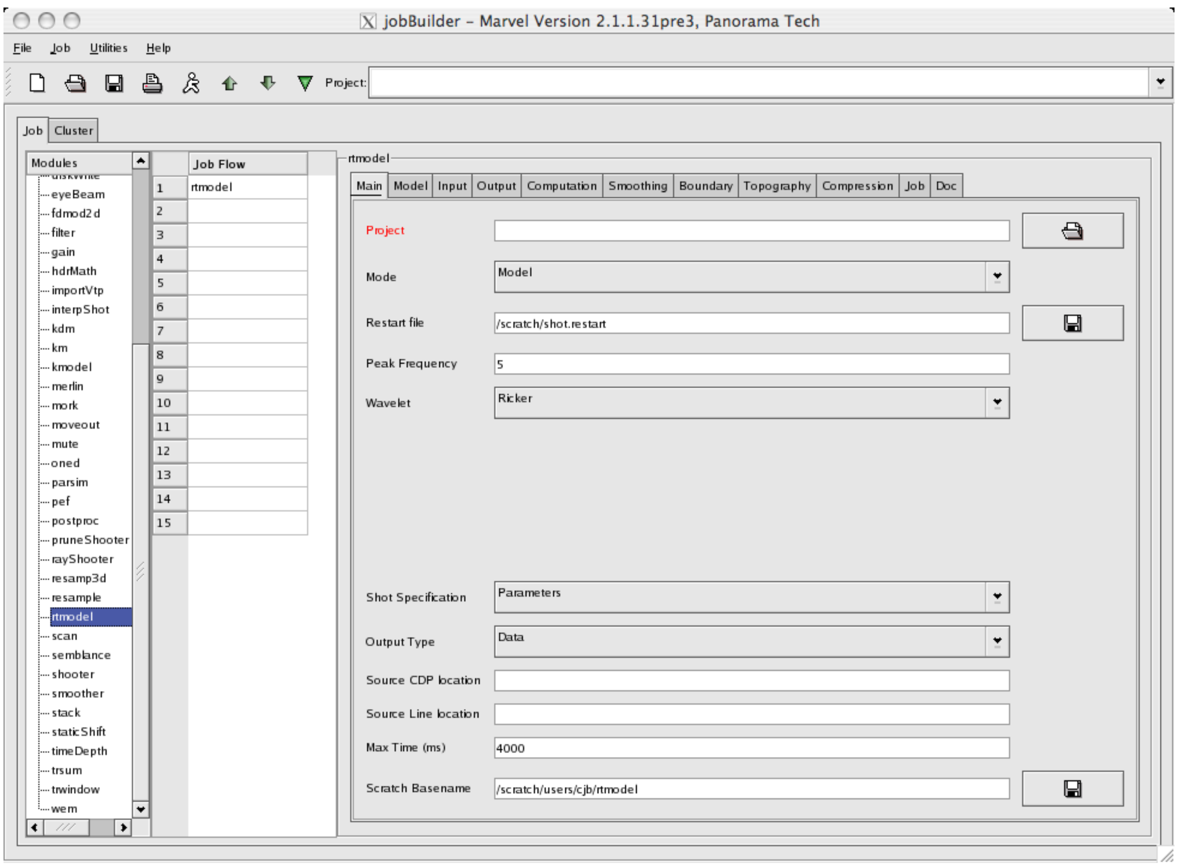


Figure 137. rtmodel Module Main Panel

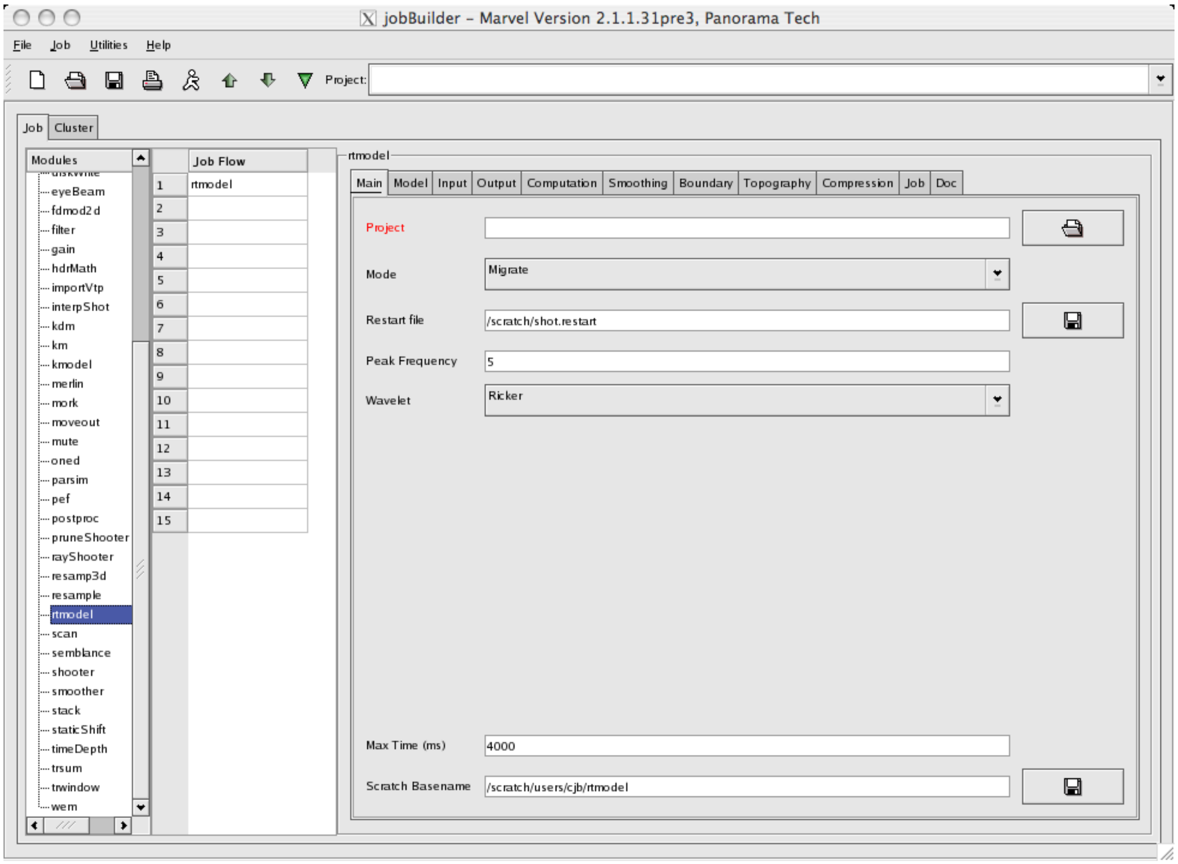


Table 106. rtmodel Module Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Model	This is a seismic file in any format MARVEL can read; typically SEG-Y. The units are m/s or ft/s, but can be any other units, depending on the choice of units in the seismic data.
Mode	Model, Migrate, Model & Migrate. Setting this field to Migrate modifies the availability of fields in the rtmodel Compression Panel, rtmodel Computation Panels, and rtmodel Input Panel panels. default: Model

continues on next page

Table 106. rtmodel Module Main Panel Fields–continued

Field	Description
Restart file	This is where the application keeps information about shots already processed. It is usually best to put it where your output files are, and to give it a similar name. For example, if your output file basename is */home/projects/marmousi/input/marmousi – shots*, you might call the restart file */home/projects/marmousi/input/marmousi – shots.restart*. default: */scratch/shot.restart*
Peak Frequency	This field has a somewhat historical definition in units of Hz. The value is based on the definition of the default Ricker wavelet, and refers to the peak frequency of the defining Gaussian pulse (since the Ricker wavelet is the second derivative of the Gaussian pulse, its peak frequency is actually higher than the Gaussian pulse itself). The maximum produced frequency will be roughly 2.8 times this number. default: 5
Wavelet	The name of the wavelet convolved with a reflectivity trace to generate a synthetic seismogram: Ricker (zero-phase) or Spike (which is mostly useful for migration), or From File (where you specify your own wavelet). If you specify a wavelet, you must then specify two additional parameters: Wavelet File and Wavelet Lead. default: Ricker
Wavelet File	When you have specified that the wavelet is From File, this field allows a single trace to be read from a seismic input file to define the source wavelet.
Wavelet Lead (ms)	When you have specified that the wavelet is From File, the specified wavelet will be centered at this point.
Source CDP Location	Either a single value, or a range: minimum, maximum, and increment. This field is not visible for Migrate Mode.
Source Line Location	Either a single value, or a range: minimum, maximum, and increment. This field is not visible for Migrate Mode.
Max Time (ms)	Data will be acquired or migrated for this length of time. default: 4000
Scratch Basename	The application needs temporary storage for acquired data, accumulated image, and others. All of these filenames will start with this prefix.

rtmodel Model Panel

The rtmodel Model panel contains only two parameters that specify the header keys to be used if different from that specified in the input data.

- Model Line Key—Use this value if different from data (see ‘Input’ group).
- Model Cdp Key—Use this value if different from data (see ‘Input’ group).

rtmodel Input Panel

Figure 138 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 107.

Figure 138. rtmodel Module Input Panel, Model Mode

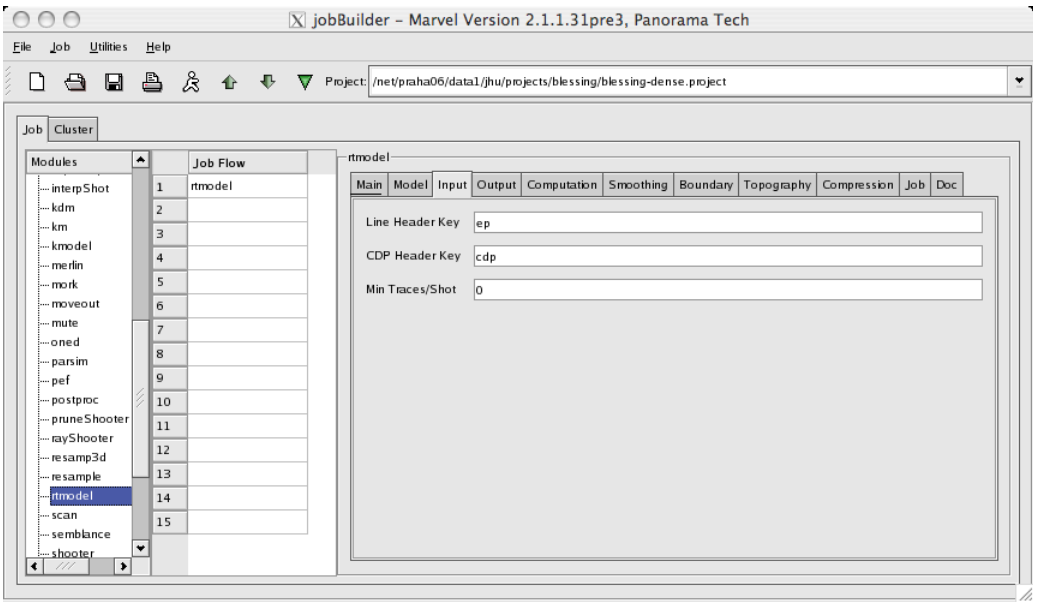


Table 107. rtmodel Module Input Panel Fields

Field	Description
Line Header Key	Header key containing line designators. MARVEL usually uses *ep*, which is a 4-byte integer at location 17 in SEG-Y files. default: ep
CDP Header Key	Header key containing line designators. MARVEL usually uses ep, which is a 4-byte integer at location 17 in SEG-Y files. default: cdp

continues on next page

Table 107. rtmodel Module Input Panel Fields–continued

Field	Description
Shot Centering	For modeling, the only generally useful choices are: Source Point - computation aperture is centered on the source. Model - computation aperture is centered at the center of the model. Generally, the apertures should be at least half the dimensions of the model in this case. default: Source Point
Input Shot Normalization	Normalization corrects for the amplitude effects of wavefront divergence and damping. It is also used when you apply a subsequent filter for eliminating the surface waves. If RMS, each input shot is divided by its RMS value before processing. Possible values: None or RMS. **Note: This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate.** **default: RMS**

rtmodel Output Panel

Figure 139 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 108.

Figure 139. rtmodel Module Output Panel, Model

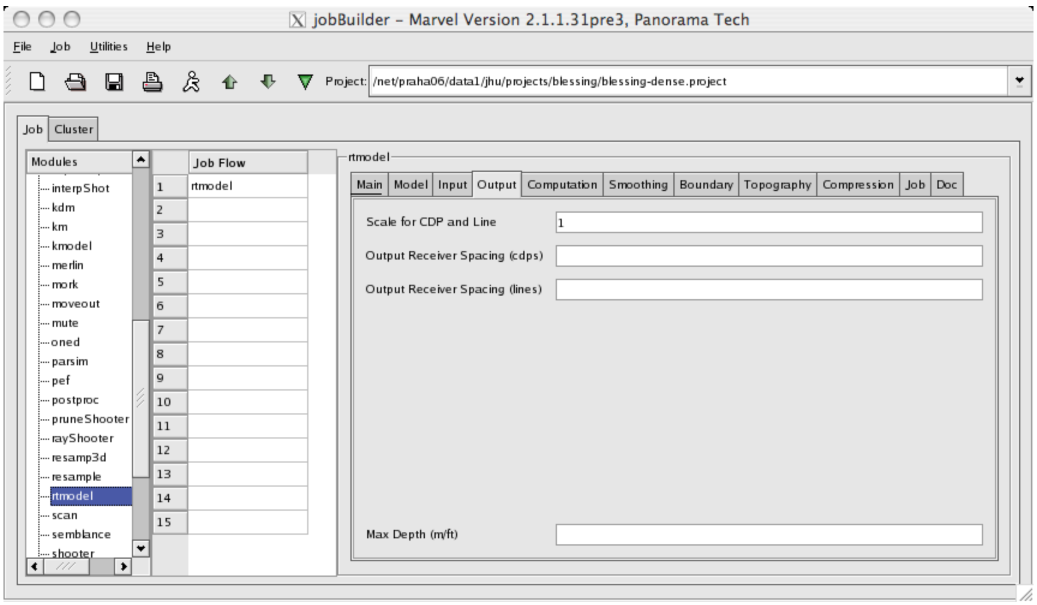


Table 108. rtmodel Module Output Panel Fields

Field	Description
Scale for CDP and Line	If the output spacings (see below) are set to odd numbers, the CDP and Line numbers will be fractional. Scaling them by 10 may help in viewing the output. MARVEL viewers do not use fractional CDP and line numbers.
Output Receiver Spacing (cdps)	Data will be acquired on a grid centered on the shot point, with this spacing along the CDP axis. *Used for modeling.*
Output Receiver Spacing (lines)	Data will be acquired on a grid centered on the shot point, with this spacing along the line axis. *Used for modeling.*
Output Lines	Min, max, and increment for lines in the output volume. *Used for migration.*

continues on next page

Table 108. rtmodel Module Output Panel Fields–continued

Field	Description
Inline Aliasing	Attempt to compensate for aliasing in the inline direction (units: lines). **Note: This can be a costly operation.** ***Used for migration.***
Output XLines	Min, max, and increment for xlines (cdps) in the output volume. *Used for migration.*
Xline Aliasing	Attempt to compensate for aliasing in the crossline direction (units: xlines). **Note: This can be a costly operation.** ***Used for migration.***
Output Depths	Min, max, and increment for depths (m/ft) in output volume. *Used for migration.*

rtmodel Computation Panels

There are six slightly different rtmodel Computation panels depending on your selections in the Mode field of the rtmodel Main panel (see Figure 136) and the Allow Surface Multiples field of the Computation panel. For simplicity, only two of these panels are shown, the others are based on these two panels. The fields on these panels are described in Table 109.

Figure 140. rtmodel Computation Panel, Model Mode and Allow Surface Multiples=Yes

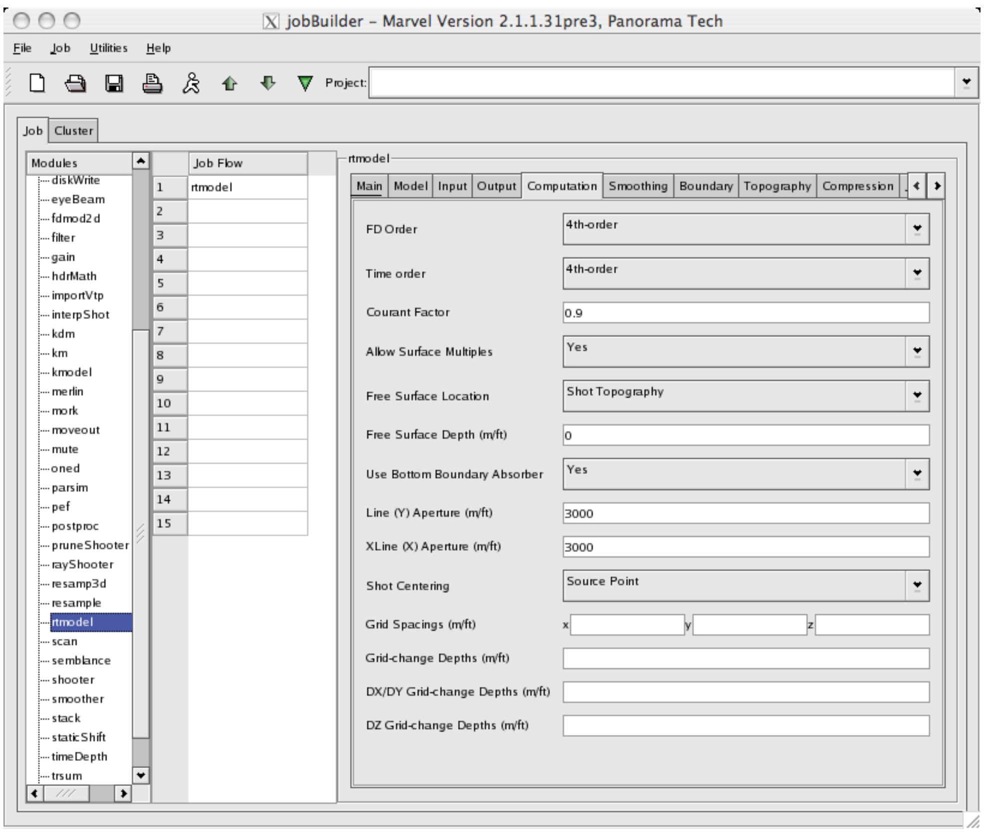


Figure 141. rtmodel Computation Panel, Migrate Mode and Allow Surface Multiples=Yes

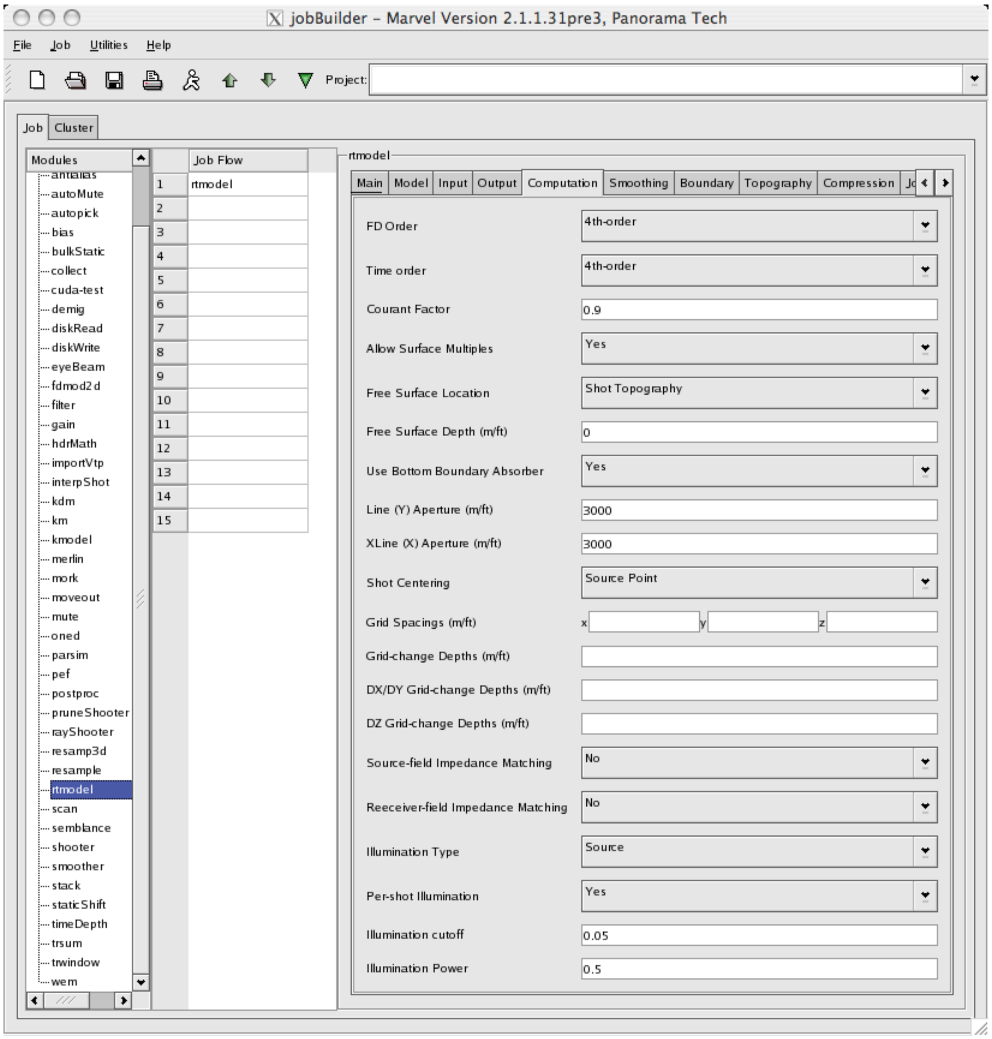


Table 109. rtmodel Module Computation Panel Fields

Field	Description
FD Order	This determines the order of accuracy of the spatial derivatives used in the simulation. For second-order, a second derivative is computed using 3 grid points. For 8^{th}-order,9 grid points are used, with 5 unique coefficients. This is usually the ideal combination for speed and accuracy. **Note: As of MARVEL version 2.1.1.28, orders higher than eight do not work on vectorized platforms; this includes 32-bit and 64-bit x86 architectures, as well as Cell/PPC.** **default: Fourth Order**

continues on next page

Table 109. rtmodel Module Computation Panel Fields–continued

Field	Description
Time order	2^{nd}-order time uses a three-point stepping algorithm. 4^{th}-order uses the wave equation to compensate for errors in the former approach (usually referred to in the industry as ‘the Dablain trick’).
Courant Factor	The internal time step is determined by the Courant stability condition, involving the grid spacing and the maximum velocity. For the default 4^{th}-order time, this code is stable with a factor of .9; for 2^{nd}-order time, a value of .85 is recommended. Slightly smaller values *may* result in slightly better output, but probably will not help.
Allow Surface Multiples	If this field is set to Yes, a free surface is modeled, and the wave field will reflect off the top, leading to multiples in the data. If the field is set to No, an absorbing zone will be placed at the top. default: Yes
Free Surface Location	This field is visible only if Allow Surface Multiples is set to Yes. There are three options to this field: • Shot Topography—Reflections occur at the topography defined for shots (see below) • Receiver Topography—Reflections occur at the topography defined for receivers (see below) • Fixed Depth—Free surface is at user-specified depth
Free Surface Depth (m/ft)	User-specified free-surface depth, when ‘Fixed Depth’ is chosen for ‘Free Surface Location’. This field is visible only if Allow Surface Multiples is set to Yes.
Use Bottom Boundary Absorber	This field has two options: • Yes—Waves are absorbed at the bottom. • No—Waves can reflect off the bottom. This generally does little harm, and costs a bit less. default: Yes
Line (Y) Aperture (m/ft)	The computation for each shot is limited along the y axis to a range above and below the center of the shot. default: 3000
XLine (X) Aperture (m/ft)	The computation for each shot is limited along the x axis to a range above and below the center of the shot. default: 3000

continues on next page

Table 109. rtmodel Module Computation Panel Fields–continued

Field	Description
Shot Centering	• Source Point • Shot+Receiver Box • Avg Midpoint • Model default: Source Point
Grid Spacings (m/ft)	If left blank, these will be determined by the 'Output Receiver Spacings' (see above). Otherwise, these specify the spacings of the computation grid.
Grid-change Depths (m/ft)	
DX/DY Grid-change Depths (m/ft)	
DZ Grid-change Depths (m/ft)	
Source Field Impedance Matching	Use 'non-reflecting' wave equation for source propagation, and is an attempt to reduce artifacts. Costly, and not very effective. NOTE - probably broken in version 2.1.1.28. This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate. Default: No
Receiver-field Impedance Matching	Use 'non-reflecting' wave equation for receiver back-propagation in an attempt to reduce artifacts. Costly and not very effective. NOTE - probably broken in version 2.1.1.28. This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate. default: No
Illumination Type	An illumination is produced. Generally, the default value of 'Source' should be used. In this case, the illumination is just the sum of the squared source fields at each image point. This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate. default: Source.Receiver

continues on next page

Table 109. rtmodel Module Computation Panel Fields–continued

Field	Description
Per-Shot Illumination	Each shot image can be divided by the illumination separately. This tends to be noisier, but can help to image steep dips in some cases. This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate.
Illumination cutoff	 This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate, and if Per-Shot illumination is Yes. default: 0.05
Illumination Power	For a value of ‘1’, the illumination is the squared source. This field is visible only if the Mode field in the rtmodel Main Panel is set to Migrate, and if Per-Shot illumination is Yes. default: 0.5

rtmodel Smoothing Panel

The Figure 142 panel enables you to specify basic information to be used by the smoothing calculations in the rtmodel module. The fields on the panel are described in Table 110.

Note:

The fields on the Smoothing panel are available only if the Mode field in the rtmodel Main panel is set to Migrate, see rtmodel Main Panel.

Figure 142. rtmodel Module Smoothing Panel, Migrate

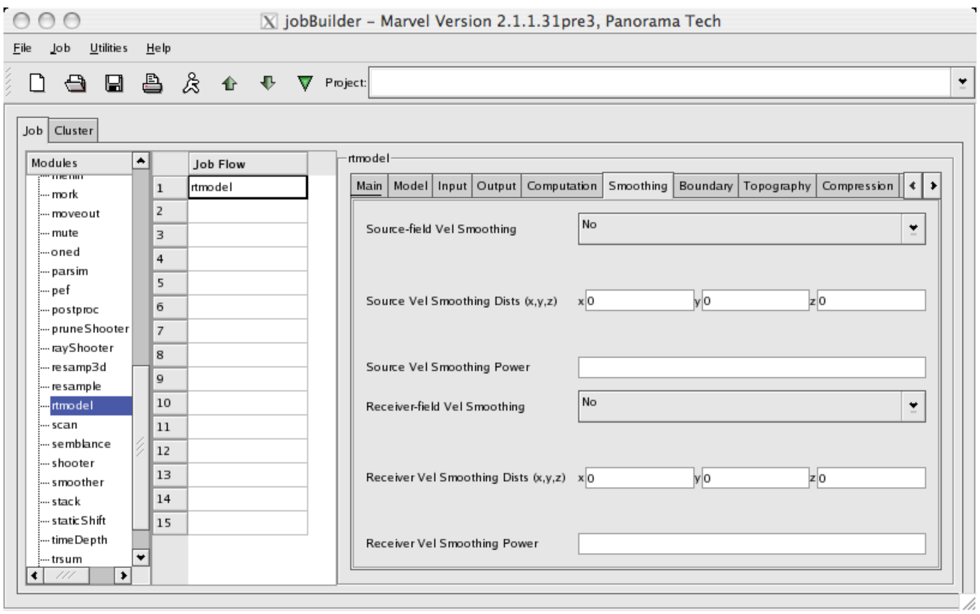


Table 110. rtmodel Module Smoothing Panel Fields

Field	Description
Source-field Vel Smoothing	Turn the smoothing of the velocity (slowness) field used to propagate the source term *on* or *off*. This process can be useful for reducing artifacts. **Note: This field is not available for Modeling or Modeling and Migration.** **default: No**
Source Vel Smoothing Dists (x,y,z)	Gaussian widths for smoothing slowness in each direction. **Note: This field is not available for Modeling or Modeling and Migration.** **default: 0**

continues on next page

Table 110. rtmodel Module Smoothing Panel Fields–continued

Field	Description
Source Vel Smoothing Power	The number of times to smooth the volume. **Note: This field is not available for Modeling or Modeling and Migration.**
Receiver-field Vel Smoothing	Turn the smoothing of the velocity (slowness) field used to propagate the receiver term *on* or *off*. This can be useful reducing artifacts. default: No
Receiver Vel Smoothing Dists (x,y,z)	Gaussian widths for smoothing slowness in each direction. default: 0
Receiver-field Vel Smoothing Power	The number of times to smooth the volume.

rtmodel Topography Panel

Figure 143 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 111.

Figure 143. rtmodel Module Job Panel

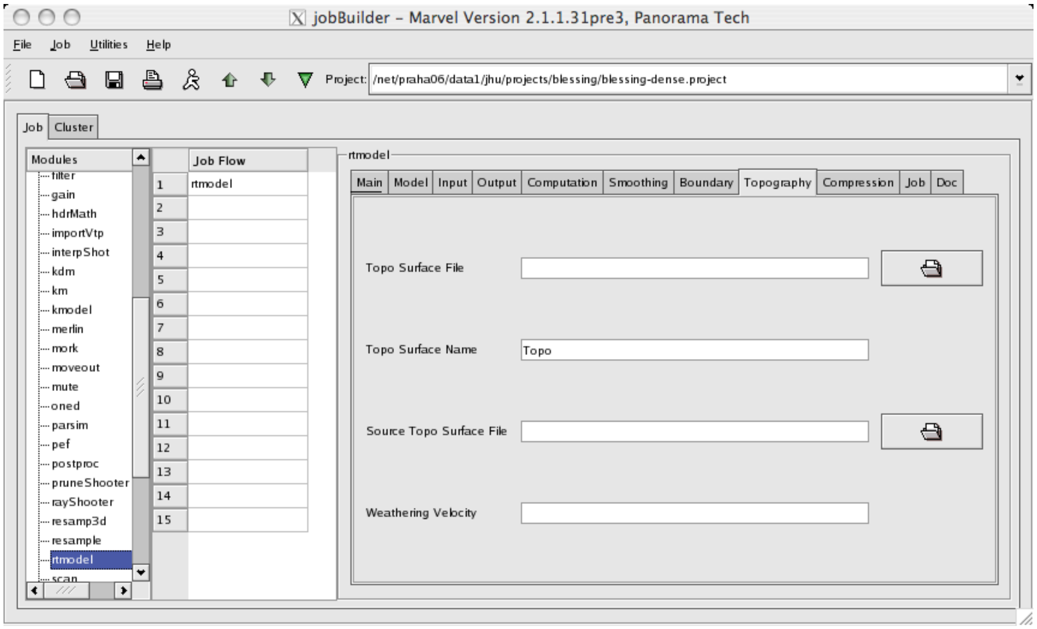


Table 111. rtmodel Module Job Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this file is used for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: `ep=100 cdp=500 z=20`
Topo Surface Name	A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo
Weathering Velocity	The weathering velocity to use in the calculations.

rtmodel Compression Panel

Figure 144 and Figure 145 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 112.

Figure 144. rtmodel Module Compression Panel

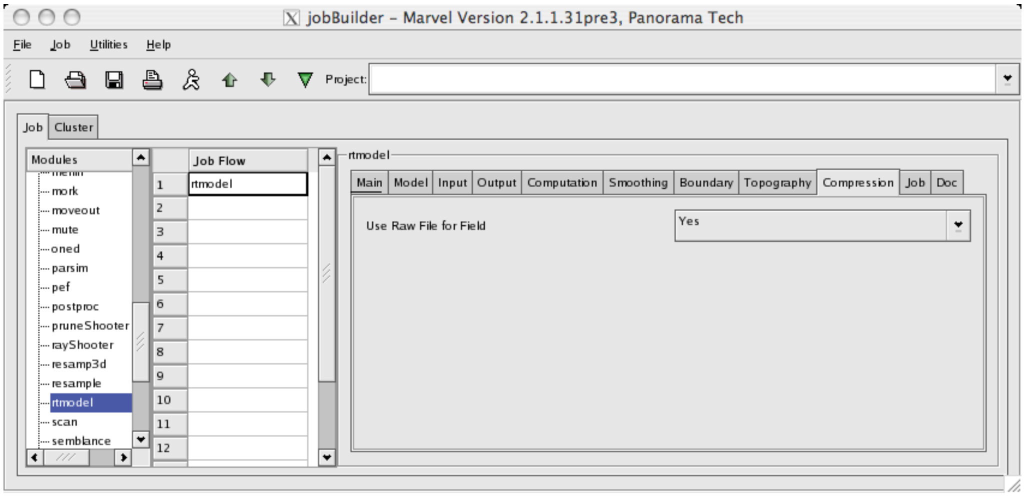


Figure 145. rtmodel Module Compression Panel

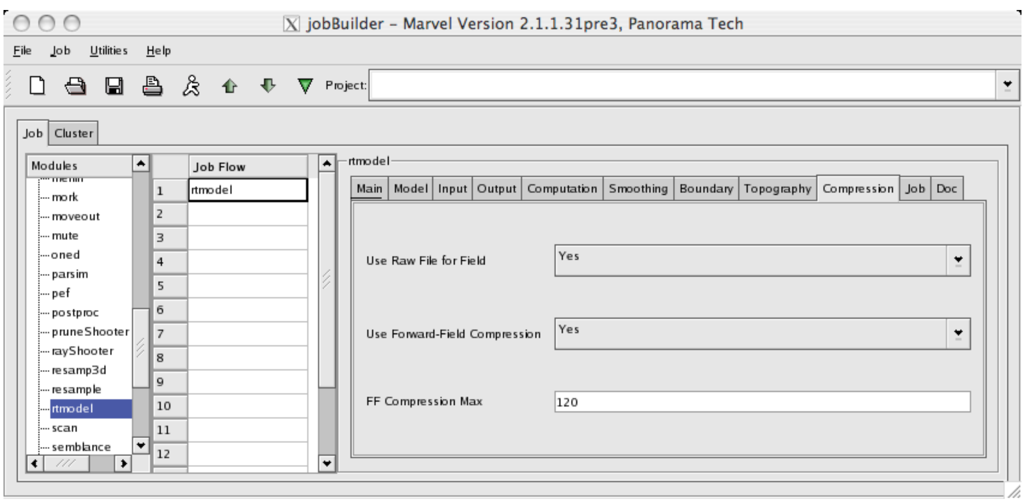


Table 112. rtmodel Module Compression Panel Fields

Field	Description
Use Raw File for Field	Necessary for compression. If No, stored source term is stored in SEG-Y files (SLOW).

continues on next page

Table 112. rtmodel Module Compression Panel Fields–continued

Field	Description
Use Forward Field Compression	Turns compression for the source term on or off. **Note:** This field is only available if the Mode field on the rtmodel Main panel is set to Migrate.
FF Compression Max	As part of the compression, this specifies the amplitude range used to store the samples. For most projects, the default of 120 produces good results, but for some projects, a more dynamic range may be needed. **Note:** This field is only available if the Mode field on the rtmodel Main panel is set to Migrate. default: 120

rtmodel Job Panel

Figure 146 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 113.

Figure 146. rtmodel Module Job Panel

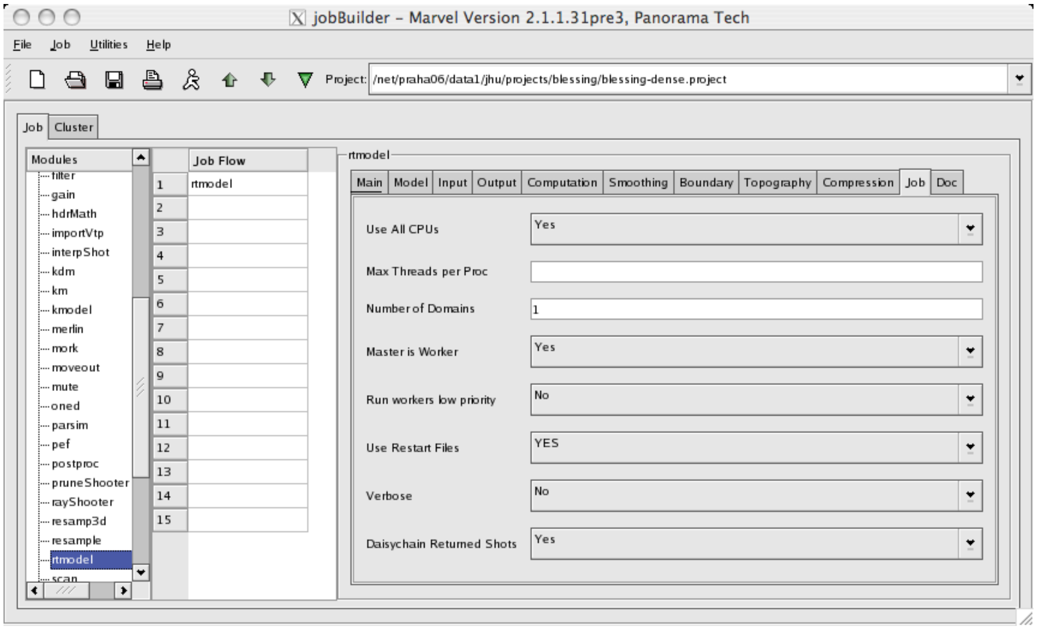


Table 113. rtmodel Module Job Panel Fields

Field	Description
Use All CPUs	This really means that each worker should use multiple threads. If *No*, then there will be one independent worker spawned for each CPU (or core) in the cluster.
Max Threads Per Proc	If *UseAllCPUs* is set to *Yes*, this field limits the number of CPUs (cores) that a single worker can use.
Number of Domains	The computation grid will be split up among this number of workers for each shot. default: 1
Master is Worker	Yes—workers will be spawned on the master node of the job. No—workers will NOT be spawned on the master node of the job.

continues on next page

Table 113. rtmodel Module Job Panel Fields–continued

Field	Description
Run workers low priority	If *Yes*, workers will be spawned with reduced priority. although the master process will remain at high priority. This can be useful especially when *MasterIsWorker* is set to *Yes*, so that one worker does not slow down the collection or submission of shots for all of the others.
Use Restart Files	If *No*, the job will ignore restart information and start from the beginning.
Verbose	Switch for turning debug printing on and off. default: 0
Daisychain Returned Shots	If *Yes*, multiple shots can be returned at once, and stacked along the way, before going out. This saves I/O time. *This field is not used for modeling.* default: 1
Movie	

scan Module

The scan module, Figure 147, scans and thresholds input traces and outputs various statistical quantities, as described in Table 114.

Figure 147. scan Panel

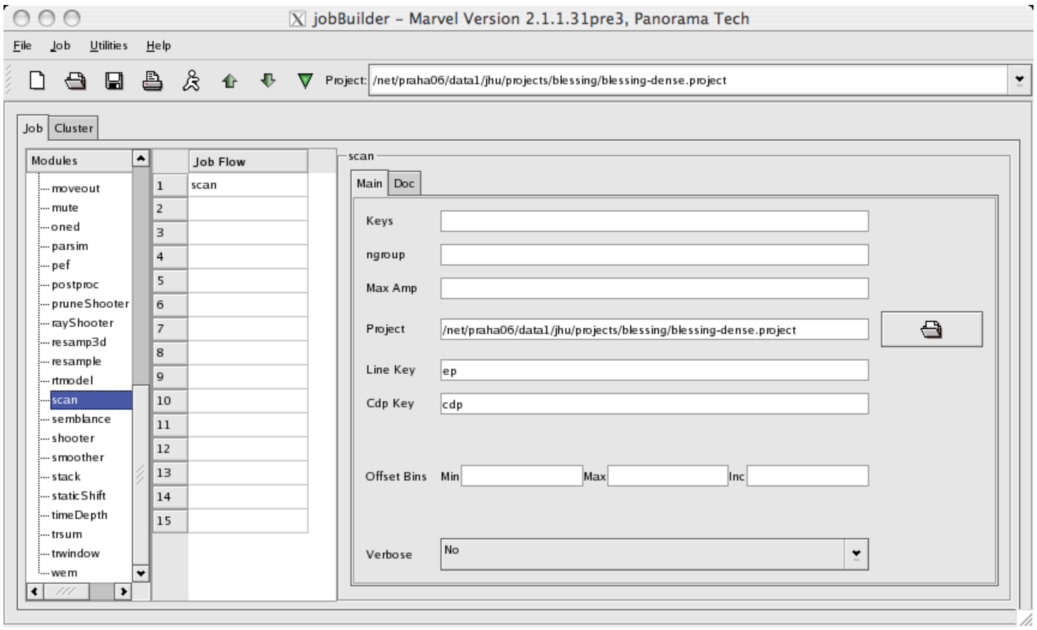


Table 114. scan Panel Fields

Field	Description
Keys	The keys defining an ensemble for reporting.
ngroup	Number of traces per ensemble. This parameter is ignored if Keys is set.
Max Amp	The maximum threshold amplitude.
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Line Key	The header key specifying where line data is stored. default: ep
Cdp Key	The header key specifying where CDP data is stored. default: cdp
Offset Bins	Specifies the offset bins in which to read the data.

continues on next page

Table 114. scan Panel Fields–continued

Field	Description
Verbose	Switch for turning debug printing on and off. default: No

semblance Module

Theory

The semblance module computes the semblance panel for a given CDP gather. Velocity analysis is usually a two-dimensional process for determining the optimal values of the vertical two-way travel-time and stacking velocity. When the travel-time curve deviates extensively from hyperbolic, the quartic term of the travel-time series must be part of the computations. In its simplest form (with $a2 = 0$), the optimization of all parameters becomes three dimensional. Repeating a conventional two-dimensional scan for each change of the quartic term produces the desired 3D time-velocity-anisotropy volume. The traveltime function for a scan of this type is defined by Equation 8. The coefficients *a1* and *a2* are assumed to be small and, consequently, deviation from hyperbolic arrival is also small. Triplications are beyond the scope of this program.

Equation 8:

$$t^2 = t_0^2 + \frac{h^2}{4v^2} - \frac{a_1 x^4}{1 + a_2 x^2}$$

Semblance is defined by Equation 9, where *n* is the number of non-zero samples after muting, and *d(t,j)* is the jth trace in the input ensemble. Both the numerator and denominator are smoothed prior to the computation of this quotient.

Equation 9:

$$s(t) = \left[\frac{\left(\sum_0^{n-1} d(t,j)\right)^2}{\sum_0^{n-1} d(t,j)^2}\right]^{pwr}$$

When the *pwr* factor is greater than 1, it acts as both a compressor and expander, with the upper range of the semblance expanded and the lower range compressed. This tends to decrease the number of large values and makes picking an easier process.

Conversely, when the *pwr* factor is less than 1, this increases the number of large values and makes picking more difficult.

Main Panel

> **Note:**
>
> This module expects input data to be in CDP order.

Figure 148 shows a semblance Module panel, and Table 115 describes the fields on the panel.

Figure 148. semblance Main Panel

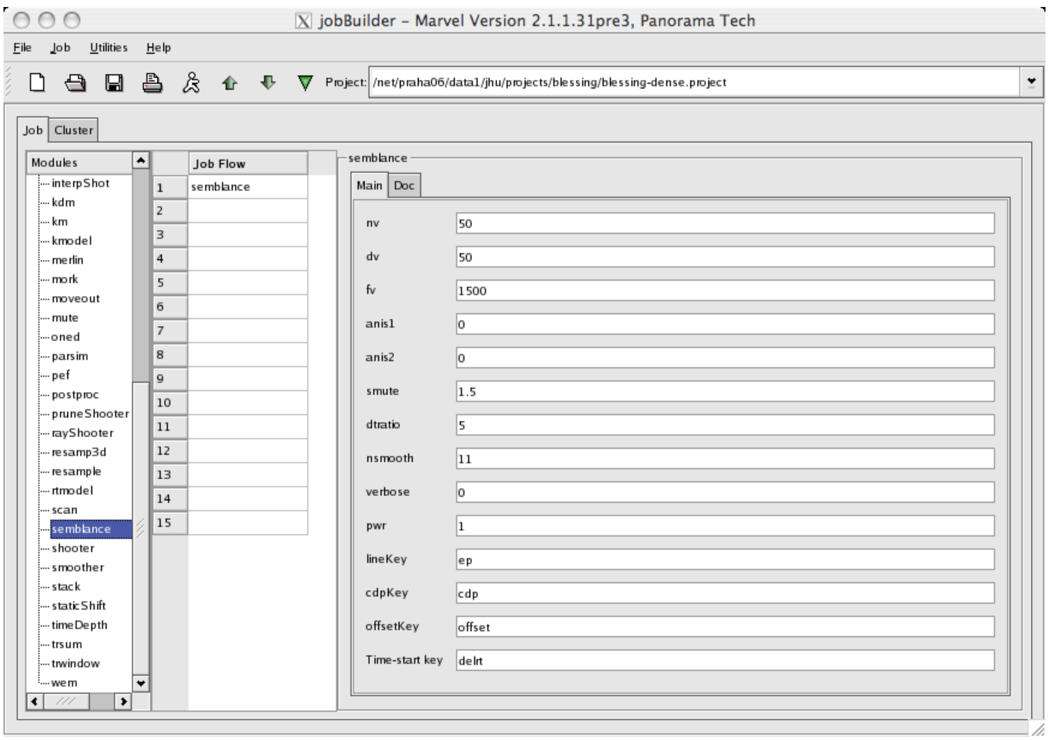


Table 115. semblance Main Panel Fields

Field	Description
nv	The number of velocities in any given scan. default: 50
dv	The velocity increment. default: 50
fv	The first velocity value. default: 1500

continues on next page

Table 115. semblance Main Panel Fields–continued

Field	Description
anis1	The anisotropy factor in the numerator in Equation 8, that is, *a1*. default: 0
anis2	The anisotropy factor in the denominator in Equation 8, that is, *a2*. default: 0
smute	The stretch mute value. default: 1.5
dtratio	The ratio of output to input time samples. default: 5
nsmooth	The number of samples to smooth the denominator and numerator in the semblance calculations. default: 11
verbose	Switch for turning debug printing on and off. default: 0
pwr	The power on the semblance function. default: 1
lineKey	The header key where line information is stored. default: ep
cdpKey	The header key where CDP information is stored. default: cdp
offsetKey	The header key where offset information is stored. default: offset
Time-start key	The header key specifying where the initial time of the trace is stored. default: deirt

shooter Module

Note:

Although this module is still provided for compatibility purposes, its use has been deprecated. It is recommended that you use the rayshooter module, instead.

See also rayshooter Module.

shooter Main Panel

Figure 149 enables you to specify basic information to be used by the module. The fields on the panel are described in Table 116.

Note:

If the output range is smaller then the aperture range, the output range is used to limit the size of the traveltime table.

Figure 149. shooter Main Panel

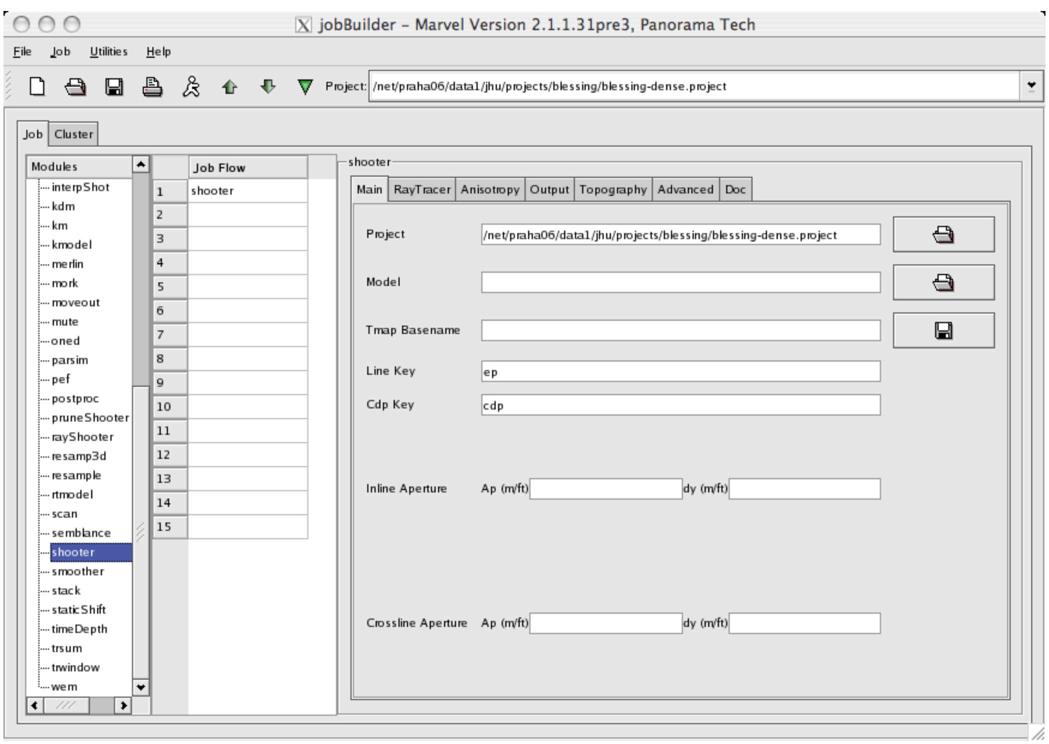


Table 116. shooter Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Model	The name of the input model.
Tmap Basename	The prefix used to produce the traveltime output files with suffix `.tmap`.
Line Key	The header key for the line number in the model file. default: ep
Cdp Key	The header key for the CDP number in the model file. default: cdp
Inline Aperture	The length, in meters or feet, in the line direction aperture limit.
Crossline Aperture	The length, in meters or feet, of the crossline, or CDP, direction aperture limit.

shooter RayTracer Panel

The shooter RayTracer panel, Figure 150, enables you to specify information that is to be used in ray tracing operations. The fields on the panel are described in Table 117.

Figure 150. shooter RayTracer Panel

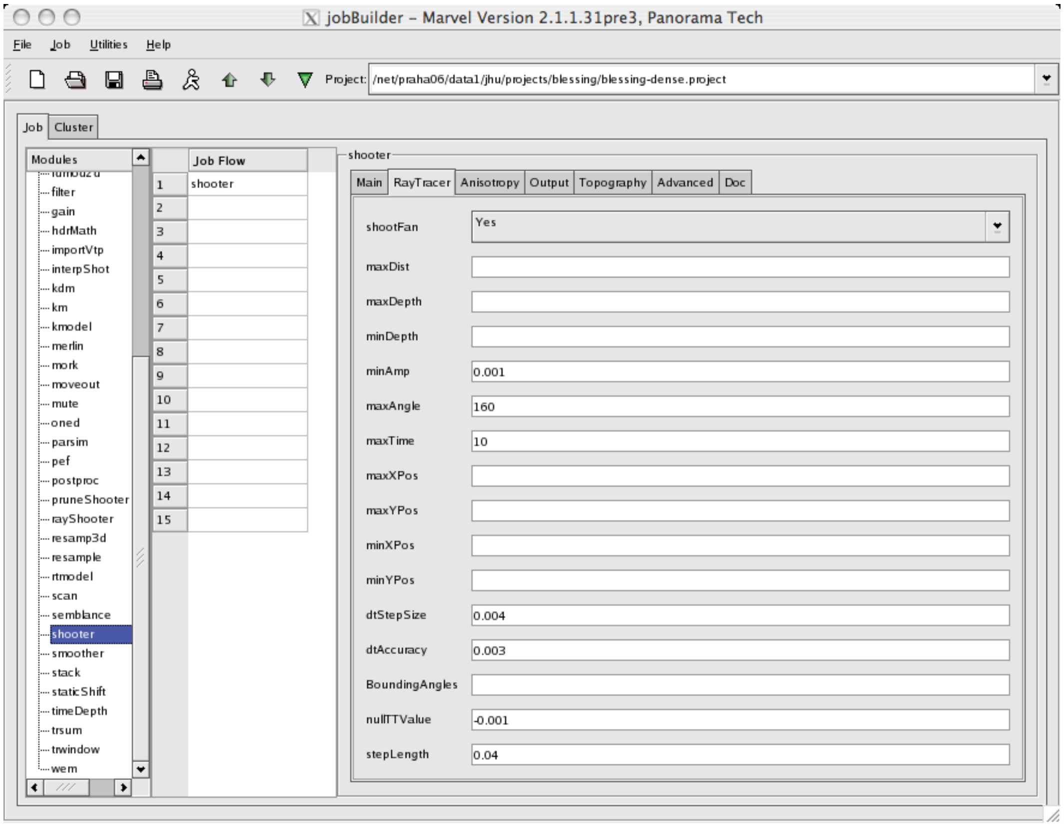


Table 117. shooter RayTracer Panel Fields

Field	Description
shootFan	Selects the shooting direction: Yes causes rays to be shot toward deeper depths, while No causes rays to be shot upward toward shallower depths. default: Yes
maxDist	The maximum horizontal distance a ray can travel. If this parameter is defaulted to zero, the maximum distance a ray can travel is set to the maximum extent of the model.
maxDepth	The maximum depth a ray can travel. If this parameter is defaulted to 0, the maximum depth of a ray is set to the maximum depth of the model.

continues on next page

Table 117. shooter RayTracer Panel Fields–continued

Field	Description
minDepth	The minimum depth a ray can travel. If this parameter is defaulted the ray has to minimum depth.
minAmp	The cutoff amplitude of a ray. This value is in terms of paraxialAmp x pathLength x velocity. • In constant velocity, this value stays at 1.0 all along the ray. • For a linear velocity gradient starting with 5000 ft/sec at the surface and reaching 10000 ft/sec at a depth of 10000 feet, this value will be 0.66 at 10000 feet for a ray straight down. **Note:** It is recommended that you set this value to about 0.10 so that only the very low amplitude rays are dropped. If you set the value to a large value, you will reduce run time at the expense of accuracy. default: 0.01
maxAngle	The maximum angle a ray can attain. When set to 180 degrees, this can potentially cause the generation of turning rays and thus produce corresponding longer traveltimes. Generally, a reasonable compromise between speed and accuracy is to set this value in the neighborhood of 160 degrees. default: 160
maxTime	The maximum time a ray can travel. default: 10
maxXPos	The maximum x or crossline direction distance a ray end point can attain. This value can potentially override the maxDist parameter.
maxYPos	The maximum y or line direction distance a ray end point can attain. This value can potentially override the maxDist parameter.
minXPos	The minimum x or crossline direction distance a ray end point can attain. This value can potentially override the maxDist parameter.
minYPos	The minimum y or line direction distance a ray end point can attain. This value can potentially override the maxDist parameter.

continues on next page

Table 117. shooter RayTracer Panel Fields–continued

Field	Description
dtStepSize	Ray tracing step length (in seconds) used for smoothing the velocity model. This is crucial for stability and for this routine to run quickly. The velocity is smoothed by 1.5 x averageVelocity x stepLength. For a 60 Hz freq, your stepLength should be about 0.040 seconds. For velocities that average 7000 ft/sec, the smoothing is then 420 feet. **Note:** Since the ray tracing is adaptive, the smoothing value can actually be fairly small, but this is not recommended. In general, your velocity should be smoothed at least a few hundred feet anyway, probably a few thousand. A value of 0.0 will turn off smoothing. If this value is not 0.0, but it is less than 2.5 x MIN(dx,dy), the value will be set to 2.5 x MIN(dx,dy). default: 0.004
dtAccuracy	The desired accuracy of travel times. The recommended value of about 0.25 x 0.5/maxFrequency. For for 60 Hz data, dtAccuracy is 0.002 sec. default: 0.003
BoundingAngles	The take-off angles anglex1, anglex2, angley1 and angley2 that bound the initial ray fan, and define the direction cosines off vertical. The four values define an initial cone and provide a convenient method for limiting near surface apertures during the migration process. These four angles usually have values of about 70, -70, 70, -70. Examples: • anglex1 = -90, angley1 = 0 means horizontal in the negative x direction • anglex2 = 0, angley2 = 90 means horizontal in the positive y direction • anglex1 = 0,angley1 = 0 means a vertical ray.
nullTTValue	The value that is set inside a given zone where no rays have penetrated. This is a marker that tells the migration module not to image in these zones. default: -1
stepLength	The length of a time step along a ray. Because this value is adaptive, there is little reason to change the default value of .04 second. default: 0.04

shooter Anisotropy Panel

The parameters in the shooter module Anisotropy panel, Figure 151, define the various velocity model input options available for the acoustic and anisotropic raytracer. The fields on the panel are described in Table 118.

Note:

You must enter these files in the proper order. What the raytracer requires is enough information to define the vvelfile and eta. Thus, one and only one of following combinations must be entered:

- epsilonfile, delfile
- vvelfile, etafile
- vvelfile, epsilon
- vvelfile, delfile

Figure 151. shooter Anisotropy Panel

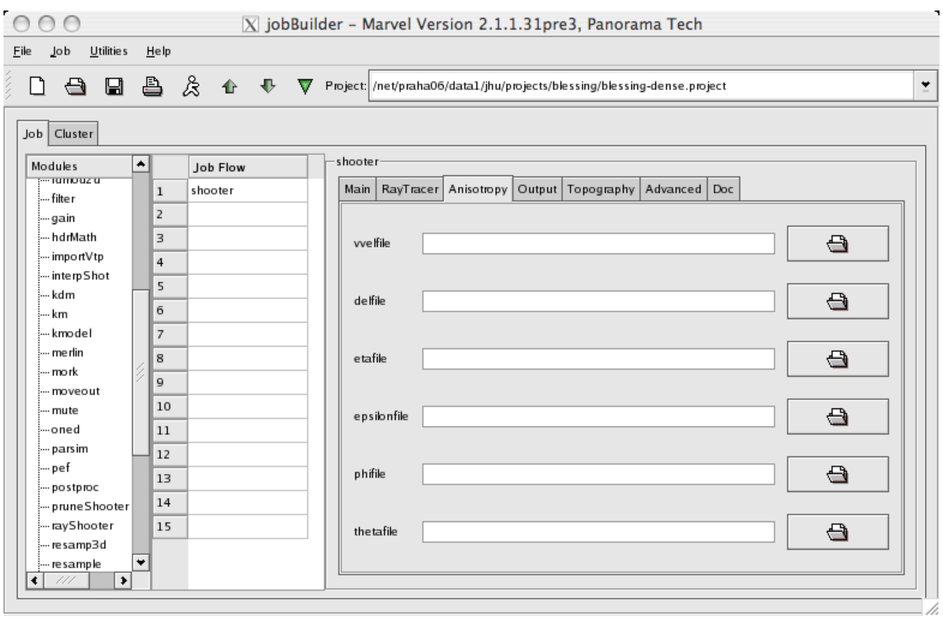


Table 118. shooter Anisotropy Panel Fields

Field	Description
vvelfile	The name of the Vnmo file. This file is closely related to the vertical velocity field.
delfile	The name of the file containing Thomsen's delta values.

continues on next page

Table 118. shooter Anisotropy Panel Fields–continued

Field	Description
etafile	The name of the file containing Thomsen's eta.
epsilonfile	The name of the file containing Thomsen's epsilon.
phifile	The name of the file containing Thomsen's phi.
thetafile	The name of the file containing Thomsen's theta.

shooter Output Panel

The output panel, Figure 152, enables you to control the output from the shooter module. Table 119 describes the fields on the panel.

Figure 152. shooter Output Panel

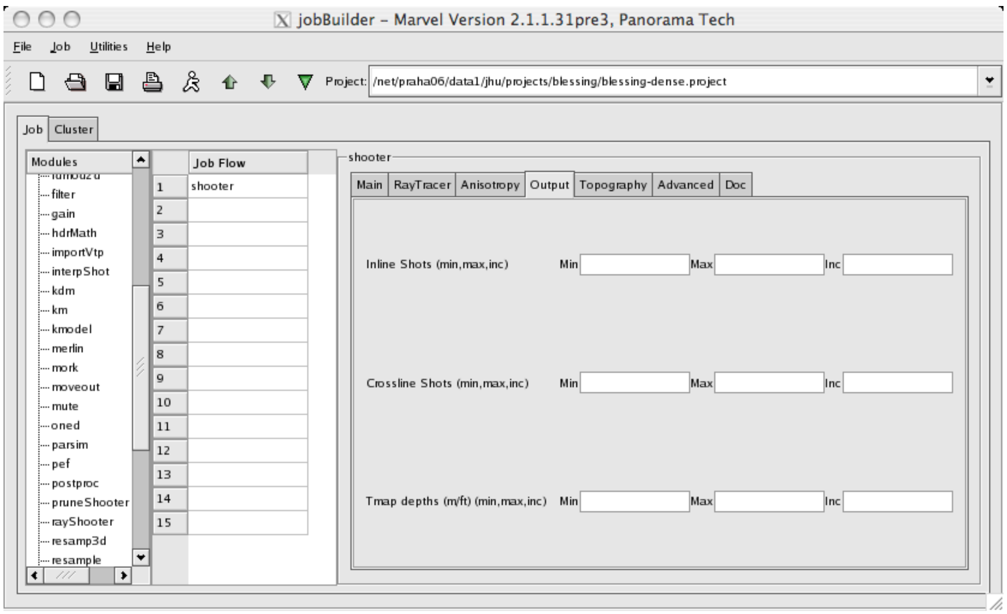


Table 119. shooter Output Panel Fields

Field	Description
Inline Shots	The Minimum, maximum, and incremental line range of the shot locations of the output travel-time volumes.
Crossline Shots	The Minimum, maximum, and incremental CDP range of the shot locations of the output travel-time volumes.
Tmap Depths	The minimum, maximum, and increment depth of each travel-time volume.

shooter Topography Panel

This panel, Figure 153, enables you to control the output from the shooter module. Table 120 describes the fields on the panel.

Figure 153. shooter Topography Panel

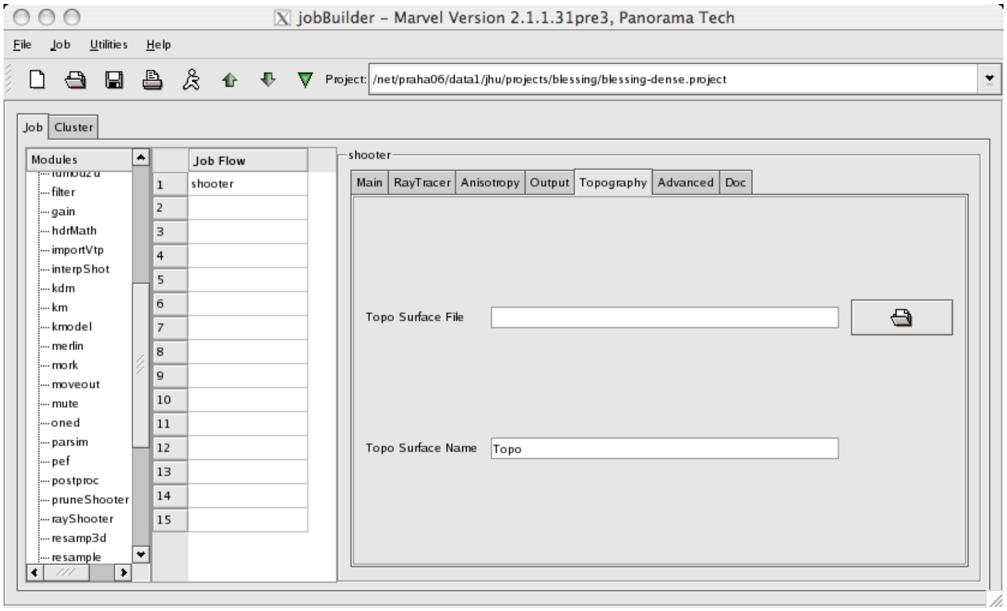


Table 120. shooter Output Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep = 100 cdp = 500 z = 20
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

shooter Advanced Panel

The shooter module displays two versions of the Advanced panel depending on your Compress selection, shown in Figure 154 and Figure 155. The field values are described in Table 121.

Figure 154. shooter Advanced Panel–Compress, No

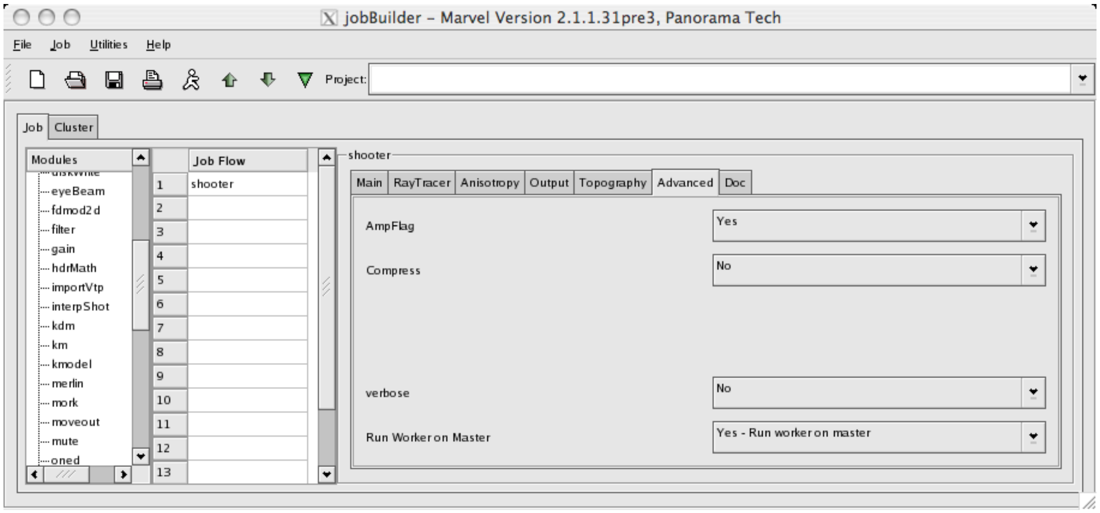


Figure 155. shooter Advanced Panel–Compress, No

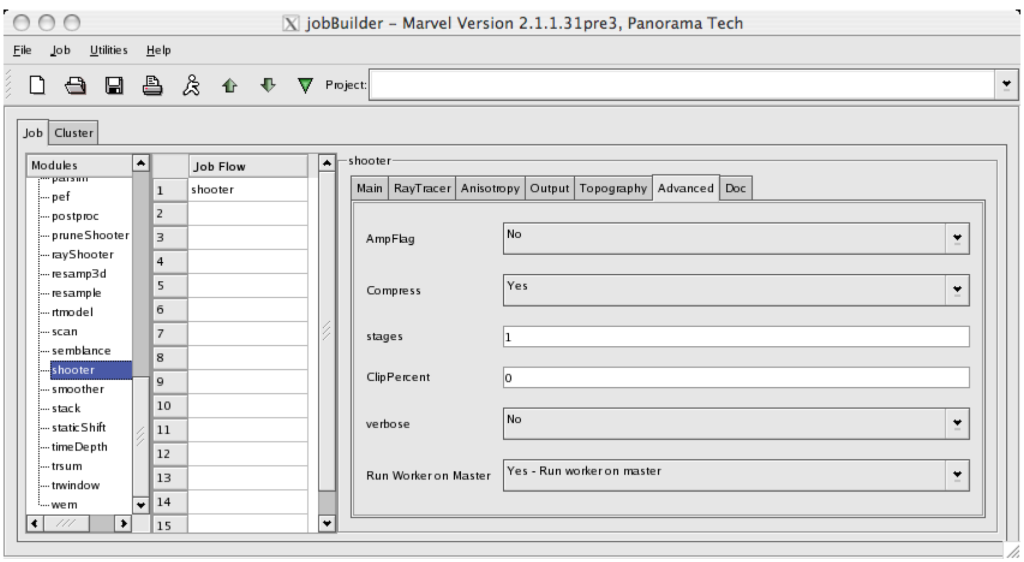


Table 121. shooter Module Advanced Panel Fields

Field	Description
AmpFlag	Determines whether or not amplitudes are calculated and output. default: No
Compress	Determines whether or not traveltimes and amplitudes (if calculated) are compressed. default: Yes
stages	The number of stages to use in the wavelet-based compression scheme. This field is displayed only if *Compress = Yes* has been selected. default: 1
ClipPercent	The percentage of the maximum amplitude defining the threshold in the wavelet domain below which amplitudes are zeroed. While clipping can increase compression efficiency, it can also seriously reduce accuracy. This field is displayed only if Compress = Yes has been selected. default: 0
verbose	Switch for turning debug printing on and off. default: No
Run Worker on Master	Determines whether or not the master is used in the computational process. default: Yes

smoother Module

The smoother module, Figure 156, enables you to control the smoothing operation performed on the output data. The fields on the panel are described in Table 122.

Figure 156. smoother Panel

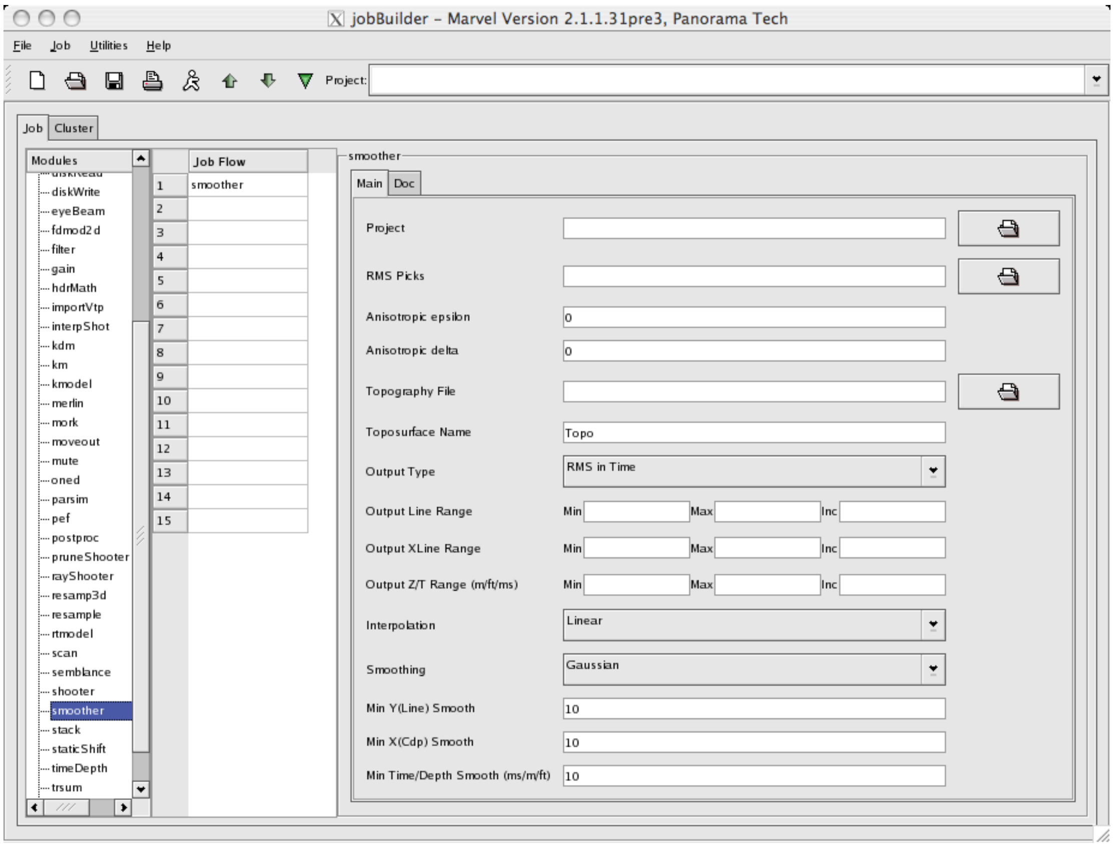


Table 122. smoother Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
RMS Picks	
Anisotropic epsilon	default: 0
Anisotropic delta	default: 0

continues on next page

Table 122. smoother Panel Fields–continued

Field	Description
Topography File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20
Toposurface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo
Output Type	Interval in Depth, or RMS in Time. default: RMS in Time
Output Line Range	Minimum, maximum and increment values for output lines.
Output XLine Range	Minimum, maximum and increment values for output crosslines.
Output Z/T Range (m/ft/ms)	Minimum, maximum and increment values for output Depth/Time values.
Interpolation	Gaussian Spray + Interpolation, or Linear default: Gaussian Spray + Interpolation
Smoothing	Gaussian, or Boxcar (Linear). This field is only visible if the Interpolation method is Linear. default: Gaussian
Min Y(Line) Smooth	Minimum Y (line) smoothing. Default: 10
Min X(Cdp) Smooth	Minimum X (CDP) smoothing. Default: 10
Min Time/Depth Smooth (ms/m/ft)	Default: 10

stack Module

The stack module, Figure 157, controls how the module stacks all traces in a given gather. The fields on the panel are described in Table 123.

Figure 157. stack Panel

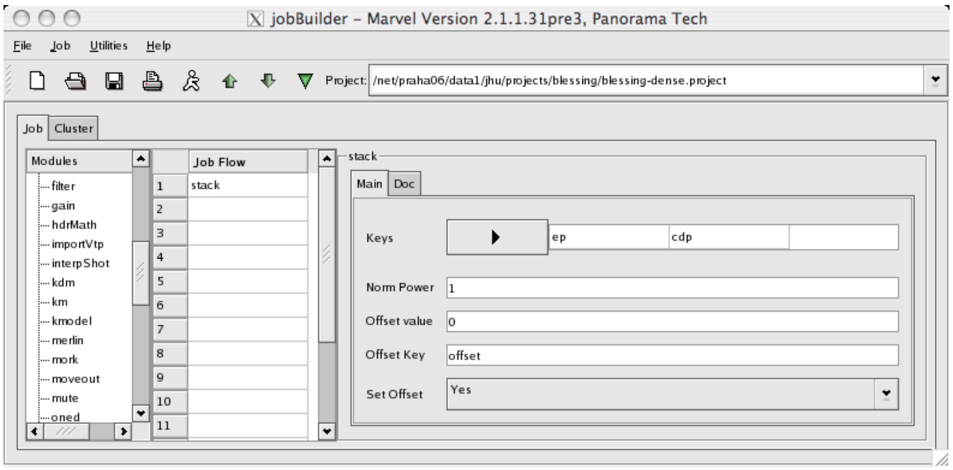


Table 123. stack Panel Fields

Field	Description
Keys	The header keys defining a gather or ensemble to stack. defaults: ep, cdp
Norm Power	Defines whether or not the stack is to be normalized by the number of non-zero values at each fixed time. When Norm Power is zero, normalization is not performed. default: 1
Offset value	The value stored in the offset field of the stacked trace. default: 0
Offset Key	The header key defining the offset field of the stacked trace. default: offset
Set Offset	The switch for setting or not setting the offset value in the header. default: Yes

staticShift Module

The staticShift module calculates and applies elevations statics. The statics can be calculated from information stored in the trace headers, or the module can simply apply a single static shift already stored in an appropriate header location. The module assumes that appropriate elevations are already stored in the trace headers.

The input field *sut* is assumed measured in milliseconds. The basic formulas are:

Equation 10:

$$outputfieldsstat = sdel - \frac{(selev + sdepth)}{swevel}$$

Equation 11:

$$outputfieldgstat = sstat - \frac{sut}{1000.}$$

Equation 12:

$$outputfieldtstat = sstat + gstat + \frac{(selev - gelev)}{wevel}$$

Table 124. staticShift Variable Definitions

Field	Description
sstat	The static time shift for the weathering layer below the source.
gstat	The static time shift for the weathering layer below the receiver.
sdel	The datum elevation at the source.
selev	The source elevation from sea level.
sdepth	The source depth.
sut	The uphole time in milliseconds.
swevel	The subweathering velocity.
wevel	The weathering velocity.

staticShift Main Panel

The staticShift Main panel, Figure 158, controls the static shift module. The fields are described in Table 125.

Figure 158. staticShift Main Panel

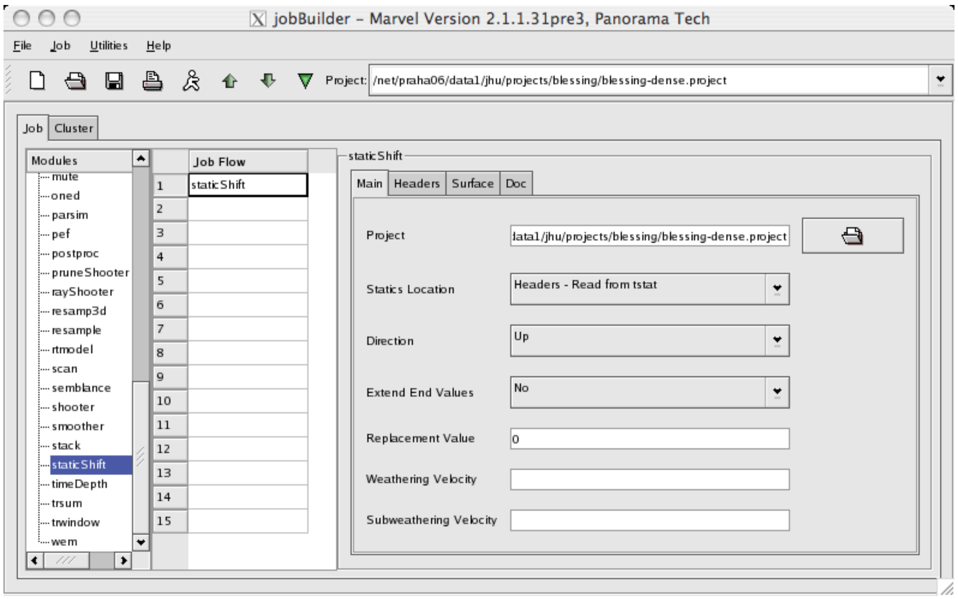


Table 125. staticShift Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
Statics Location	Where to find the statics data, read headers from *tstat*, or calculate using the methodology given in staticShift Module, or read from a surface file. If you select Surface, enter the surface information in the staticShift Surface Panel. Determines how to get the weathering velocity and the subweathering velocity. default: Headers–Read from tstat
Direction	The direction of the shift: Down or Up. Down means to shift to longer times, while Up means to shift to shorter times. default: Up
Extend End Values	

continues on next page

Table 125. staticShift Main Panel Fields–continued

Variable	Description
Replacement Value	default: 0
Weathering Velocity	The actual weathering velocity to use.
Subweathering Velocity	The actual subweathering velocity to use. The subweathering velocity is the velocity of the main top layer.

staticShift Headers Panel

The staticShift module headers panel, Figure 159, enables you to specify the headers used for the static shift module. The fields on the panel are described in Table 126.

Figure 159. staticShift Module Headers Panel

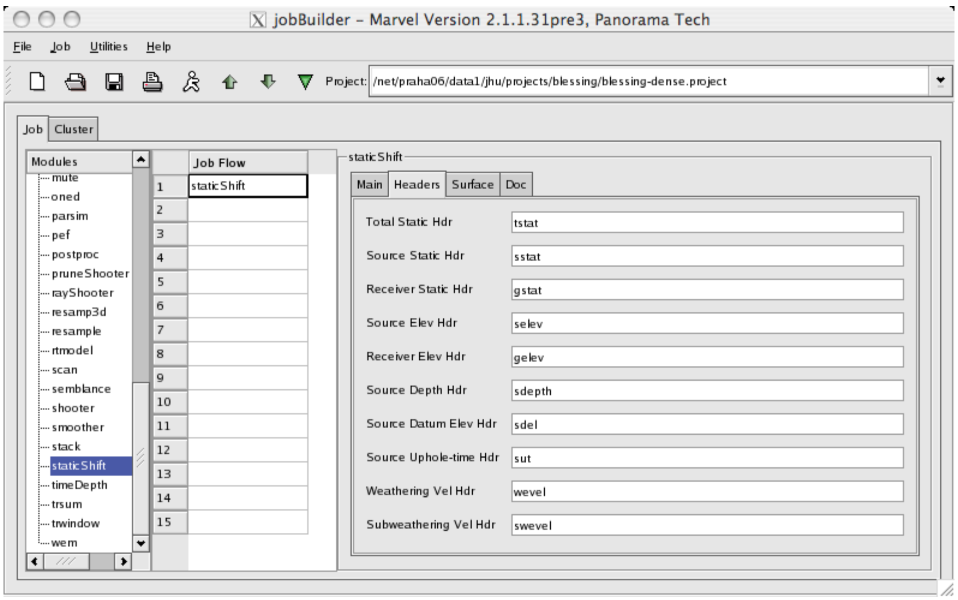


Table 126. staticShift Module Headers Panel Fields

Field	Description
Total Static Hdr	The keyword specifying the value of the total static correction for this trace. default: tstat
Source Static Hdr	The keyword specifying the value of the source static correction. default: sstat
Receiver Static Hdr	The keyword specifying the value of the receiver static correction. default: gstat
Source Elev Hdr	The keyword specifying the value of the source elevation. default: selev
Receiver Elev Hdr	The keyword specifying the value of the receiver elevation. default: gelev
Source Depth Hdr	The keyword specifying the value of the source depth. default: sdepth

continues on next page

Table 126. staticShift Module Headers Panel Fields–continued

Field	Description
Source Datum Elev Hdr	The keyword specifying the value of the datum elevation. default: sdel
Source Uphole-time Hdr	The keyword specifying the value of the source uphole time. default: sut
Weathering Vel Hdr	The keyword specifying the value of the weathering velocity. default: wevel
Subweathering Vel Hdr	The keyword specifying the value of the subweathering velocity. default: swevel

staticShift Surface Panel

The staticShift Surface panel enables you to specify the headers used for the staticShift module. There are only two fields on this panel, and they are only displayed if you select Surface for the Statics Location on the staticShift Main panel. These two fields are:

Surface File—The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20

Surface Name—The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo

timeDepth Module

The timeDepth module converts time-to-depth values and depth-to-time values.

timeDepth Main Panel

There are two different Main panels depending on the model type, Gridded (Figure 161) or Single Function (RMS) (Figure 160), the terms are defined in Table 127.

Figure 160. timeDepth Main Panel–Model Type, Single Function (RMS)

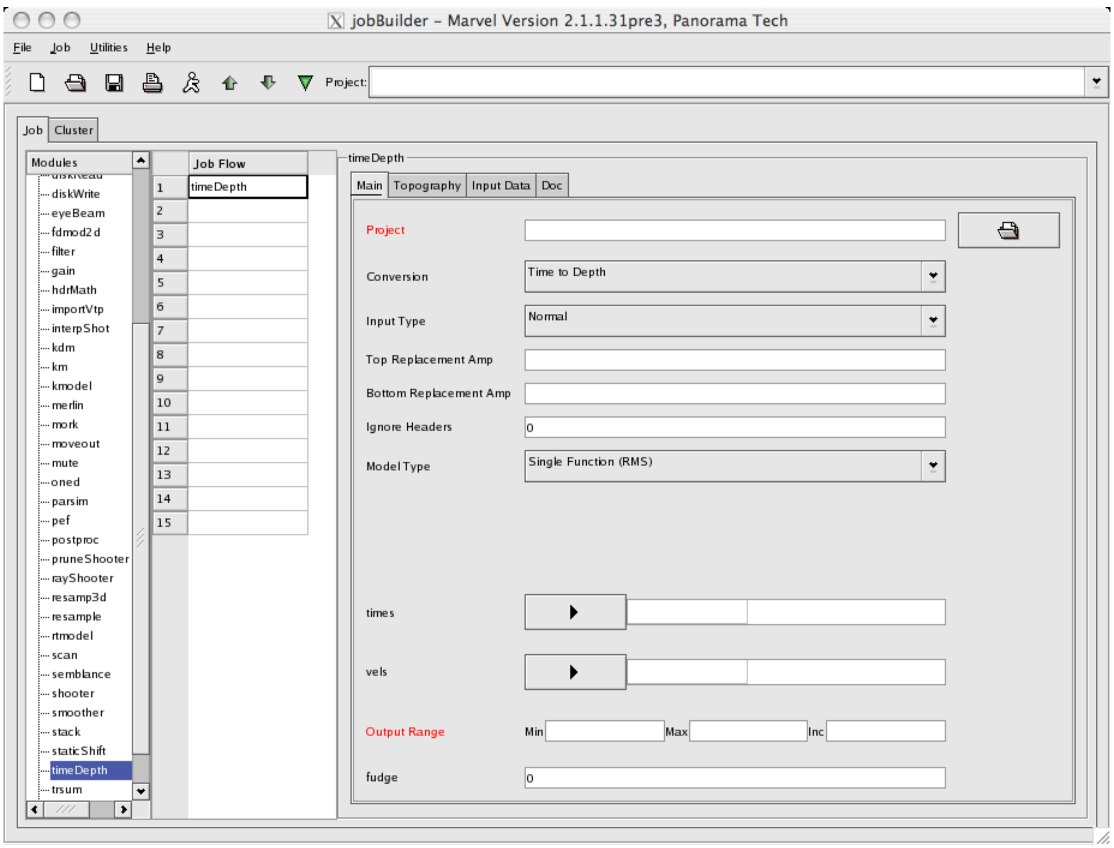


Figure 161. timeDepth Main Panel–Model Type, Gridded

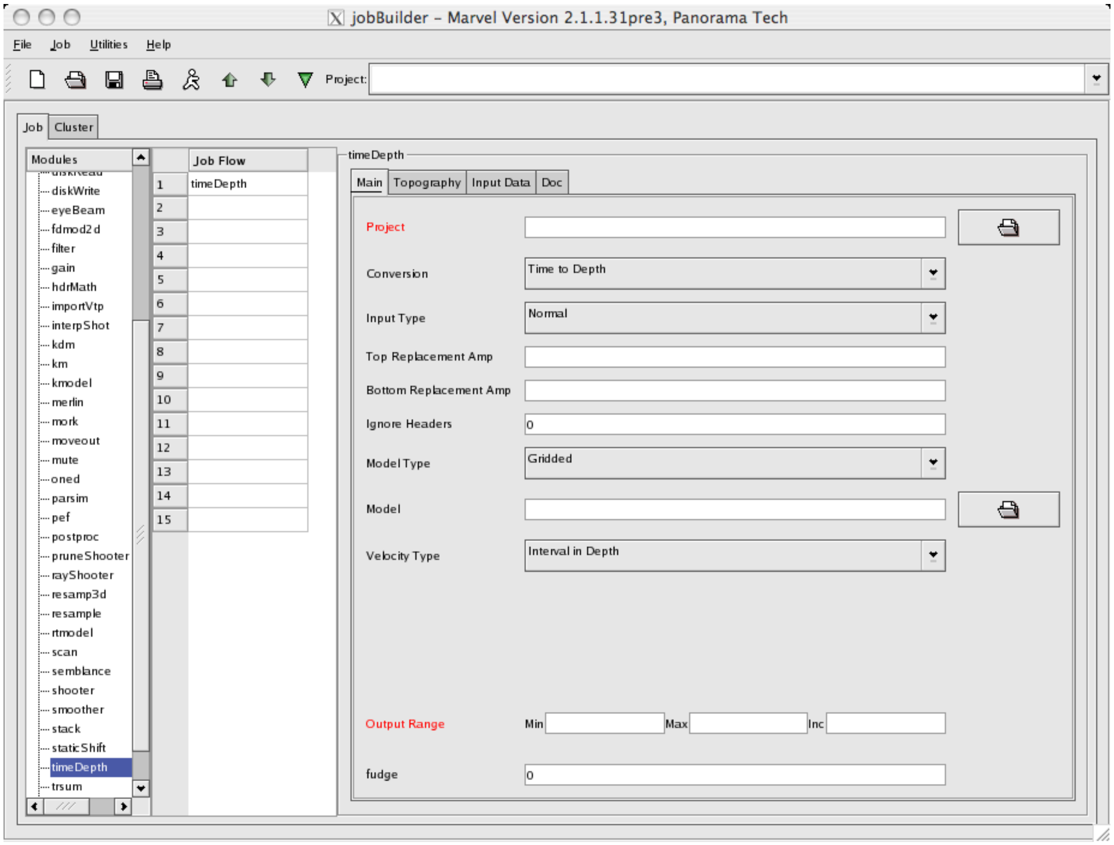


Table 127. timeDepth Main Panel Fields

Field	Description
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a required entry.**
Conversion	Flag indicating whether the conversion is to be performed Depth to Time, or Time to Depth. default: Time to Depth
Input Type	Flag indicating whether the data is a PSTM from Topography, or a Normal conversion. default: Normal
Top Replacement Amp	

continues on next page

Table 127. timeDepth Main Panel Fields–continued

Variable	Description
Bottom Replacement Amp	
Ignore Headers	default: 0
Model Type	Flag indicating whether the model is Gridded, or Single Function (RMS). default: Gridded
Model	The filename of the input model. **This field is only displayed for the Gridded Function Type.**
Velocity Type	Flag indicating whether the velocity is Interval in Depth or RMS in Time. **This field is only displayed for the Gridded Function Type.** default: Interval in Depth
Output Range	Provides the minimum time/depth, maximum time/depth, and incremental time/depth values. **This is a REQUIRED entry.**
times	Pick times for a (single) velocity function. **This field is only displayed for the Single Function Function Type.**
vels	Pick velocities for a (single) velocity function. **This field is only displayed for the Single Function Function Type.**
Output Range	Provides the minimum time/depth, maximum time/depth, and incremental time/depth values. **This is a REQUIRED entry.**
fudge	

timeDepth Topography Panel

The timeDepth topography data panel, Figure 162, enables you to specify the header keys used with the timeDepth module. The fields in the panel are described in Table 128.

Figure 162. timeDepth Topography Panel

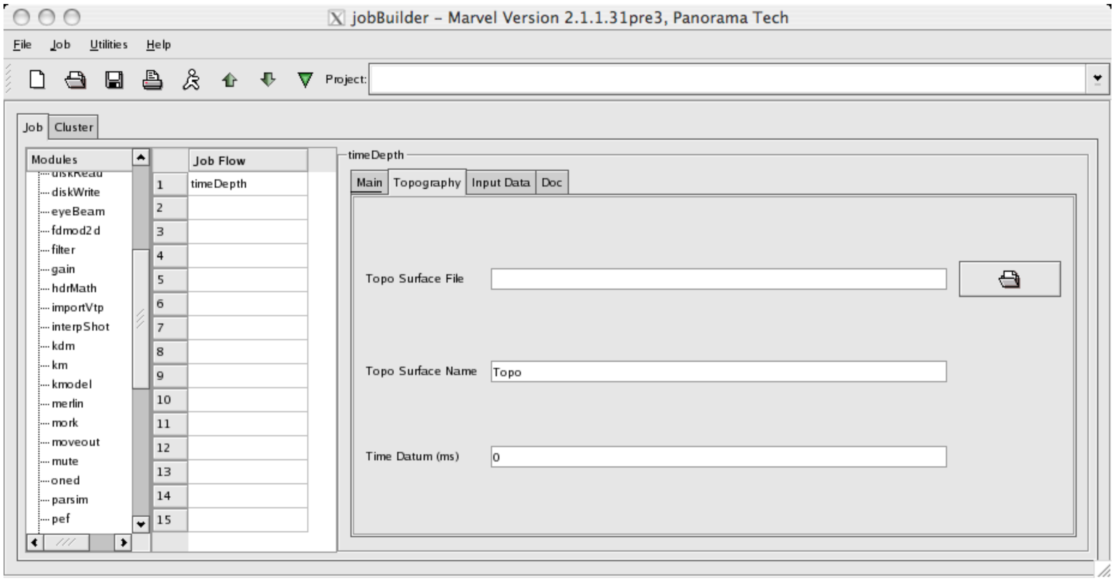


Table 128. timeDepth Input Data Panel Fields

Field	Description
Topo Surface File	The path and name of the topographic surface file. If given, this specifies the acquisition topography (and if no Source Topo File is given, this is for both sources and receivers). This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20 default: ep
Topo Surface Name	The header key specifying where the topographic data are stored. A MARVEL surface file can have many surfaces. This is the name of the one to be used. default: Topo
Time Datum (ms)	

timeDepth Input Data Panel

The timeDepth input data panel, Figure 163, enables you to specify the header keys used with the timeDepth module. The fields in the panel are described in Table 129.

Figure 163. timeDepth Input Data Panel

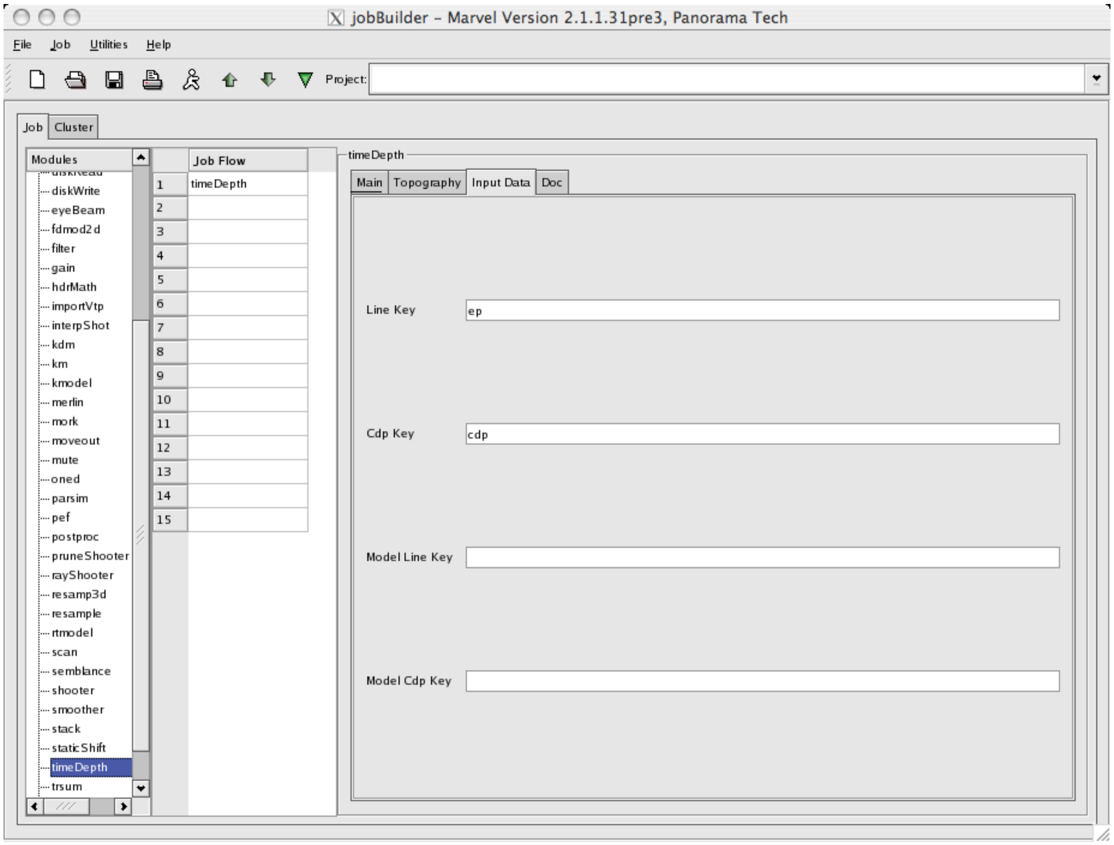


Table 129. timeDepth Input Data Panel Fields

Field	Description
Line Key	The header key specifying where line data is stored. default: ep
Cdp Key	The header key specifying where CDP data is stored. default: cdp
Model Line Key	The header word key for line information when the model is gridded. Use if different from the data.
Model Cdp Key	The header word key for CDP information when the model is gridded. Use if different from the data.

trSum Module

The trSum module enables you to perform basic operations on the input data stream. Figure 164, enables you to specify several control parameters used in the module, and the parameters are described in Table 130.

Figure 164. trSum Panel

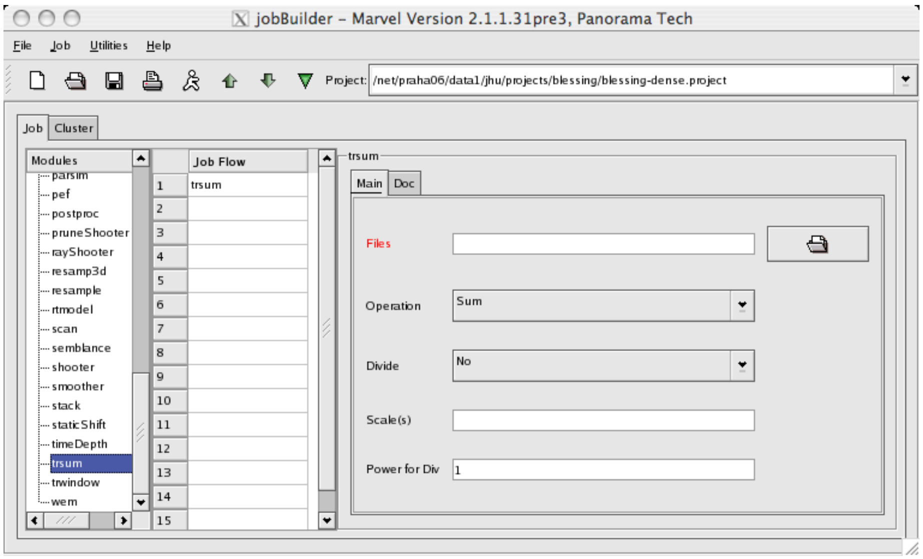


Table 130. trSum Panel Fields

Field	Description
Files	**This is a required entry field.**
Operation	Sum, Subtract, Multiply, or Divide
Divide	Yes, or No
Power for Div	default: 1

trWindow Module

The trWindow module performs a spatial windowing operation on the input data stream. The trWindow panel, Figure 165, enables you to specify several control parameters used in the module. The parameters are described in Table 131.

Figure 165. trWindow Panel

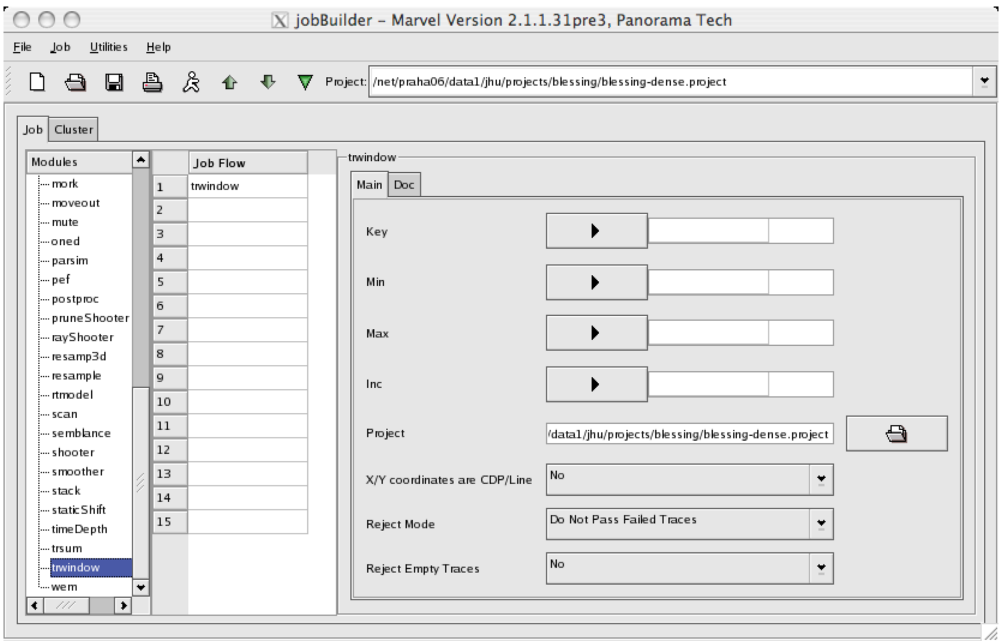


Table 131. trWindow Panel Fields

Field	Description
Key	The header word key specifying the value on which to window.
Min	The minimum value to pass.
Max	The maximum value to pass.
Inc	The increment to pass. For example, if you set Inc to 2, then alternating traces with the indicated header word will be passed
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates.
X/Y corrdinates are CDP/Line	Yes or No

continues on next page

Table 131. trWindow Panel Fields–continued

Variable	Description
Reject Mode	• Do Not Pass Failed Traces • Pass Only Failed Traces • Zero Failed Traces • Zero Good Traces
Reject Empty Traces	Yes or No

wem Module

The wem module is Panorama Technologies' wave-equation migration module. This program can run in either the common-shot mode for prestack shot-profile migrations, or it can run in the poststack mode for poststack migrations. Regardless of which mode is selected, this is a one-way phase panel method.

A typical migration job has the following job flow: diskRead ⇒ wem ⇒ collect

For faster restarts, the Mode option in the diskRead module should be set to Shot Migration (see diskRead Module).

Note:

You should be sure the Restart File parameter is in sync with the wem module. If you edit the one in wem, the one in diskRead will be updated.

Note:

The collect module is designed to stack output from migrations. By default, it does this first-come, first-served, and the output files will be unsorted. Choose the Preallocate Volume option in the collect module to avoid this behavior (see collect Module). As with the Restart File option in the diskRead module, make sure the output parameters to collect are in sync with those in wem.

wem Main Panel

There are two different Main panels depending on the mode, Common-shot (Figure 166) and Poststack (Figure 167). The parameters are described in Table 132.

Figure 166. wem Main Panel, Common-shot Mode

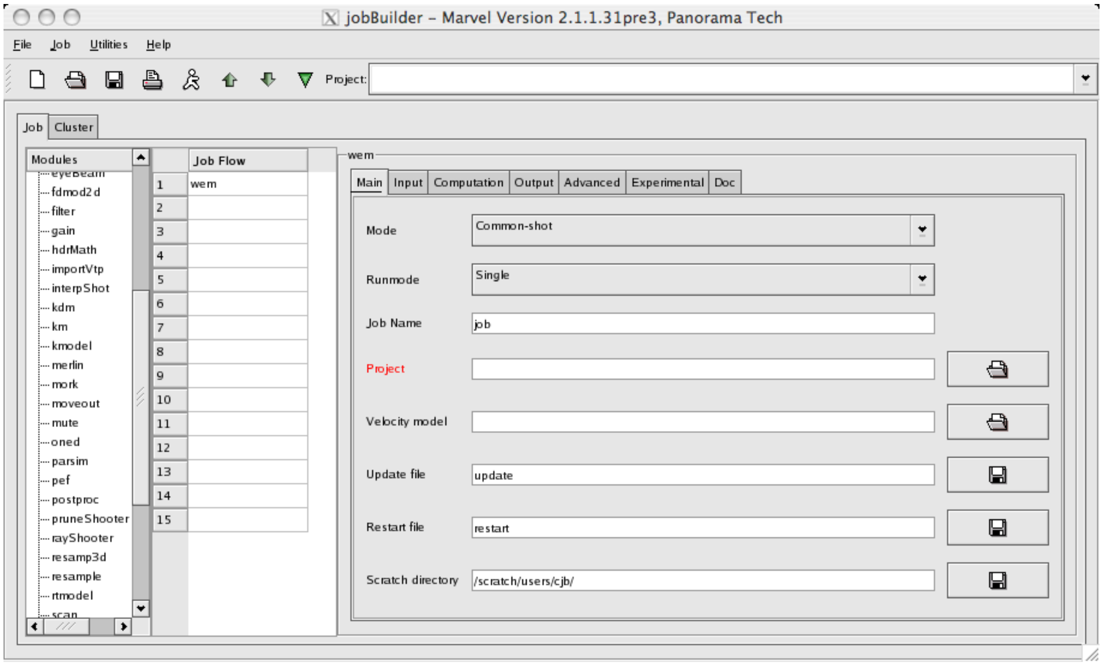


Figure 167. wem Main Panel, Poststack Mode

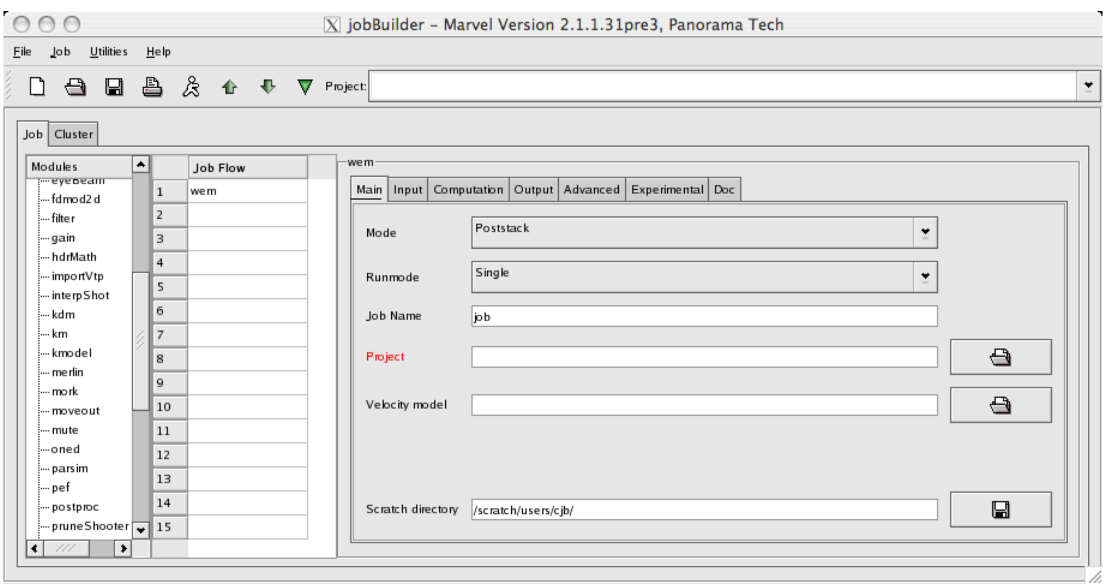


Table 132. wem Module Main Panel Fields

Field	Description
Mode	Specifies the mode in which the job is run, common-shot mode for prestack shot-profile migrations, or post-stack mode for post-stack migrations. default: Common-shot
Runmode	Is the job being run as Master in a cluster, or as Single processor? default: Single
Job Name	Name of the job to be run. default: job
Project	The path and name of the project file. This file describes the coordinate system, and how line, crossline and CDP data relate to the x and y coordinates. **This is a REQUIRED entry.**
Velocity Model	Name of the file containing the Vint/z velocity model. If the model is not given, MARVEL tries to get the model from the project.
Update file	Name of a temporary file to update as shots come in. **This field is only displayed for Common-Shot Mode.** default: update
Restart file	The application keeps information about shots already processed in this file. It is usually best to put it in the same directory where your output files are located and to give it a similar name. **This field is only displayed for Common-Shot Mode.** default: restart
Scratch directory	Name of the directory where the scratch files will be located. default: */scratch/users/cjb*

wem Input Panel

This panel enables you to specify the keys used with the web module.

Figure 168. wem Input Panel

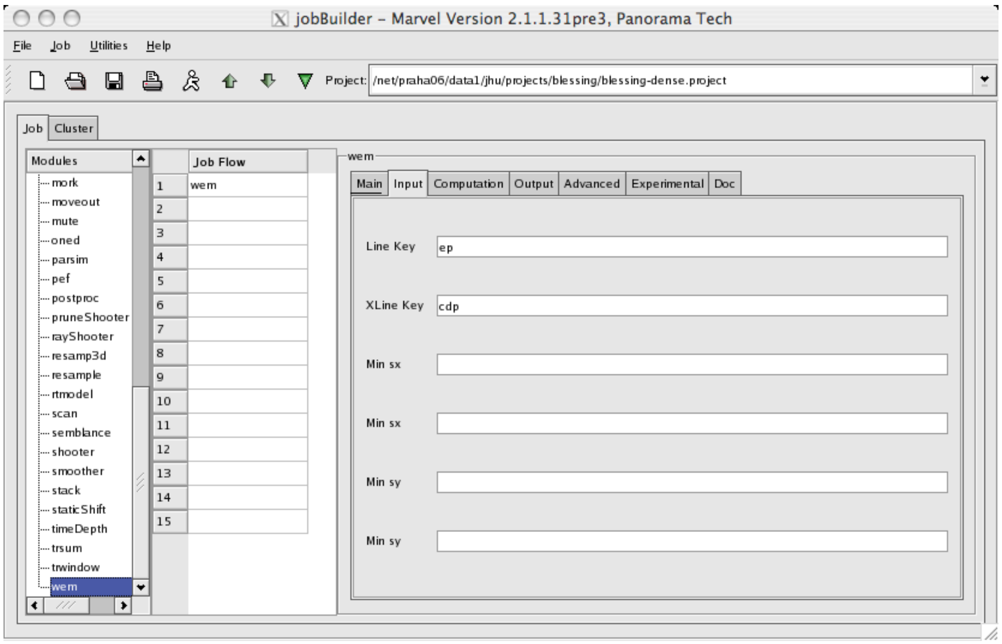


Table 133. wem Input Panel Fields

Field	Description
Line Key	Header key in which to find the line number. default: ep
XLine Key	Header key in which to find the crossline number. default: cdp
Min sx	
Min sx	
Min sy	
Min sy	

wem Computation Panel

The wem computation panel, Figure 169, enables you to specify several parameters used in the wave-equation migration calculations. These parameters are described in Table 134.

Figure 169. wem Computation Panel

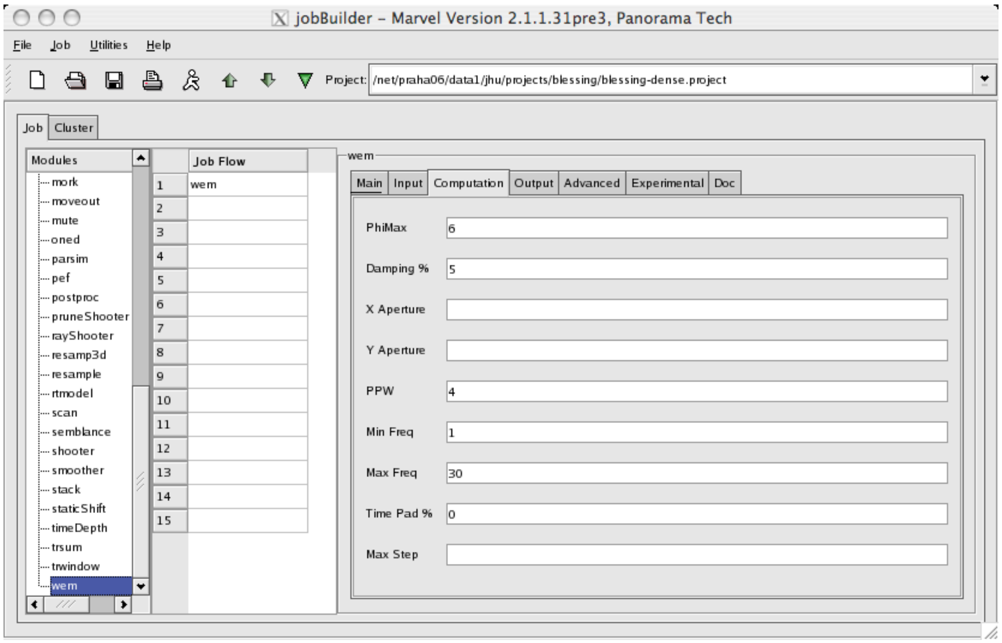


Table 134. wem Computation Panel Fields

Field	Description
PhiMax	Maximum phase-shift difference to tolerate for background velocities. default: 6
Damping	Transverse damping given as a percent of the maximum full aperture. default: 5
X Aperture	The full aperture in the x, or line, direction.
Y Aperture	The full aperture in the y, or crossline, direction.
PPW	Maximum depth step to take, specified as points per wavelength. default: 4
Min Freq	Minimum frequency to be allowed by filtering. default: 1
Max Freq	Maximum frequency to be allowed by filtering. default: 30

continues on next page

Table 134. wem Computation Panel Fields–continued

Variable	Description
Time Pad	Percent padding to apply to input traces. default: 9
Max Step	

wem Output Panel

The wem ouput panel, Figure 170, enables you to specify various module output parameters. These parameters are described in Table 135.

Figure 170. wem Output Panel

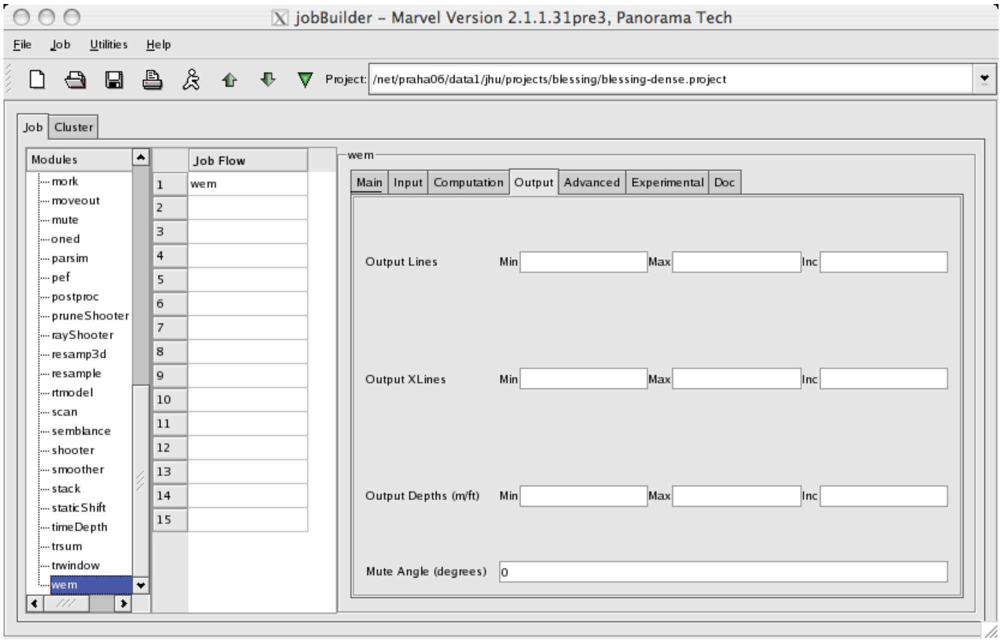


Table 135. wem Output Panel Fields

Field	Description
Output Lines	The minimum, maximum, and increment values for output lines. default: values in the model
Output XLines	The minimum, maximum, and increment values for output crosslines. default: values in the model
Output Depths	The minimum, maximum, and increment values for output times. default: values in the model
Mute Angle	The angle, in degrees, measured down from the surface defining a cone limiting the near surface aperture. default: 0

wem Advanced Panel

The wem advanced panel, Figure 171, enables you to set special operating parameters, which are described in Table 136.

Figure 171. wem Advanced Panel

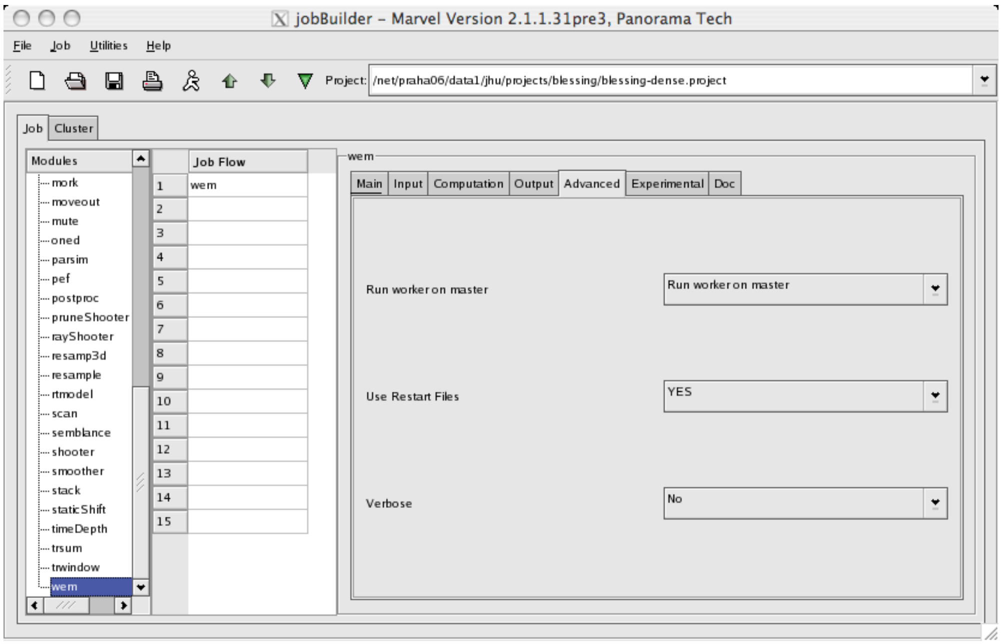


Table 136. wem Advanced Panel Fields

Field	Description
Run worker on master	Determines whether or not the master is used in the computational process. default: Run master on worker
Use Restart Files	If NO, the job will ignore restart information and start from the beginning. default: Yes
Verbose	Switch for turning debug printing on and off. default: No

wem Experimental Panel

The wem module experimental panel, Figure 172, enables you to specify various special operating parameters, which are described in Table 137.

Figure 172. wem Module Experimental Panel

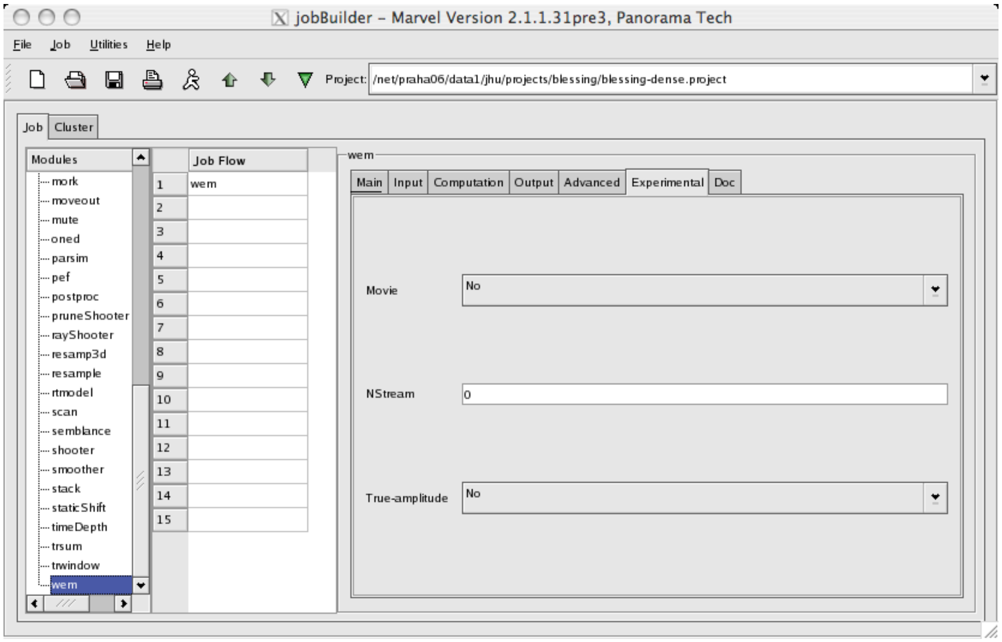


Table 137. wem Module Experimental Panel Fields

Field	Description
Movie	If set, runs movie of the depth slices as calculations progress. (This field is experimental, and probably does not work correctly.) default: No
NStream	Specifies the number of depth steps to take before streaming output to a viewer. default: 0
True amplitude	If set, apply true-amplitude calculation. (This field is experimental, and does not work correctly.) default: No

Chapter 4

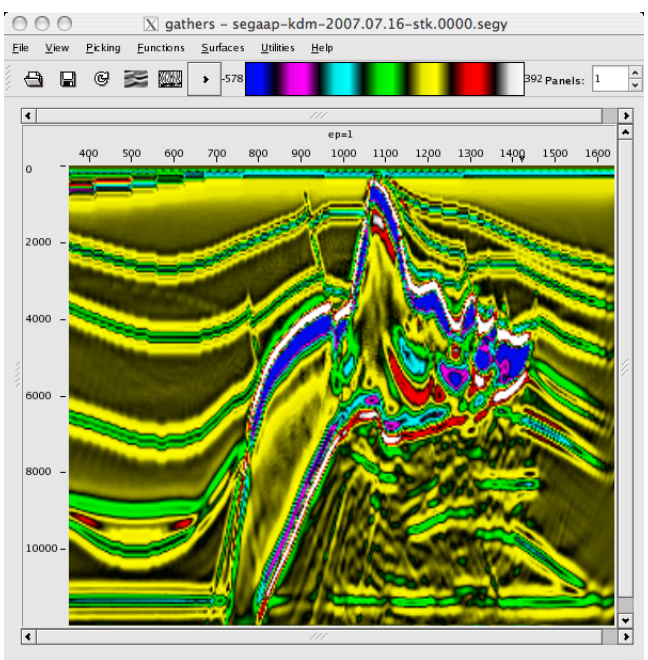
Inline Section Operations

Inline Section Operations allow you to visually inspect and interact with line-oriented data. When operating in this mode, you are able to pick or define time or depth horizons and surfaces for use in subsequent velocity model building procedures.

gathers Module

The Gathers module is the velocity analysis module supplied by Panorama Technologies. Figure 173 shows an example of the gathers window displaying the SEG AA′ 2D model.

Figure 173. Gathers Panel



gathers Menus

The gathers window has seven menus: File, View, Picking, Functions, and Surfaces, Utilities and Help. They are described in this section.

File Menu

Figure 174. File Menu

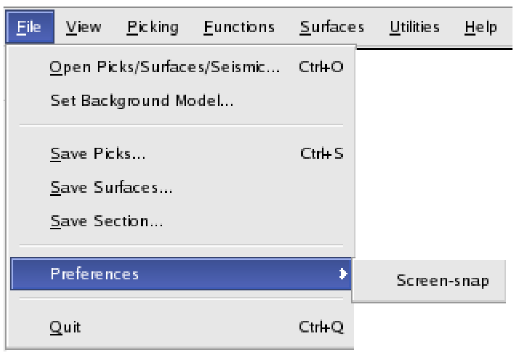


Table 138. Inline Section File Menu

Command	Description
Open Picks/Surfaces...	Displays an Open dialog box enabling you to select a picks file, or surfaces, datasets or projects, with extensions (`.pick`, `.surface`, `.segy`, `.dataset`, or `.project`).
Set Background Model...	Displays an Open dialog box enabling you to select a model file (extension .model) to be used as... . default: `model.model`
Save Picks...	Displays a Save As dialog box enabling you to save the current picks. default: `picks.picks`
Save Surfaces...	Displays a Save As dialog box enabling you to save the current surfaces information. default: `surfaces.surfaces`
Save Section...	Displays a Save As dialog box enabling you to save the current section. default: `seismic.segy`
Preferences	Displays a submenu enabling you to ...
Quit	Closes the gathers dialog box.

View Menu

Figure 175. View Menu

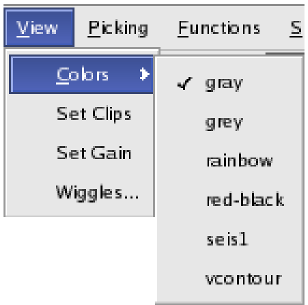


Table 139. Inline Section View Menu

Command	Description
Colors	Displays a submenu that enables you to select the color pattern used for displaying the gathers. • grey–white: white troughs to black peaks • gray–black: black troughs to white peaks • rainbow: full color spectrum • red–black: • seis1: standard seismic display colors • vcontour:
Set Clips	Displays window enabling you to set upper and lower boundaries for filtering the data being displayed, see Gathers Settings Window on page 255.
Set Gain	Displays window enabling you to set the gain for the display, see Gathers Settings Window.
Wiggles...	Displays the Wiggles View Parameters window, see Wiggle View Parameters Window on page 257.

Picking Menu

Figure 176. Picking Menu

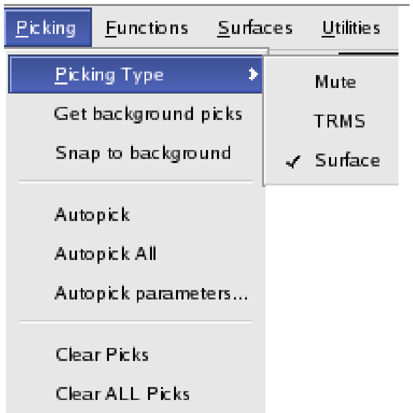


Table 140. Inline Section Picking Menu

Command	Description
Picking Type	Displays a submenu that enables you to select the type of picking to be used in the autopicking procedure. • Mute • TRMS • Surface Default: Surface
Get Background Picks	
Snap to Background	
Autopick	Autopicks the displayed panels.
Autopick All	Autopicks all ensembles in the project.
Autopick parameters....	Displays a window that enables you to set the parameters controlling the autopick process.
Clear Picks	Deletes the picks in the displayed panels.
Clear ALL Picks	Deletes all picks in the project.

Functions Menu

Figure 177. Functions Menu

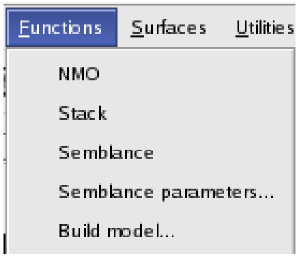


Table 141. Inline Section Functions Menu

Command	Description
NMO	Performs a normal moveout on the data.
Semblance	Performs a semblance on the data.
Semblance parameters...	Displays a panel that enables you to set the parameters associated with semblance, see Semblance Parameters Window on page 262.
Build model...	Displays a panel that enables you to set the parameters associated with building a model, see Build Model Window on page 260.

Surfaces Menu

Figure 178. Surfaces Menu

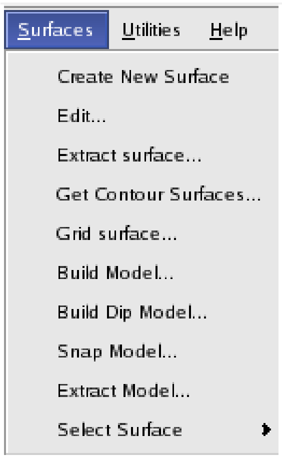


Table 142. Inline Section Surfaces Menu

Command	Description
New surface...	Displays a panel that enables you to create a new surface in the project.
Extract surface...	
Grid surface...	
Delete surface...	
Delete current surfaces	Deletes the current surfaces.
Select Surface	Displays a submenu that enables you to select a surface from a list of the currently defined surfaces.

Gathers Settings Window

Figure 179 shows the Gathers Settings window. This window enables you to... It contains four tabs: Gain, Data, Cursor/Zoom, and Topography. The fields on the windows are defined in Table 143.

Figure 179. Gathers Settings Window

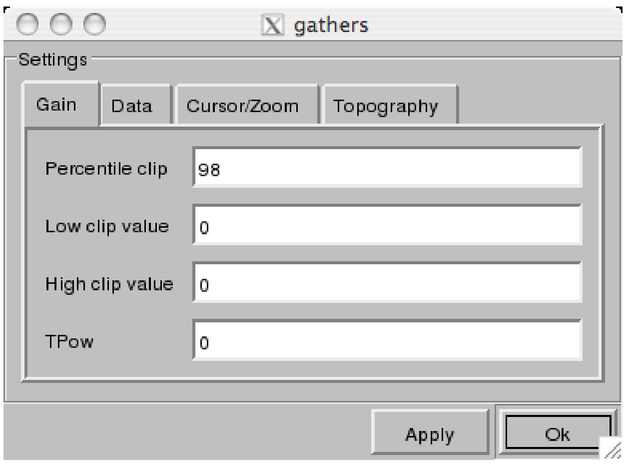


Table 143. Gathers Settings Window Fields

Tab	Field	Description
Gain	Percentile clip	default: 98
	Low clip value	default: 0
	High clip value	default: 0
	Tpow	Scale traces by time raised to a power. default: 0
Data	Data-sort Mode	• Inline • Crossline • CDP • Shot • Offsets • Semblance

continues on next page

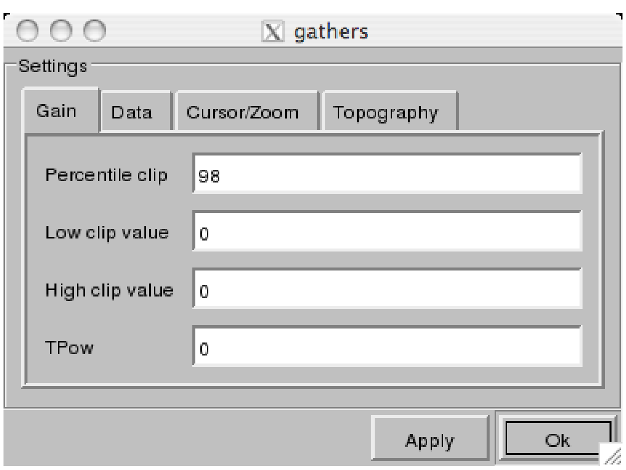
Table 143. Gathers Settings Window Fields–continued

Tab	Field	Description
Cursor/Zoom	Export Cursor	
	Follow Cursor	
	Export Zoom	
	Follow Zoom	
Topography	Topo File	The path and name of the topographic surface file. If given, this specifies the acquisition topography. This can be a MARVEL surface file, or a simple flat file defining the topography, with each line containing the line, crossline and depth values, for example: ep=100 cdp=500 z=20.
	Weathering Velocity	The propagation velocity of seismic waves through the heterogeneous surface layer. default: 4000
	Subweathering Velocity	The propagation velocity through a layer between the surface and the datum. default: 4000

Clips Window

For information about fields on this window, see Gathers Settings Window on page 255.

Figure 180. Clips Window



Wiggle View Parameters Window

Figure 181. Wiggle View Parameters Window

The only two parameters on the window are: Wiggle Overlap and Clip Wiggles.

- Wiggle Overlap–
- Clip Wiggles–

Autopicking Parameters Window

Figure 182 enables you to change the values of several parameters used in the autopicking process, Table 144.

See autopick Module on page 25 for detailed information about how MARVEL performs autopicking.

Figure 182. Autopicking Parameters Window

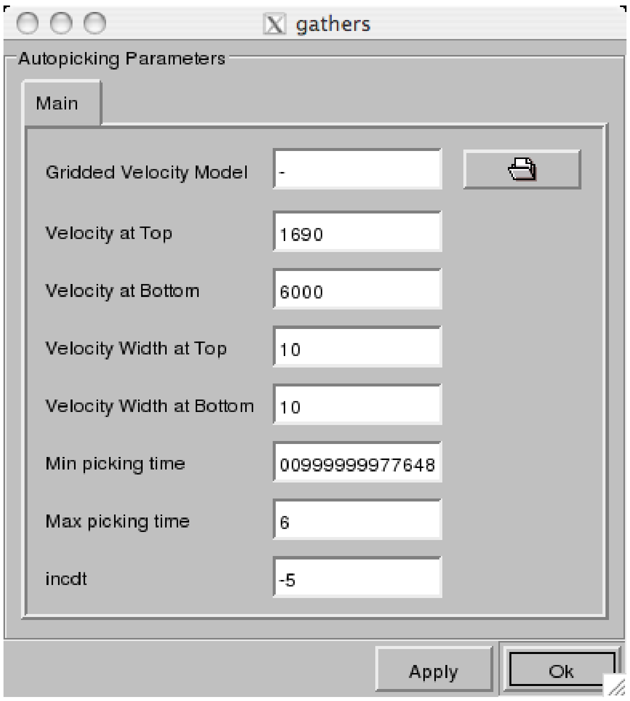


Table 144. Autopicking Parameters Window Fields

Field	Description
Gridded Velocity Model	
Velocity at Top	default: 1690
Velocity at Bottom	default: 6000
Velocity Width at Top	default: 10
Velocity Width at Bottom	default: 10

continues on next page

Table 144. Autopicking Parameters Window Fields–continued

Field	Description
Min picking time	default: 0.25
Max picking time	An override time at which picking stops and the reference function is used to define velocities. Normally, this is set to the maximum trace time. default: 6
incdt	Increment for the `dt` value. incdt should always be negative. default: -5

Build Model Window

The Build Model window, Figure 183, enables you to control the model building operation performed on the output data. The fields on the panel are described in Table 145.

Figure 183. Build Model Window

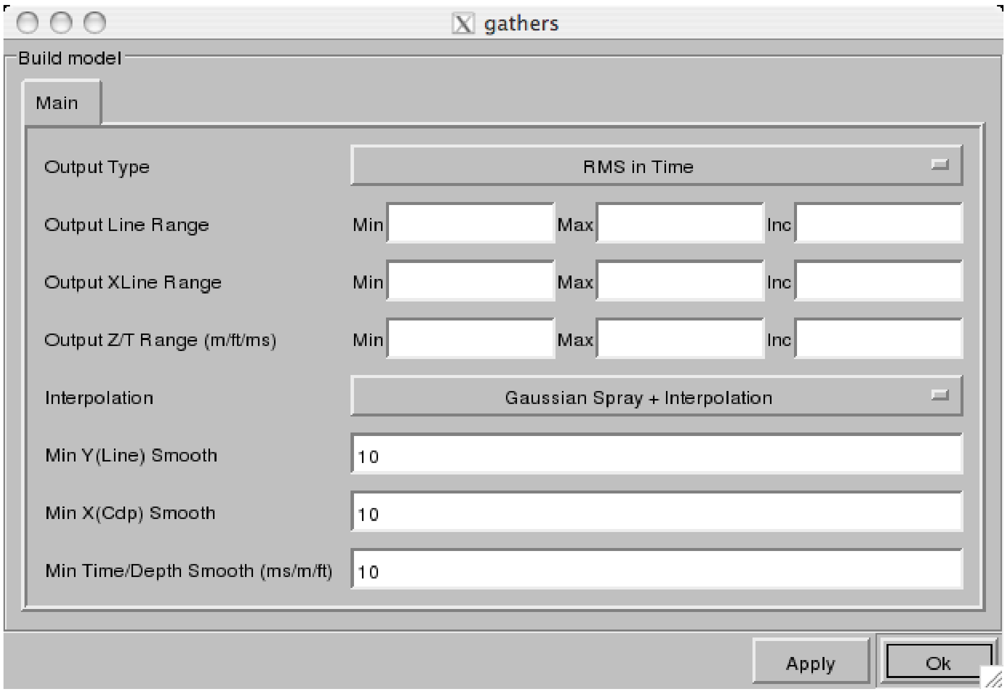


Table 145. Build Model Window Fields

Field	Description
Output Type	Interval in Depth, or RMS in Time. default: RMS in Time
Output Line Range	Minimum, maximum and increment values for output lines.
Output XLine Range	Minimum, maximum and increment values for output crosslines.
Output Z/T Range	Minimum, maximum and increment values for output Depth/Time values.
Interpolation	Gaussian Spray + Interpolation, or Linear default: Gaussian Spray + Interpolation

continues on next page

Table 145. Build Model Window Fields–continued

Field	Description
Min Y(Line) Smooth	Minimum Y (line) smoothing. Default: 10
Min X(Cdp) Smooth	Minimum X (CDP) smoothing. Default: 10
Min Time/Depth Smooth (ms/m/ft)	Minimum time and depth smoothing. Default: 10

Semblance Parameters Window

Figure 184 shows a semblance Module window, and Table 146 describes the fields on the window.

See semblance Module for detailed information about how MARVEL performs a semblance.

Figure 184. Semblance Parameters Window

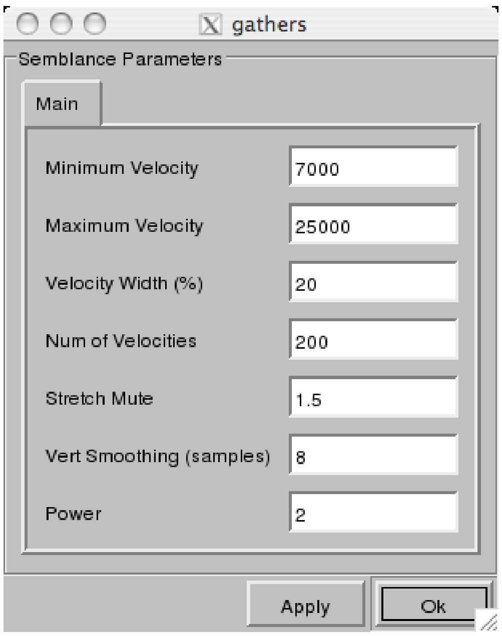


Table 146. semblance Module Window Fields

Field	Description
Minimum Velocity	default: 7000
Maximum Velocity	default: 25000
Velocity Width (%)	default: 20
Num of Velocities	default: 200
Stretch Mute	The time, in seconds, defining when the stretch mute is applied. Samples that are larger than the stretch factor are muted. default: 1.5

continues on next page

Table 146. semblance Module Panel Fields–continued

Field	Description
Vert Smoothing (samples)	default: 8
Power	default: 2

Set Background Model Window

Figure 185. Set Background Model Window

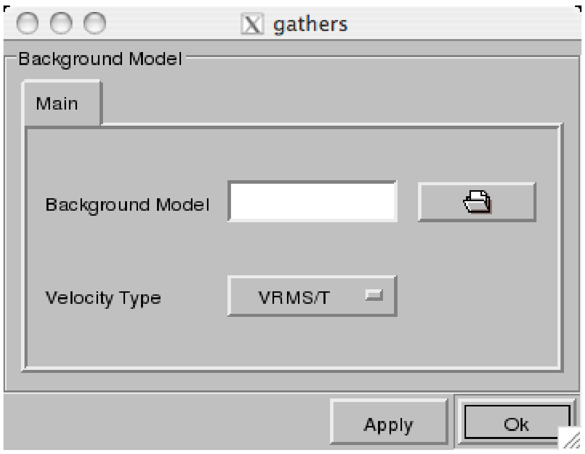


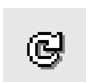
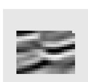
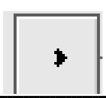
Table 147. Set Background Model Window Fields

Field	Description
Background Model	
Velocity Type	VRMS/T or VINT/Z default: VRMS/T

Gathers Toolbar

Figure 186. Gathers Toolbar

Table 148. Toolbar Commands

Symbol	Description
	Opens a project dataset.
	Saves the project using the current project name.
	Reloads and redisplays the dataset.
	Toggles variable density display.
	Toggles wiggles display as either right-filled wiggles or standard wiggles.
	Displays the next panel.

Chapter 5

XLine Operations

Crossline Section operations allow you to visually inspect and interact with crossline oriented data. When operating in this mode, you are able to pick or define time or depth horizons and surfaces for use in subsequent velocity model building procedures.

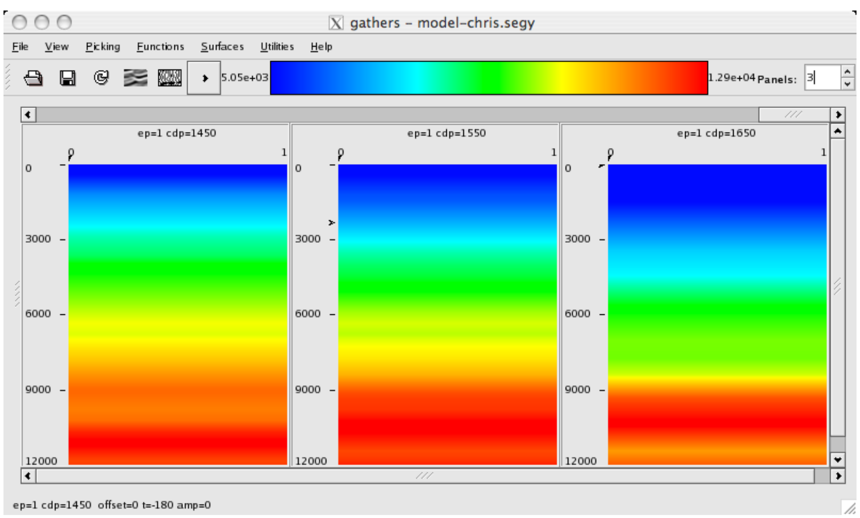
Refer to Inline Section Operations on page 249 for information.

Chapter 6

CDP Gathers Operations

CDP Gathers Operations enable you to visually inspect and interact with display data. You can also pick time-velocity pairs and time-mute pairs manually, or enable MARVEL to pick time-velocity pairs automatically. You can also select the range of gathers on which you want to work. See Figure 187 for an example of the CDP Gathers panel.

Figure 187. CDP Gathers Panel



Chapter 7

Shot Gathers Operations

Shot Gathers Operations enable you to visually inspect and interact with display data. You can also pick time-velocity pairs and time-mute pairs manually, or enable Marvel to pick time-velocity pairs automatically. You can also select the range of gathers you on which you want to work.

Refer to CDP Gathers Operations on page 269 for information.

Chapter 8

eyeGlass Cluster Monitor Operations

Panorama Technologies' cluster monitor technology is named eyeGlass™. eyeGlass enables you define the cluster on which distributed jobs will be executed and monitor the current CPU status for each node in that cluster. Figure 188 shows an eyeGlass display of a cluster. Table 149.

Figure 188. eyeGlass Panel

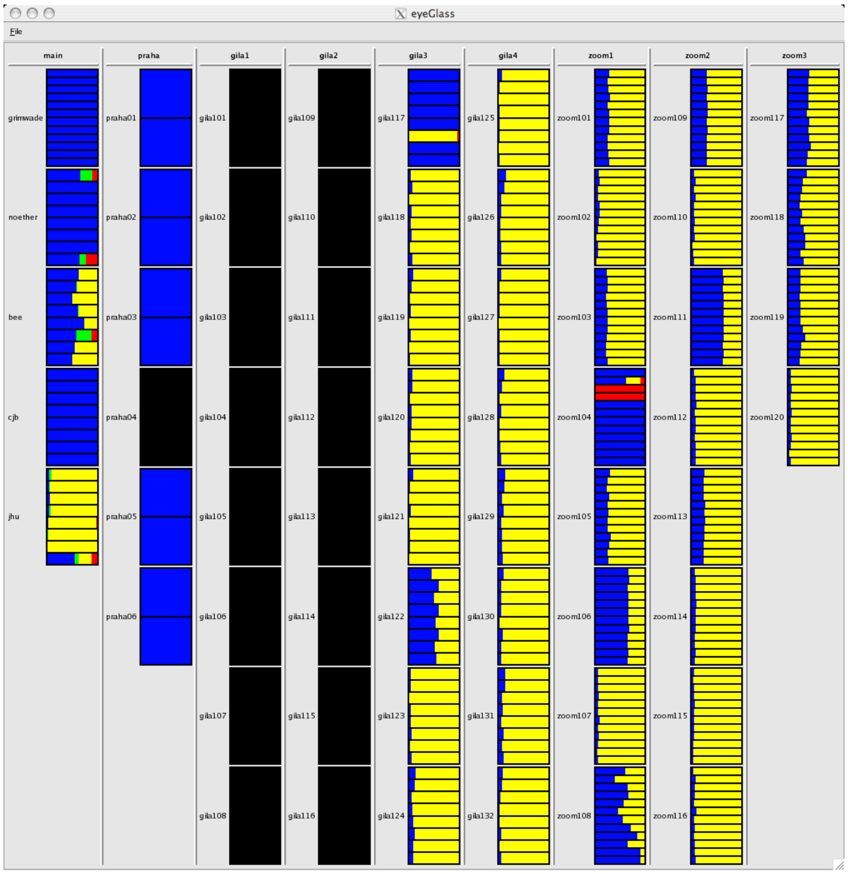


Table 149. eyeGlass Panel Descriptions

Field	Description

The size of any given output volume, together with the amount of memory available in a given node, determines the number of nodes required to hold the output volume in memory without swapping. In the example in Figure 188, MARVEL requires four single CPU nodes to hold the output volume in memory, and there are four such groups. If the output volume was smaller, the same system could be set up as eight groups, each containing two CPUs.

Within each group, the output volume is distributed over CDPs to minimize load balancing problems. Data is distributed so that each group only processes one-quarter of the input. This means that, given a sufficient number of nodes, you can process extremely large output volumes in a single job.

Appendix A

File Formats

All MARVEL control files use the XML specification. The features of XML make it well-suited for use in these types of files. Specifically,

- it is simultaneously human- and machine-readable;
- it has a self-documenting format that describes structure and field names as well as specific values;
- it has strict syntax and parsing requirements that allow the necessary parsing algorithms to remain simple, efficient, and consistent.

Appendix B

Topographic Migration Velocity Analysis

This appendix provides a work flow on which topographic migration velocity analysis can be based. As such, the focus is on the direct estimation of a reasonable first velocity volume from datum-corrected data, followed by a general recipe for the subsequent velocity analysis from the true, or nearly true, topographic surface.

Appendix C shows how MARVEL can be used to perform a topographic migration velocity analysis.

Generalized Topographic Migration Analysis

Introduction

It is necessary to migrate seismic data from the Earth's surface in areas of significant elevation variation. Proper application of this technology has two necessary requirements:

- The topographic surface of elevations must be part of the migration algorithm. Whether performing prestack-time or prestack-depth migrations, travel times must be calculated from this surface rather than from datum.
- The topographic surface represents time zero, and, as such, all velocity analysis must be performed from this surface.

This second statement is true regardless of whether or not migration is part of the analysis procedure. Rough topographic surfaces generally make the initial velocity analysis difficult or impossible, and as a result, velocity estimation is usually based on data to which elevation statics have been applied. While this method frequently produces an acceptable image, velocities estimated in this way are not normally useful in a migration from topography. Consequently, when the initial model is estimated from data at the datum, the image must be shifted back to the true topographic surface to be useful in the migration velocity analysis stage.

After a reasonable initial model is available, subsequent migration from topography velocity analysis can update the initial model to improve the image until differences between neighboring iterations are negligible. Thus, a major problem with migration from topography is not how to perform the process, but, instead, how to estimate a reasonable starting velocity to start the iterative process that determines a reasonable final imaging velocity volume.

Table 150 identifies the terms used in the equations in the rest of this appendix.

Table 150. Equation Terms Used in the Appendix

Term	Description
selev	source elevation
sdepth	source depth
gelev	receiver elevation
wevel	weathering velocity
swevel	sub weathering velocity
sdel	datum elevation

continues on next page

Table 150. Equation Terms Used in the Appendix–continued

Variable	Description
sut	source up hole time
sstat	source static (time)
gstat	receiver static (time)
tstat	total static (time)
τ	time from datum

Elevation Statics

There are three simple equations for computing elevation statics. These equations are:

Equation 13:

$$sstat = \frac{sdel - (selev - sdepth)}{swevel}$$

Equation 14:

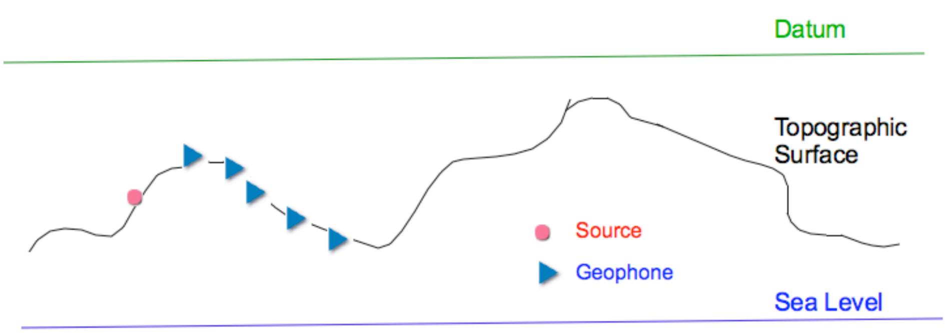
$$gstat = sstat - sut$$

Equation 15:

$$tstat = sstat + gstat + \frac{selev - gelev}{wevel}$$

To fully understand this process, consider Figure 189, where you can see all of the features of a typical land or ocean bottom cable acquisition. It is a simple topographic schematic with sources and receiver on the topographic surface. There is a zero datum or sea level, a datum that is above all source and receiver elevations, and a topographic surface on which the data is actually recorded. Normally, the datum would be set equal to the highest source or receiver elevation, but this is purely a matter of choice. In fact, the datum could be chosen anywhere on the model. It could even be below sea level, but this is rarely done.

Figure 189. Simple Topographic Schematic



Elevation static correction consists of two basic steps. As shown in Figure 190, the first step vertically shifts all of the receivers so they are theoretically aligned on the source. The second step simply shifts this entire shot profile to the desired datum.

Figure 190. Simple Topographic Schematic After Correction to Source Position

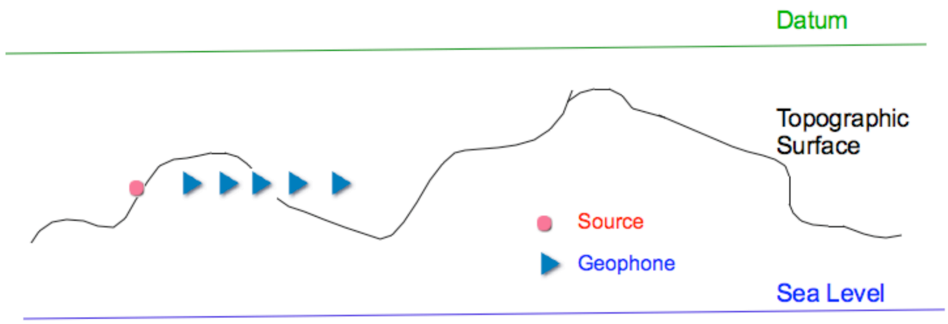
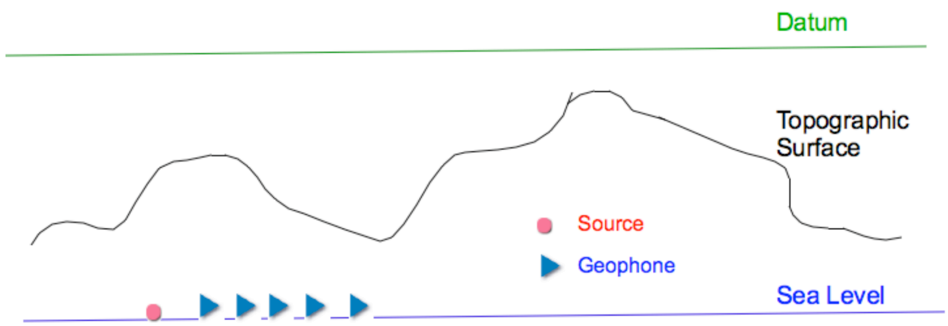


Figure 191 shows what happens if you set the datum elevation to zero, that is, sea level.

Figure 191. Simple Topographic Schematic After Correction to Sea Level



In this case, the term $\frac{selev-gelev}{wevel}$ shifts the trace samples so that, in effect, both source and receiver are at the same level. Then, Equation 16 shifts the trace samples so that the sources and receivers now lie on the surface representing zero datum or sea level.

Equation 16:

$$sstat + gstat = 2.0\left[\frac{sdel - (selev - sdepth)}{swevel} - sut\right]$$

After the trace has been shifted so that it resides at sea level, the datum elevations term, *sdel* in Equation 13 takes over and shifts the traces so that sources and receivers are now essentially on the datum surface. This is illustrated in Figure 192.

Figure 192. Simple Topographic Schematic After Correction to Datum Elevation

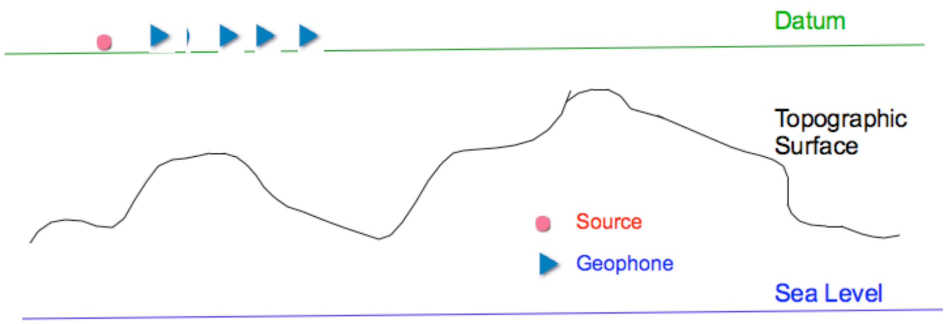
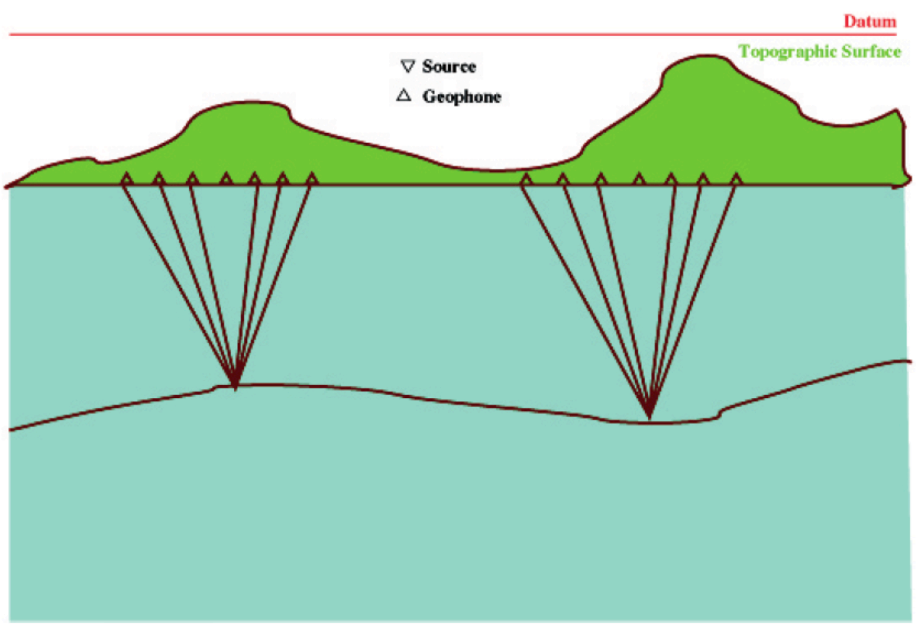


Figure 193 represents how data just prior to the beginning of the imaging or migration part of the processing sequence. At this point, you will probably be able to make reasonable estimates of an initial velocity volume. The area above the flat datum is assigned a constant velocity, while velocities are estimated using traditional-style, hyperbolic-arrival assumptions below the datum.

Figure 193. Building an initial velocity model from topography using a single datum



Initial Velocity Models

It is important to note that velocity analysis can only take place when and if the midpoints of each trace within a given CDP are located on the same level. As Figure 193 and Figure 194 show, elevation static corrections can be applied trace-by-trace to produce a data set for which each CDP has this property. Figure 193 shows data that are shifted to a flat datum. In this figure, the datum is at the minimum topographic elevation, but as indicated in Figure 194 any datum, including the true topographic surface, will suffice.

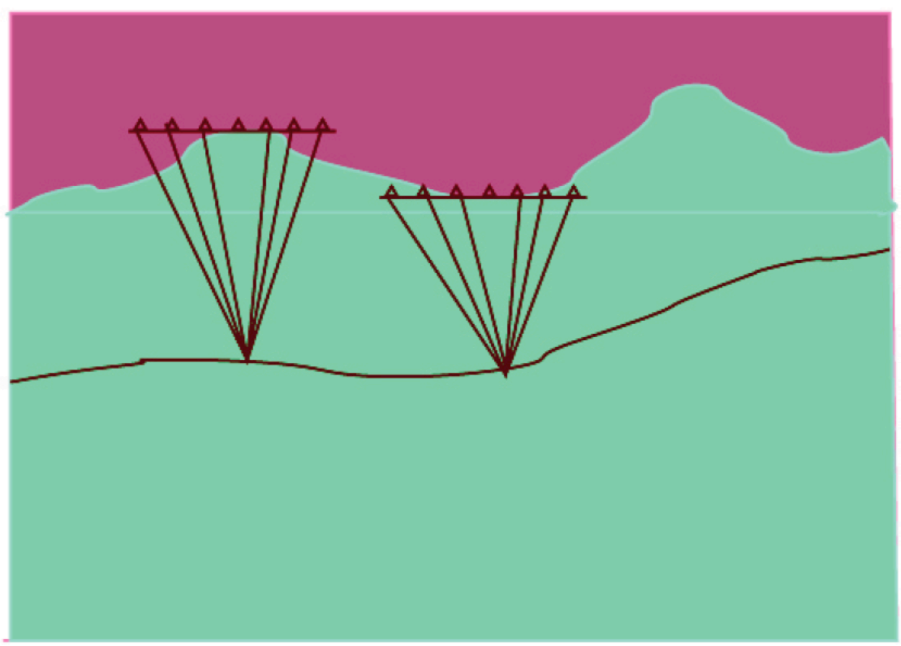
Of course, you should chose *swevel* and *wevel* as close to the true weathering and subweathering velocities as possible, but the real objective is to produce CDP's with arrivals that are as close to hyperbolic as you can achieve. If *swevel* and *wevel* satisfy this requirement, arrivals will be sufficiently hyperbolic so that traditional velocity analysis can proceed, at least in the short-offset case. Moreover, if you choose the CDP-by-CDP shift properly (in other words, to the right surface), this suggests that the initial velocities will be more accurate than those estimated from datum.

Thus, it is clear that to obtain a reasonable initial velocity field, you must first shift the input data to a suitably chosen horizon.

To make this as simple for you as possible, Panorama Technologies has chosen to shift all the traces automatically within any given CDP to whatever you specify as the 'true' topographic surface.

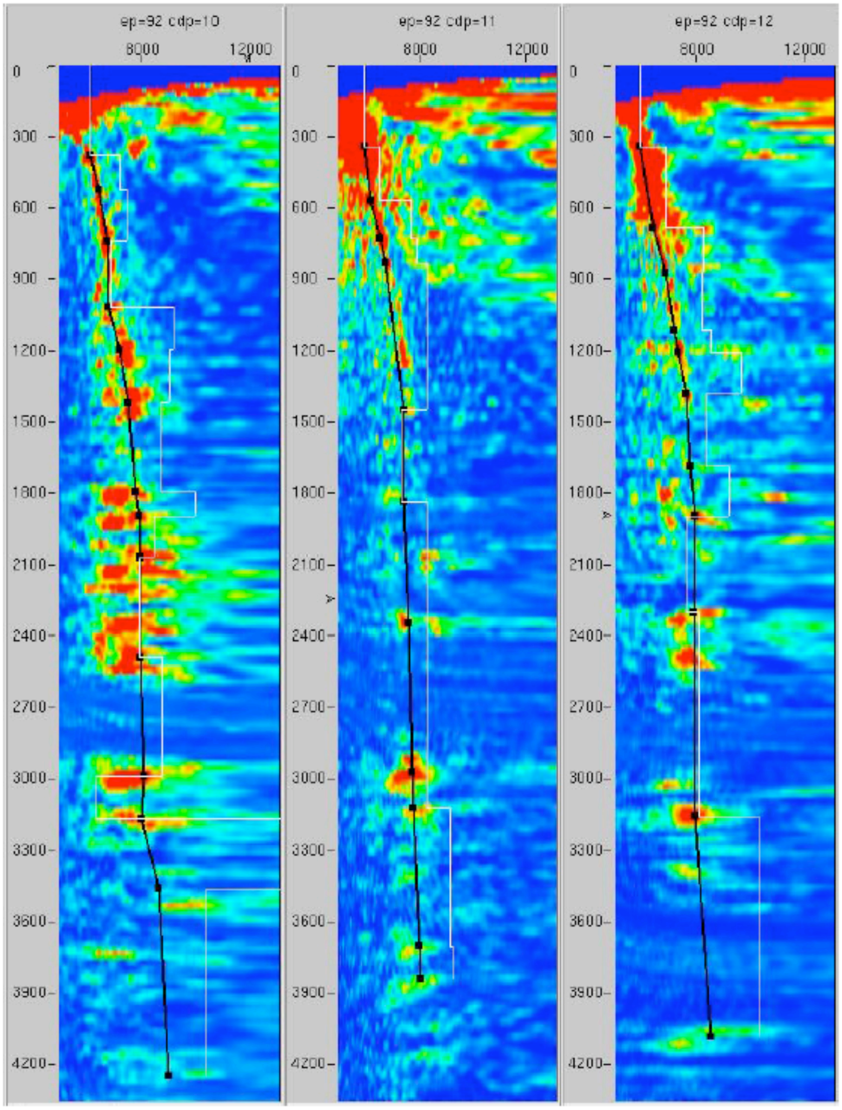
Thus, assuming that appropriate values are in proper header locations, the Gathers module, which is the velocity analysis module supplied by Panorama Technologies, performs the shift automatically to be consistent with Figure 194. You should recognize that, although this is seldom done, you can allow *swevel* and *wevel* to vary across the entire midpoint range.

Figure 194. Initial Velocity Model



After the data headers have been set properly, the initial velocity analysis is straightforward. Semblance panels are analyzed and picked in exactly the same manner as you do when the topographic elevation variations are negligible. The picking process, as illustrated in Figure 195, is exactly the same as in a normal processing mode. If the topographic variation within a CDP is relatively small, this process should work well. Note that you will not see the shift to a topographic surface.

Figure 195. Picking an initial velocity model from topography



Migrating from Topography

Before you migrate from topography, you need to make sure that the observed seismic data are shifted to their original time zero locations. This means that sources and receivers must be at the topographic surface as indicated in Figure 189.

If the input data is hung from datum, you must first apply the appropriate static shift module to place the data back at the correct surface elevations. Since the Gathers module automatically applies the proper static shifts to the data on input, it is also necessary that data trace headers be set correctly. When these objectives have been met, the application of the Panorama Technologies time and depth migration modules in topographic mode is quite simple.

The time migration module handles all topographic variations automatically, and calculates the proper travel times from the given topographic model. To produce accurate travel times, Panorama Technologies' most energetic raytracer must be provided with a suitable topographic model and surface. On successful execution of the either of the three raytrace modules, shooter, pruneshooter or raytracer, the resulting travel time tables contain all of the necessary information for an accurate migration of the input data.

Migration Velocity Analysis

Migration velocity analysis from topography proceeds through a normal iterative process. Since migration has the net effect of producing coincident source and receiver data, you can think of the migration output as having been topographically shifted as indicated in Figure 194, which shows building an initial velocity model from topography using multiple datums. Note that at each midpoint, the datum is exactly equal to the midpoint's elevation. In this case, velocity estimation is directly *from topography*. Thus, migration velocity analysis proceeds in exactly the same manner as it did for the initial stacking velocity analysis of the preceding section. The only serious concern is that you have to perform all of these tasks without error.

Workflow

The following simple workflow provides a procedure for migrating from topography. The sequence is as follows:

1. Prepare the data so that header locations corresponding to *selev*, *sdepth*, *gelev*, *wevel*, *swevel*, *sdel*, *sut*, *sstat*, *gstat*, and *tstat* are set correctly.

2. Remove any elevation statics that may have been applied to the data. Residual statics need not be removed, but refraction statics must not have been applied.

3. Perform an initial stacking velocity analysis to determine an initial migration velocity model. (Make sure that the Gathers module is in topographic mode.)

4. If running a depth migration, generate travel times from topography.

5. Migrate using the current velocity model.

6. Repeat the migration velocity analysis until you obtain suitable results.

Topographic Migration Velocity Analysis in MARVEL

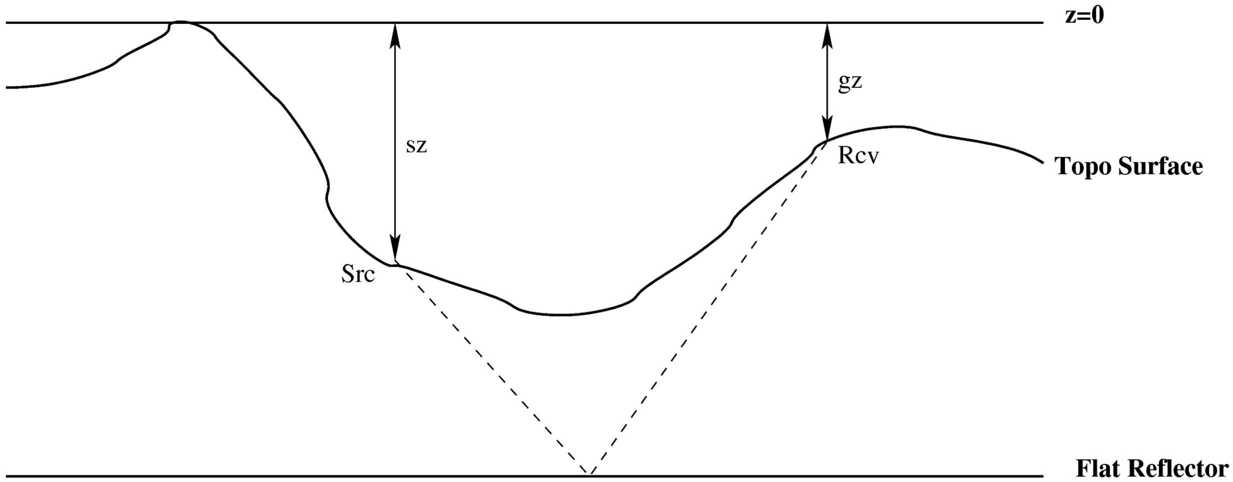
While Appendix B presents a generalized analysis of how topographic migration velocity analysis is performed, this appendix shows how MARVEL can be used to perform such an analysis.

Imaging, modeling, and velocity analysis in the presence of topography often leads to confusion on the part of the user. This confusion is partly due to the varying approaches used by different software packages, and partly because a better understanding of the general techniques is needed to make the transition to non-flat surfaces.[1] This appendix explains the approach used in the MARVEL package. The key is that the MARVEL migrations calculate traveltimes directly from the $3D$ surface to the output locations.

Depth Migration from Topography

In Figure 196, the sources and receivers are all on the topographic surface, while there is a single flat reflector beneath the surface. The real surface is the curved line in the figure, while the top flat line is the highest point on the surface. We have arbitrarily labeled this elevation, which is everywhere above the surface, as $z = 0$. As we continue, we will be interested in building a model of the earth's velocity beneath the surface. Although we will include "velocities" between $z = 0$ and the surface to create a regularly gridded model, there is no relationship between these velocities and the real medium in those positions, *and we do not use these velocities in the calculations*.

Figure 196. Topographic Acquisition

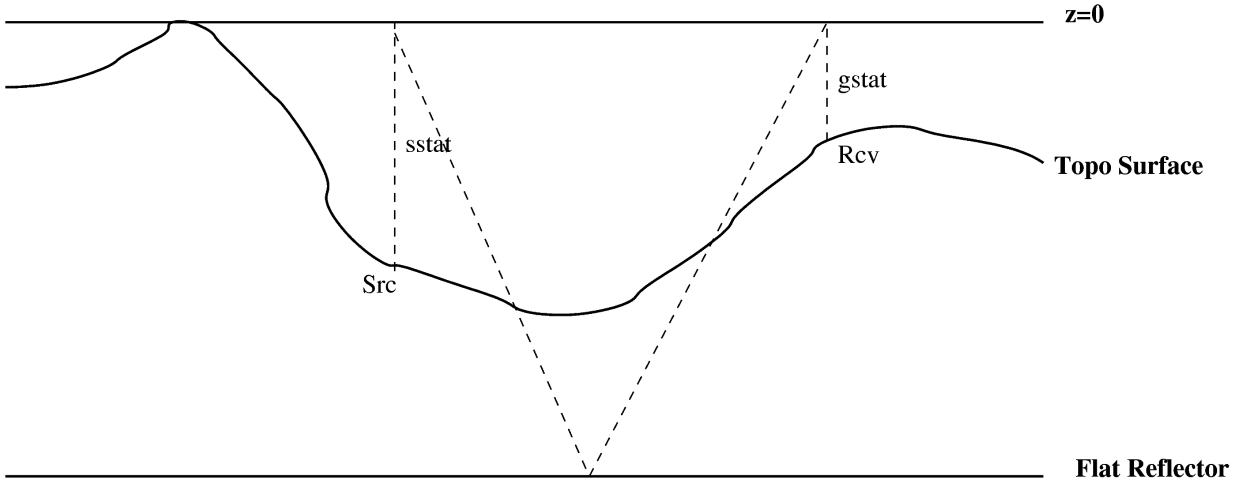


The acquisition is shown schematically for one trace in Figure 196. The source is at depth *sz* and the receiver is at depth *gz*. Static shifts, *sstat* and *gstat*, will be applied to the trace.

[1]Stanislaw Ulam said "using a term like nonlinear science is like referring to the bulk of zoology as the study of non-elephant animals." In a similar vein, "non-flat surfaces" can also be compared in importance to "non-elephant animals".

Before discussing the method MARVEL uses to migrate directly from topography, it is worth looking at something you may already be using in other packages. In some packages, an artificial “replacement velocity” is used everywhere above the surface, and a static shift, $sstat + gstat = (sz + gz)/v_{repl}$, is applied to the traces to try to synthesize data acquisition from the fixed datum, as shown in Figure 197.

Figure 197. Fixed-datum migration.



Note that:

1. This type of shift cannot produce a trace that will image correctly in more than one place.
2. A velocity model built to get a good image with this method will not match the real medium.

From Figure 196, you can see that to image this trace, you just need the traveltime from the source to the output location and from the receiver to the output location. To calculate traveltimes for depth migration, you only need to know the source and receiver positions (including depth) and the velocities beneath the surface. Once you know these values, you can sweep the trace out to the correct output locations using a model that matches the real velocities of the medium.

In MARVEL, traveltimes are computed directly from the topographic surface down into the model. Naturally, there are no traveltimes computed above the surface. For the most part, the Kirchhoff pre-stack depth migration (PSDM) can then migrate as usual, ignoring topography (except in interpolating traveltimes).

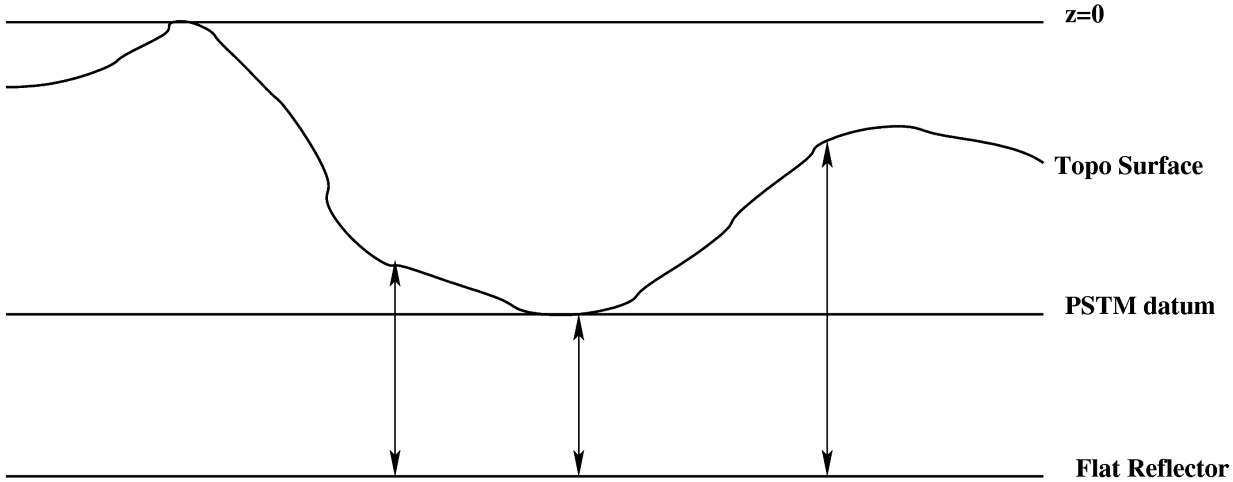
Depth To Time Conversion

To convert a stacked section from depth to time, it is just necessary to agree on the mapping of one reference depth datum to one reference time datum. In the absence of topography, it is normal for $z = 0$ to correspond to $t = 0$, while, everywhere else, the connection between depth and time depends on the local velocity function. With topography, it is not necessarily best to make this same connection, since we don't really have velocities above the surface, and any attempt to make the connection requires an artificial velocity in that location. Thus, the most sensible thing to do is to connect the lowest depth on the surface to a specific time.

The PSDM stores the output maximum depth of the surface in the header *sdepth*. The depth-to-time conversion can then continue using the maximum depth of the surface and a time datum.

For conversion from depth to time, we only have velocity information from the surface down. We can compute the time from the surface down to any output depth, but for stacking, of course, we would like to have the traces shifted properly to account for the topography. The best way to do this is to identify a depth which is everywhere at least as deep as the surface (ideally, this depth can be equal to the maximum depth), and to tie that depth to a specific time. This depth is labeled "PSTM datum" in Figure 198.

Figure 198. Depth to Time Conversion



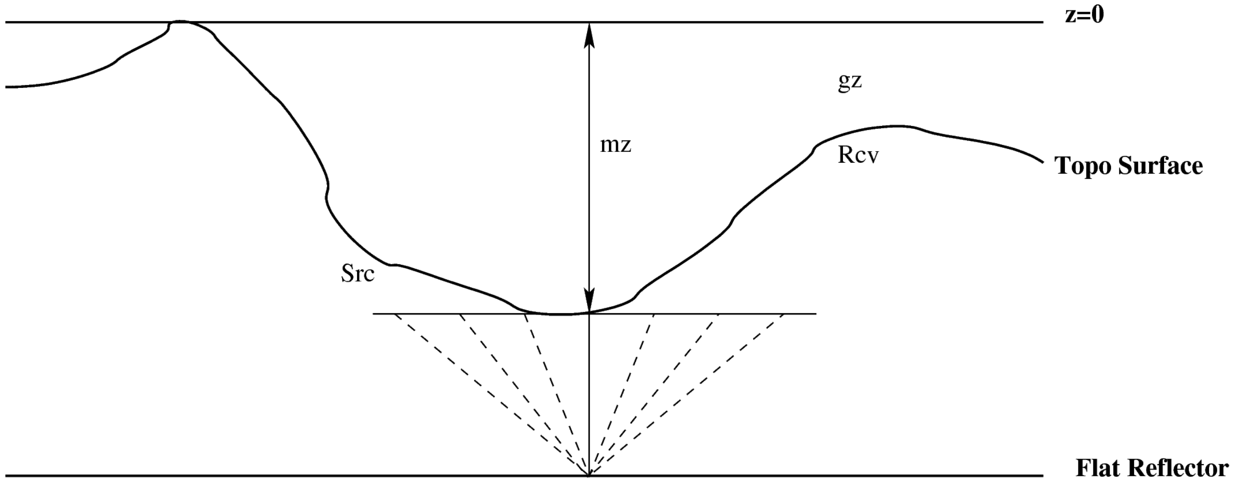
To preserve all output data, the time used should be at least the maximum (two-way) traveltime from the surface down to the depth we have chosen. For a constant subsurface velocity, this will be the time from the highest point on the surface down to the reference depth. For more complicated velocities, it will have to be calculated. Note that this process effectively redefines the surface in time, using only subsurface velocities.

The MARVEL **timeDepth** module takes a VINT/depth model and a topographic surface (provided either separately or in the model *tstat* header) and calculates a time section, as needed, with the reference depth stored in *sdepth* and the maximum time from surface to *sdepth* stored in *laga*.

Depth Velocity Update from Topography

To back out velocities for updating, you need to consider what information to use. After migration is complete, only the depth of the surface at the midpoint is important. The data must first be shifted up by the depth of the surface at the midpoint, and then depth-to-time conversion and NMO can be performed using the valid velocities below the surface. After picking velocities, topography can be used to build a model with $z = 0$ at the top.

Figure 199. Statics for backout



Note that the MARVEL model builder, **smoother**, will not insert a replacement velocity above the surface in depth, but will simply smooth subsurface velocities into that region. This is by far the safest approach for all migration, time/depth and moveout operations to ensure that no "wild" velocities are used in calculations.

Data Preparation

To perform topographic migration velocity analysis, the data should be acquired and the surface built using the methods described in this section.

Fixed Datum versus Real Surface

It should be noted that the previous discussion assumes the input data are in an "as-acquired" state; that is, static corrections were not used to move the data to a datum, as in Figure 197, either floating or static. If static corrections have been performed, these shifts must be removed from the data before MARVEL migrations are performed. MARVEL migrations make no use of "replacement velocities" above the surface; these are only needed if they have been used to shift the data to a datum.

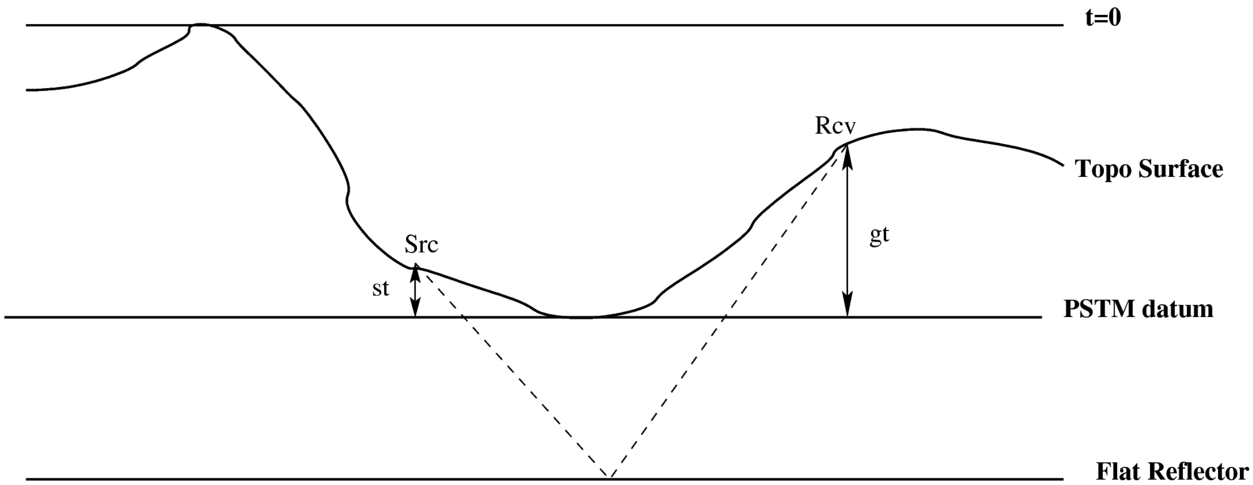
Building the Actual Surface

To create the surface needed for various processing steps, the data should either come with a separate surface specification, or the surface may be stored in trace headers, for example, *selev* and *gelev*. These are usually specified as elevations of source and receiver relative to sea level. The migration and other modules expect to have a measurement down from some arbitrary elevation which is everywhere above the real surface. For example, if you choose your fixed datum to be d, where $d \geq \{selev, gelev\}$, the surface for MARVEL should be defined as $d - \{selev, gelev\}$. A **buildSurface** module will be provided to scan data to build this surface [2], and to shift it, should you choose to move the fixed datum.

Time Migration from Topography

The situation is more difficult in time migration since topography is naturally described in terms of depth. To translate topography into time, only subsurface velocities may be used; any artificial replacement velocity above the surface is irrelevant (except, of course, that it may be necessary to remove a to-datum shift as described previously). Figure 200 shows topographic acquisition as seen by pre-stack time migration (PSTM).

Figure 200. Topographic Acquisition As Seen by PSTM



For time migration, it is important to ensure that the traveltimes from the surface down to the reflector are adjusted for the difference in time from the surface down to a fixed reference. The safest way to do this is:

1. Find the maximum depth of the surface, z_{max}.
2. For each point on the surface, compute the time down to z_{max}.
3. Use this to define the surface in time.

[2] At the time of this writing, version 2.1.1 of MARVEL does not include this module.

All of this is done internally by the MARVEL PSTM.

Thus, a flat reflector near the bottom of the surface will be as well-imaged as possible. Note, however, that the position *in time* of the bottom of the surface will change depending on the model. Note also that the highest point of the surface *in time* is not necessarily the highest point *in depth*, and can also change depending on the model.

The output of MARVEL's PSTM is always such that the highest point of the surface *in time* appears at $t = 0$, and z_{max} appears across the section at time t_{max}.

Depth Estimation for PSTM Topography Output

To convert time to depth for output of MARVEL PSTM with topography, you will need to know values and functions you can get the easy way or the hard way:

The easy way:

1. The location of the surface on the output section, *tstat*. This is stored in the trace headers by the PSTM.

2. The velocity function from *tstat* down to the output location:
   - If using an RMS model with "t=0 is surface", this is the function from 0 to $t_{out} - tstat$.
   - If using a VINT/DEPTH model, this is the velocity function from the (depth) topographic surface down.

or,

The hard way:

1. The maximum depth of the surface, z_{max}.
2. The value t_{max} corresponding to z_{max} on the output section.
3. The velocity function from t_{max} down to the output location.

Time Velocity Update from Topography

Since the output of the PSTM does not need to be converted to time, this makes for somewhat less effort in backing out velocities. A **staticShift** with default parameters will shift the data back to the surface, and NMO, picking, and other operations may be done then.

Note:

When working with RMS/TIME models, it is best to leave the model such that $t = 0$ corresponds to the topographic surface. When working with INT/DEPTH models, it is currently necessary to build the model with topography, since the raytracers will need it in this form. The MARVEL **smoother** module will place the velocity functions correctly to follow the topography.

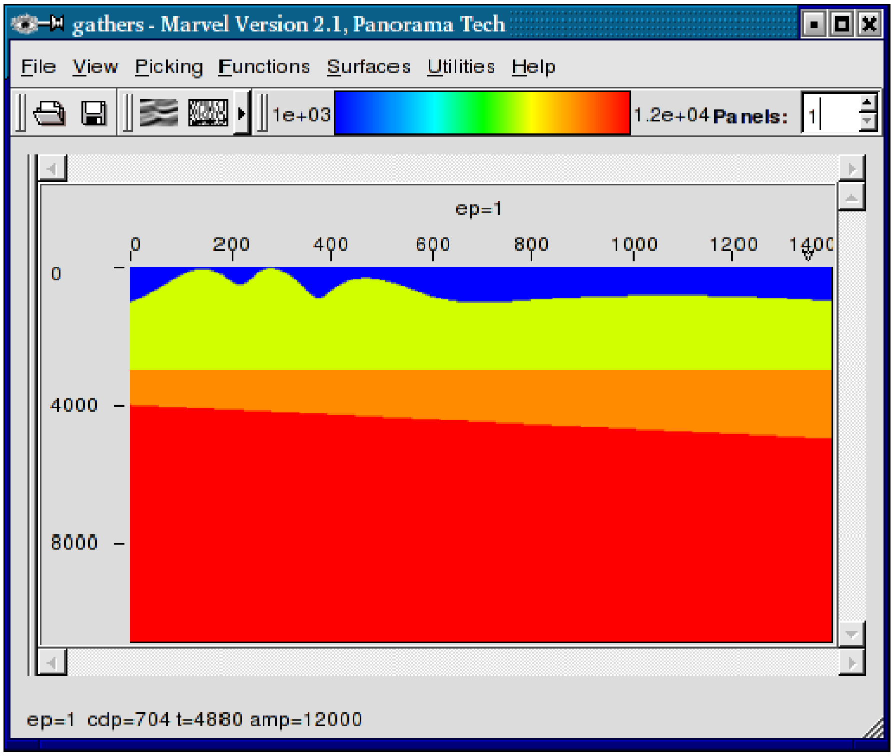
In general, when working with topography, it is best to work with VINT/DEPTH models.

Example: The NewTopo Project

The `NewTopo` project provides an example and test of migration from topography in MARVEL.

The model shown in Figure 201 is fairly simple and has only four layers. Data have been acquired with sources and receivers resting on the top surface (between blue and yellow), and there are three reflectors (only two can be seen on the model). A MARVEL topographic surface file is provided, along with the model and data.

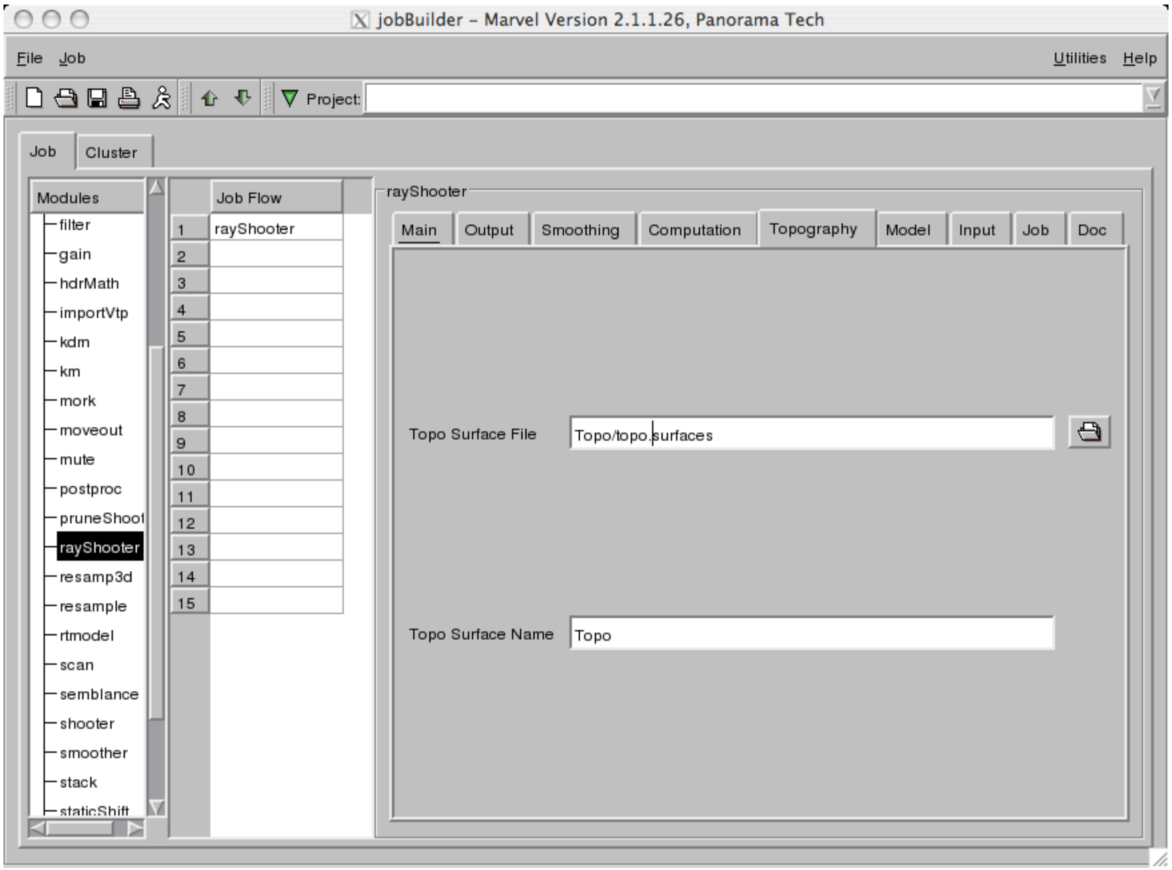
Figure 201. Simple Topographic Model



Depth Migration

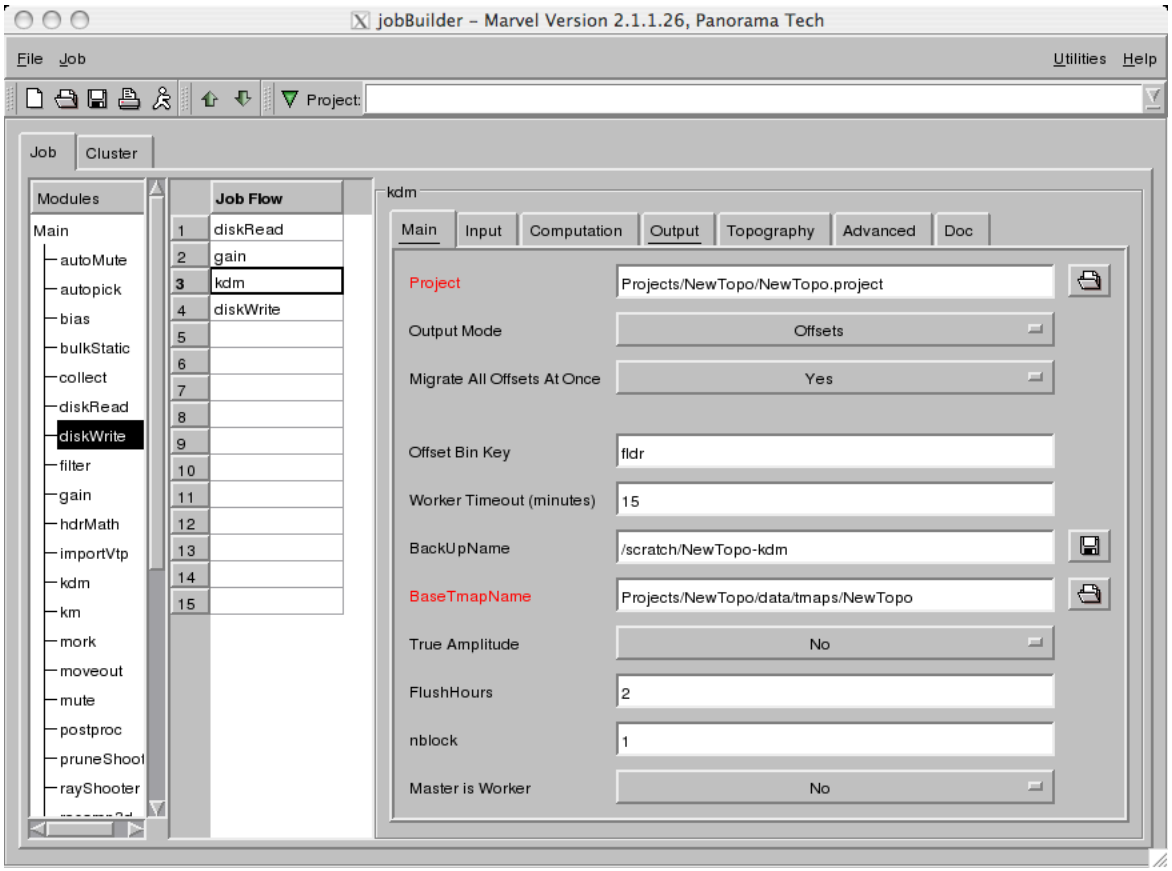
For depth migration, you must first run the raytracer using module **rayShooter** with the proper topographic information, as shown in Figure 202. All you need to provide is the topographic information, while the other parameters are as usual.

Figure 202. Raytracer (rayShooter) Job Setup for Topography.



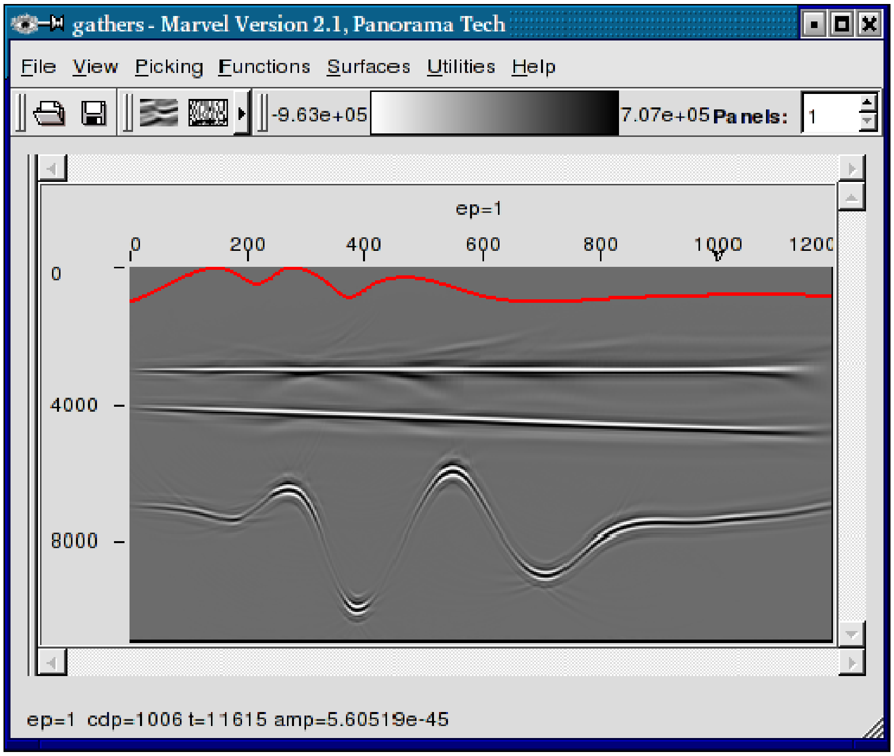
With the *tmaps* available, you can actually just run the depth migration, **kdm** as normal (see Figure 203), without any indication of topography, and you should be able to get a reasonable result (much of the topography is stored in the *tmaps*). However, for best results, and to set output headers correctly, you should include the topographic surface in the `Topography` tab; otherwise, this is the same as running the module without topography. Note in particular that **kdm** will do a much better job of interpolating traveltimes if it has the topographic surface.

Figure 203. kdm Job Setup for Topography.



For this project, the stacked result should look like that in Figure 204. The topographic surface shown in red is included in the headers, and was extracted in *gathers* with the `Extract Surface` menu (see Surfaces Menu on page 254 in Inline Section Operations).

Figure 204. Stacked Kirchhoff Depth Migration (kdm) of Data



Depth-to-Time Conversion and Stack

To produce an image shifted to match the output of the time migration for conversion from depth to time, the **timeDepth** module will also need the topographic surface; other parameters are shown in Figure 205. The results are shown in Figure 206, and should match the PSTM results.

Figure 205. Job Setup for timeDepth with Topography

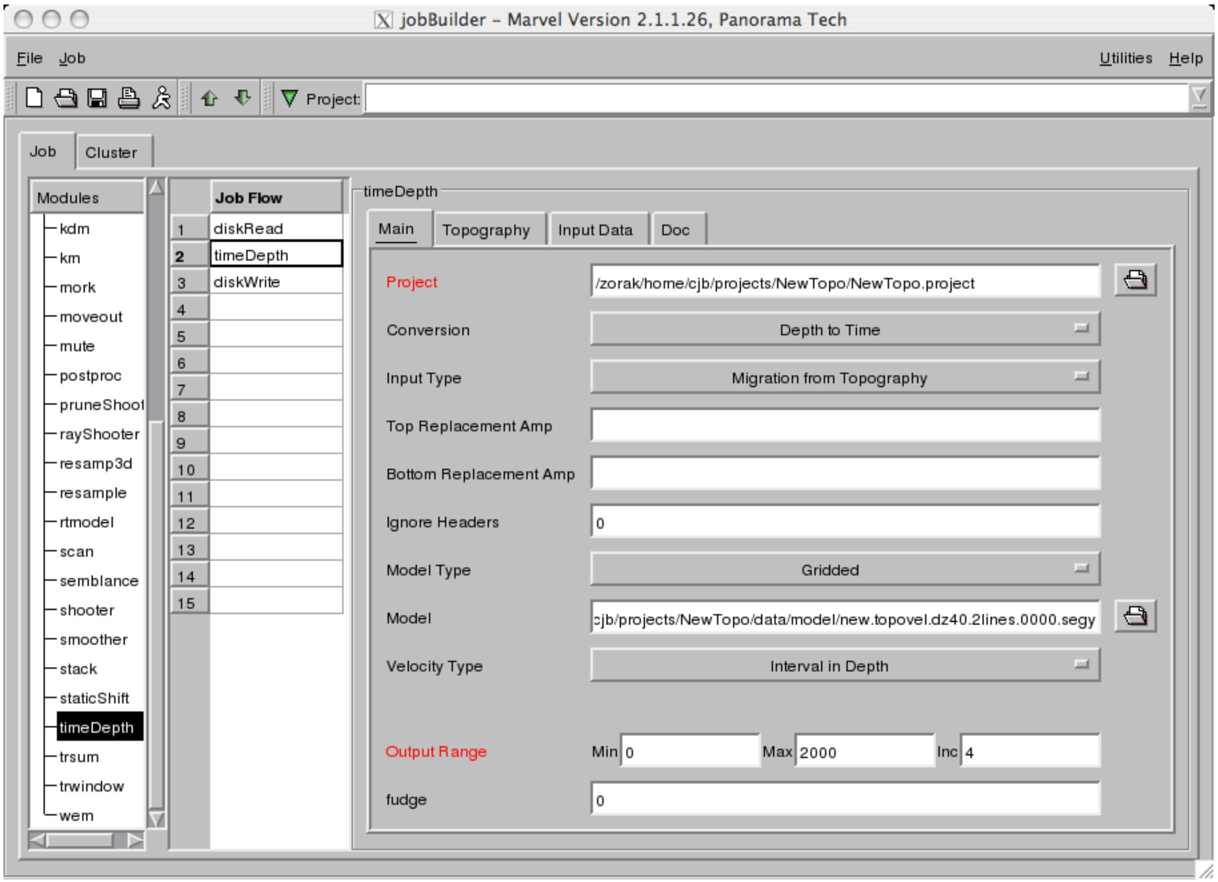
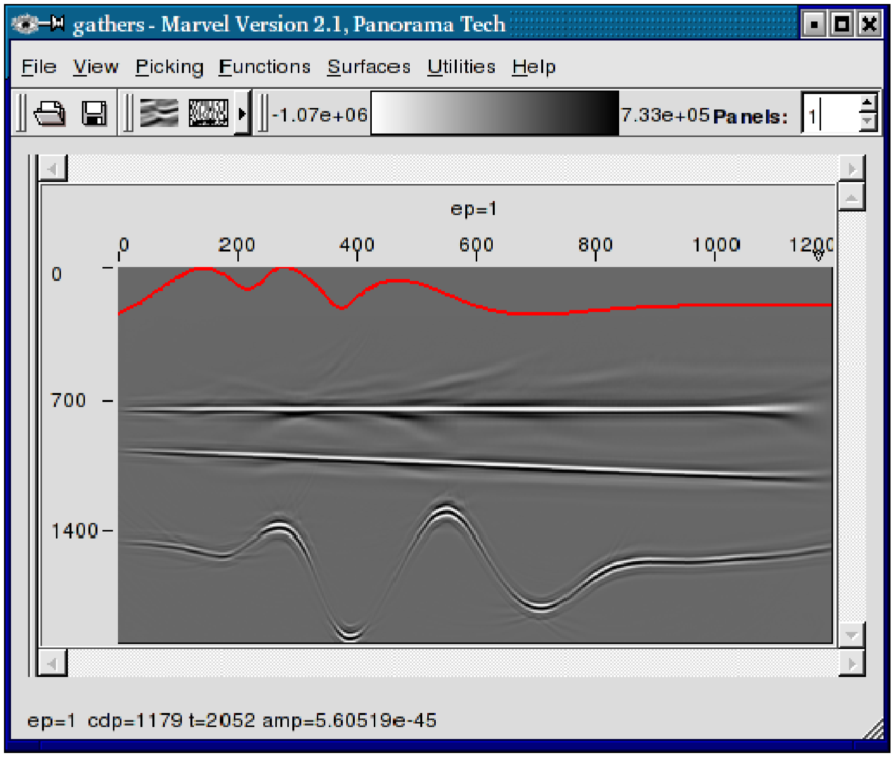


Figure 206. Stacked Kirchhoff Depth Migration (kdm) of Data, Converted to Time (Note: Surface Also Converted).



Appendix C

3D Surface Related Multiple Elimination

This appendix explains the parameters defining Panorama Technologies' 3D Surface Related Multiple Elimination algorithm (SRME3D) and provides a brief explanation of the assumptions underlying the process. These assumptions essentially define the optimum acquisition scheme to assure the best possible results.

Auto Convolution

The underlying concepts embodied in SRME3D are quite simple, and this is especially true in one-dimension. If we assume a one-dimensional Earth with a free acquisition surface, then the time of the first multiple is easily predicted by a simple convolution of the recorded trace with itself. If the first arrival occurs at t_0, the first arrival of the convolution is at the arrival of the first order multiple, that is, $2t_0$. If we perform a second convolution using the original recorded trace and the first convolution, the result is a trace where the first arrival is at $3t_0$, which is the time of the second multiple. Continuing this process as many times as desired results in a series of traces containing the first order multiples, the second order multiples, the third order multiples, and so on. While the time of each multiple trace is exact, the amplitude and phase of the actual multiple sequence is incorrect. Nevertheless, the sequence of multiple traces can be match filtered to suppress, or, in some cases, completely eliminate, the free surface generated multiples.

In three dimensions, the *nth* order multiple data series $d_n(\vec{x}_s, \vec{x}_r, \omega)$ is predicted from a de-ghosted, obliquity-corrected and first-break-muted version of the original shot data, $d_0(\vec{x}_s, \vec{x}_r, \omega)$, through the auto-convolution given by Equation 17.

Equation 17:

$$d_n(\vec{x}_s, \vec{x}_r, \omega) = \int \int d_0(\vec{x}_s, \vec{x}, \omega) d_{n-1}(\vec{x}, \vec{x}_r, \omega) d\vec{x}$$

Note that this process only utilizes the surface acquired data. It does not require any knowledge of the subsurface, and, as far as the obliquity factor is concerned, only superficially requires knowledge of the velocity in the water column. For each multiple order, the process also produces a completely new set of shots and receivers.

Multiple Suppression

Data available after computing the multiple sequence described in Equation 17 consists of the data, $d_0(\vec{x}_s, \vec{x}_r, \omega)$, and the multiple estimates, $d_n(\vec{x}_s, \vec{x}_r, \omega)$.

For each source and receiver, the demultipled data, $d_m(\vec{x}_s, \vec{x}_r, \omega)$, satisfies a series of the form shown in Equation 18, where $W(\omega) = W(\vec{x}_s, \vec{x}_r, \omega)$ is a special wavelet designed to optimally correct the phase and amplitudes of the estimated multiples to optimize the suppression.

Equation 18:

$$d_m(\vec{x}_s, \vec{x}_r, \omega) = d_0(\vec{x}_s, \vec{x}_r, \omega) - W(\omega) d_1(\vec{x}_s, \vec{x}_r, \omega) - W^2(\omega) d_2(\vec{x}_s, \vec{x}_r, \omega) - \ldots$$

Wavelet Estimation

In the current version of SRME3D, the wavelets $W(\vec{x}_s, \vec{x}_r, \omega)$ are estimated by solving a set of time domain normal equations of the form shown in Equation 19.

Equation 19:

$$\begin{pmatrix} r_0 & r_{-1} & \ldots & r_{-nw+1} \\ r_1 & r_0 & \ldots & r_{-nw+2} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ r_{nw-1} & r_{nw-2} & \ldots & r_0 \end{pmatrix} \begin{pmatrix} w_0 \\ w_1 \\ . \\ . \\ . \\ w_{nw-1} \end{pmatrix} = \begin{pmatrix} c_0 \\ c_1 \\ . \\ . \\ . \\ c_{nw-1} \end{pmatrix}$$

In this equation, nw is the number of time domain coefficients in the wavelet, $w_n = w(\vec{x}_s, \vec{x}_r, n\Delta t)$ is the discrete wavelet, r_n are the multiple autocorrelation coefficients, and c_n are the co-efficients determined by cross correlation of the original data and the estimated first order multiple. One such wavelet is estimated for each source in the input data set.

Parameterization

Panorama Technologie's 3D SRME has the parameters listed in Table 151:

Table 151. SRME 3D Parameters

Term	Description
Required Parameters	
Project	project name used for this data set
ShotXRange	min,max,inc
ShotYRange	min,max,inc
ReceiverXRange	range relative to shot: min,max,inc
ReceiverYRange	range relative to shot: min,max,inc
Optional Parameters	
waveletfile	(blank)
pathname	default: /scratch/users
cdpKey	CDP location in header default: cdp
lineKey	line location in header default: ep
sxKey	shot X location in header default: sx
syKey	shot Y location in header default: sy
gxKey	receiver X location in header default: gx
gyKey	receiver Y location in header default: gy
f1	lowest frequency to process default: 0.0
f4	highest frequency to process default: 60.0
norder	Highest multiple order to compute default: 1
niter	Number of wavelet optimization iterations default: 1

continues on next page

Table 151. SRME 3D Parameters–continued

Variable	Description
nwav	Length of the wavelet in ms default: 200
wnn	White Noise factor in percent default: 1
alpha	Time domain damping factor (1)
nfill	infill option default: 0–no infill
mutsw	restore mute switch default: 0–no restore
nice	run in Nice mode default: yes
MasterisWorker	Flag that controls whether the master I/O controller is also used for performing calculations. default: no

Data Assumptions

All inverse-scattering based multiple suppression techniques assume that the input data has full source-receiver reciprocity. This is a very stringent constraint that most, if not all, current acquisition schemes fail to produce. The most important aspect of this assumption is the sub-requirement that each shot in the input data stream contain a trace at zero offset. In many cases, the traces in a short offset DMO-corrected stack can be used to fulfill this requirement. Traces at other offsets may be obtained through a careful application of differential moveout. In most cases, high quality results can only be achieved through a careful regularization of the input data.

Appendix D

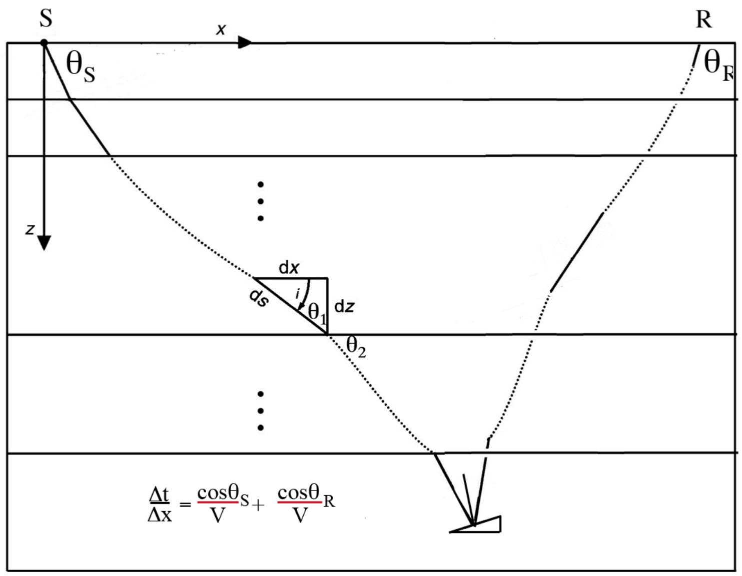
eyeBeam Module

This chapter discusses the optimum utilization of Panorama Technologies eyeBeam module and provides a brief explanation of the assumptions underlying the process. The article is divided into three parts. First, a brief overview summarizes the fundamental principles on which the module is based. Second, the focus is directed toward data preparation for optimum results. Third, the module's parameters are explained in detail.

Overview

In contrast to the Kirchhoff smear stack approach, eyeBeam estimates local dip elements, or beamlets, from the input data and then applies classical imaging principles to produce a properly migrated image. To a large extent, the process is based on Figure 207. Together with the near surface velocity, V, Equation 20 provides the precise relationship between the apparent dip, $\frac{\Delta t}{\Delta x}$, and the source and receiver take-off angles, θ_S and θ_R, respectively. As indicated in the figure, raytracing is used to locate the reflector that gave rise to the apparent dip. The opening angle, or either incidence angle at the intersection of the two rays, determines reflector dip. The sum of the source and receiver take-off angles are directly related to the apparent dip of a subsurface reflector. The opening angle (sum of the incidence angles) define the local reflector dip.

Figure 207. Fundamental components of Panorama Technologies eyeBeam module.



Equation 20:

$$\frac{\Delta t}{\Delta x} = \frac{cos\theta_S}{V} + \frac{cos\theta_R}{V}$$

The ratios $\frac{cos\theta_S}{V}$ and $\frac{cos\theta_R}{V}$ are the derivatives, $\frac{d\tau_S}{dx}$ and $\frac{d\tau_R}{dx}$, of the source and receiver traveltimes, that is, the gradients in 3D. This fact allows you to compute dynamic traveltimes and provide proper amplitude correction to preserve AVO response and approximate true amplitude imaging. Figure 207 shows the schema for two-dimensions, but the general concept remains valid in three dimensions. In 3D, the source and receiver take-offs are specified by an azimuth and dip.

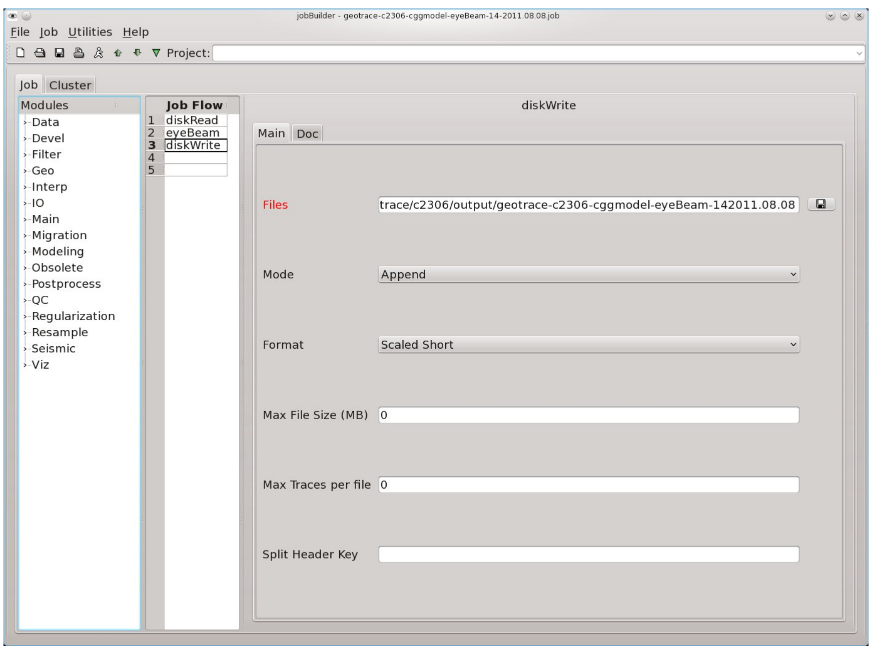
Key features of eyeBeam and its dynamic raytracer include

- Migration From Topography
- Full TTI imaging based on the dynamic raytracer
- Raytrace arrivals include
  - maximum energy
  - minimum velocity
  - minimum distance

Data Preparation

The quality of the final image produced by eyeBeam is controlled by the quality of the input data. In many cases, the quality of the final image can be controlled by proper preprocessing of the input data volume. Because estimates of local apparent dip are paramount, data preparation can and should focus on input data coherency and frequency content. In many cases, coherency be increased through signal enhancement applications and also careful choice of the frequency bandwidth. Spectral analysis should reveal the extent to which the data can be resampled to a larger sampling increment. Efficiency is highest when the maximum frequency can be limited to 31.5 Hz. To maximize throughput, data preparation should also include storing the properly processed data in a scaled 16-bit format. This reduces the input data size and results in faster data reads and writes. As shown in Figure 208, you do this by setting the output data format to `Scaled Short`. This setting effectively halves the output file size, thereby improving overall performance and efficiency of eyeBeam migrations.

Figure 208. Setting the output file format to scaled-short in diskWrite



Parameterization

Parameterization of an eyeBeam project uses both the diskRead module and the eyeBeam module.

diskRead

Parameterization of an eyeBeam project begins with the diskRead module. Figure 209 shows the Main panel of diskRead along with the parameters required to ensure that diskRead will construct appropriately-sized super-gathers (patches) to feed to the eyeBeam module. At your discretion, the parameters below diskRead's Mode field can also be set in the eyeBeam module. While several of these fields have reasonable defaults, they should always be reviewed before job submission. The fields are defined in Table 152.

Table 152. diskRead Main Panel Fields

Field	Description
Migrate all Offsets at Once	If set to YES, traces are read in exactly the order they are stored. If set to NO, traces are read in common offset order. This should be set to NO for Beam Migrations.
Report (secs)	This is the report time for diskRead. For example, a value of 60 causes diskRead to report every minute.
Calculate Bins	If the input data has only CDPs and lines in the headers, this will calculate the real world coordinates for selecting super-gathers.
Calculate xy	If the input data does not have CDPs and lines set in the header, set this parameter to YES to have diskRead calculate CDP and line information from the world coordinates in the trace headers.
backupName	The name and location of the backup file used in restarts and recovery operations.
Offset Bins	These three fields are the minimum, maximum, and increment defining the leading edges of the offset bins. For example, if these values are set to 0, 20000, 100, then 199 offset bins beginning at 50 will be output.
Offset Bin Key	The header key for storing the Offset Bin value.
Output Lines	These three fields are the minimum, maximum, and increment for the desired output line range. Figure 209 is a 2D setup so the values are set to output a single 2D line.

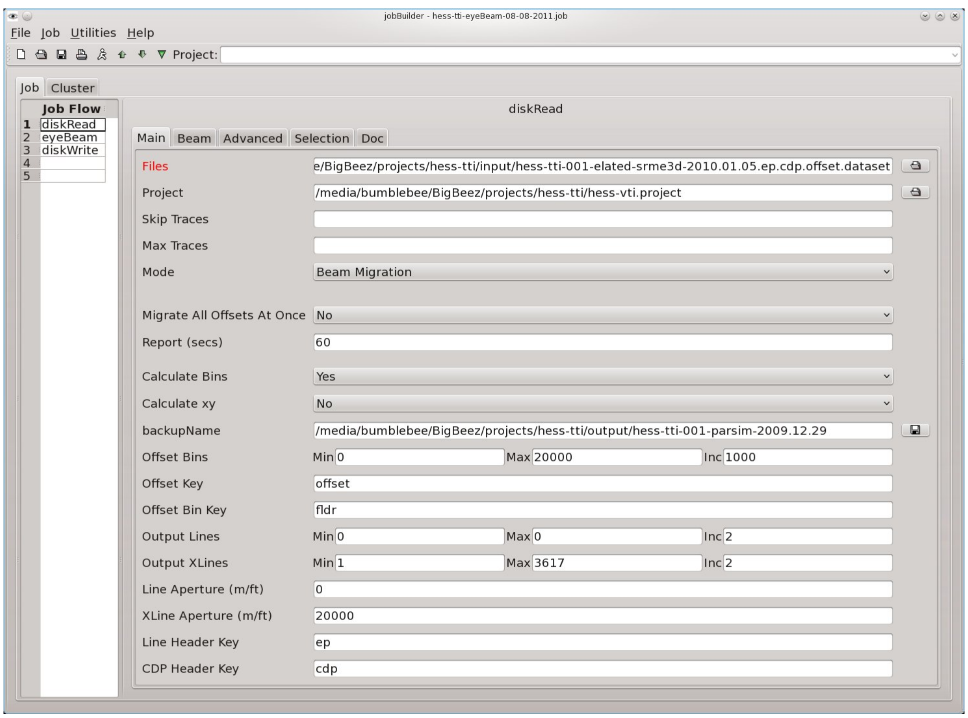
continues on next page

Table 152. diskRead Main Panel Fields–continued

Field	Description
Output XLines	The minimum, maximum and increment for the desired output line range.
Line and Xline Aperture	The desired line and crossline half-apertures.
Line and CDP Header Keys	The header locations where this information is stored.

The diskRead main panel is shown in Figure 209. The panel shows selection of `Beam Migration` in the Mode field. This ensures that diskRead constructs appropriate patches to feed to the eyeBeam module after the sort has been performed.

Figure 209. diskRead Main Panel



The diskRead Beam panel is shown in Figure 210. The most important field in diskRead's Beam panel is the patch field. This field defines the size of the patch in both line and crossline directions. Reasonable values are project dependent, but are typically in the neighborhood of 200 meters. The diskRead Beam fields are defined in Table 153.

Figure 210. diskRead Beam Panel

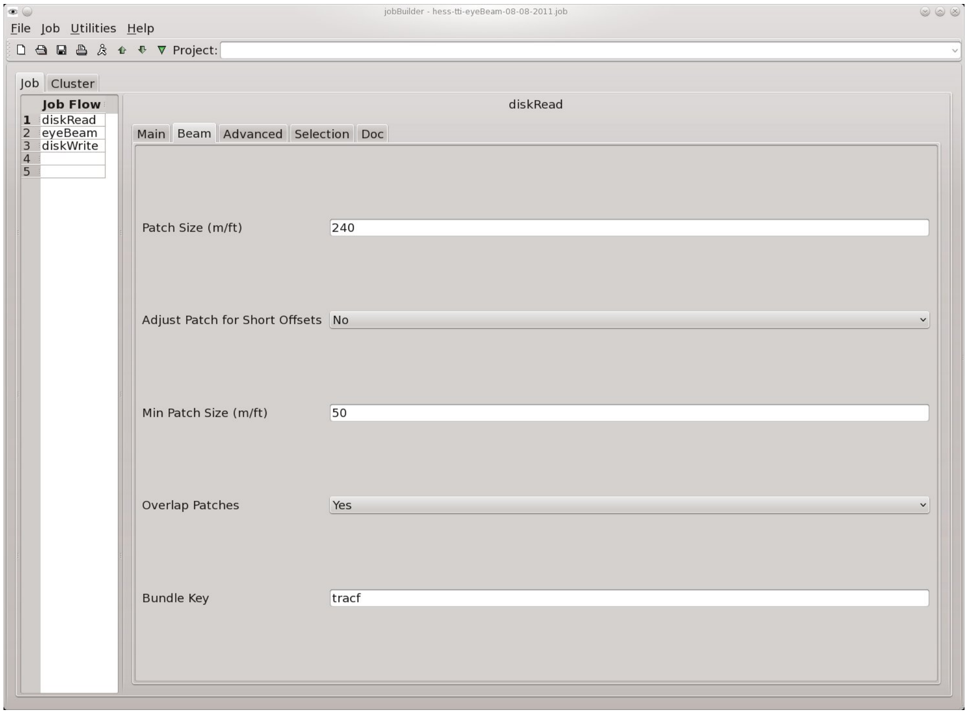


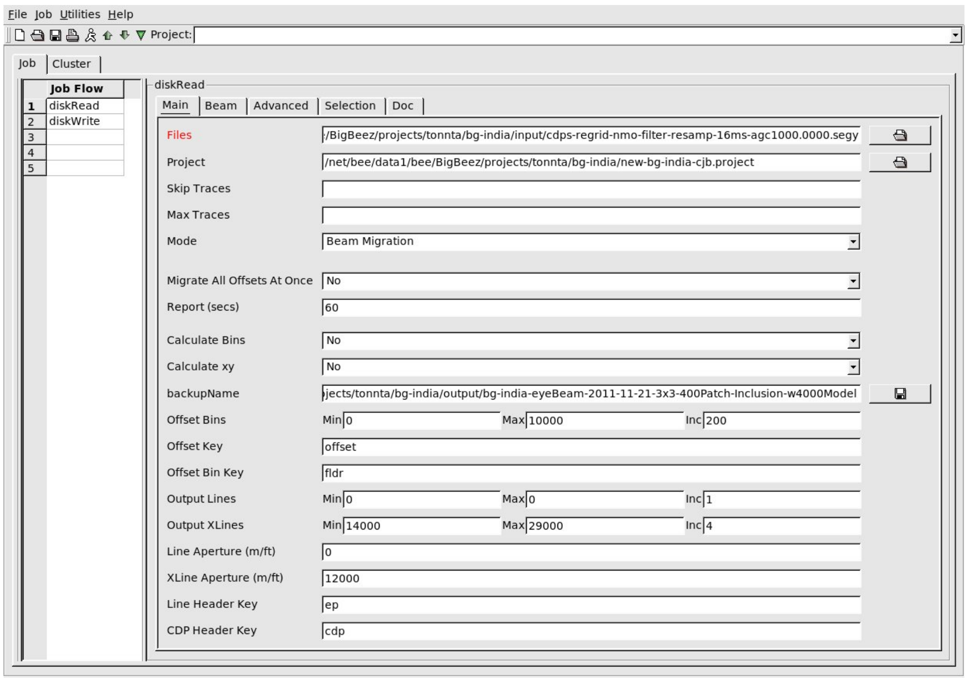
Table 153. diskRead Beam Panel Fields

Module	Description
Patch Size (m/ft)	The actual patch or super gather size. The value defines a square around sources and receivers. Every trace with a source and a receiver in the corresponding square is included in the patch.
Adjust Patch for Short Offsets	This switch specifies whether or not eyeBeam reduces the patch size for small offsets. It enhances coherence to improve beamlet estimation.
Min Patch Size (m/ft)	The minimum patch size allowed for short offset reduction when the previous field is set to YES.
Overlap Patches	Set this to YES to increase the coherence at shallow depths.
Bundle Key	The header word location containing the unique value assigned to each patch.

The input field in Figure 209 points to either a `.segy` file with properly filed headers or to a `.dataset` file containing the appropriate coordinate information to enable proper sorting of the input data into offset binned super gathers. Depending on the computer system being used, the sort may take awhile.

If you plan to do multiple migrations using the same input, the diskRead data stream of super gathers can be output in presorted form by feeding the output from diskRead directly into diskWrite, as shown in Figure 211. The diskWrite module writes the data to the specified super-gather-sorted output file. In subsequent applications of eyeBeam, diskRead's input file field must contain the `.segy` super-gather-sorted output file and the Mode field must be set to General. Note that this approach can also be used effectively during the data preparation step.

Figure 211. diskRead General Panel



eyeBeam

Figure 212 shows the eyeBeam Main panel. The fields are explained in Table 154, and give the necessary information for a successful run of the module.

Figure 212. eyeBeam Main Panel

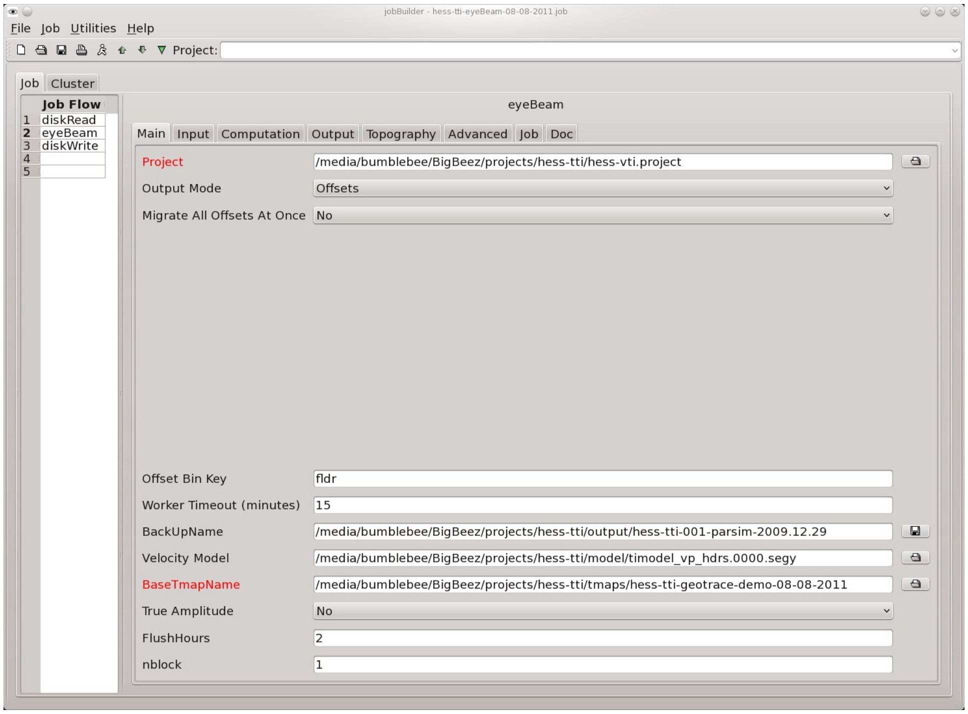


Table 154. eyeBeam Main Panel Fields

Module	Description
Project	This required field defines the input data geometric coordinates.
Output Mode	The output mode is normally Offsets or Stack. Use Offset mode to produce a range of offsets, and Stack to produce a stack of all offsets
Migrate All Offsets At Once	This should always be set to NO for eyeBeam migrations.
Offset Bin Key	It is recommended that this field be left at the default value, but any available header key can be used. **Note: Avoid using cdp, line, sx, sy, gx or gy used in other header related fields.**

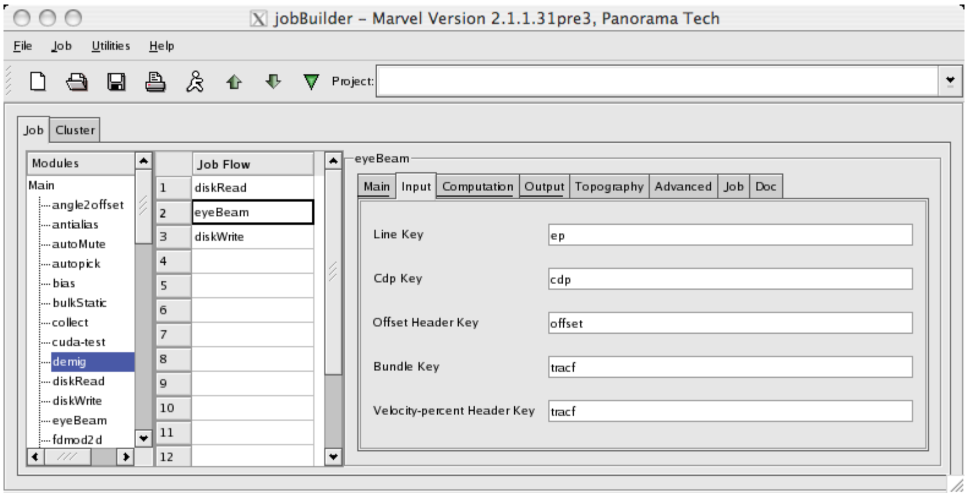
continues on next page

Table 154. eyeBeam Main Panel Fields–continued

Tab	Description
Worker Timeout (minutes)	This field defines the length of time eyeBeam will allow a worker to be inactive. If communication is not achieved after this time limit, the eyeBeam master assumes that the worker is dead.
BackUpName	This file is used to store backup information to enable a restart after any suspension of execution.
Velocity Model	When given, the velocity model serves two purposes. It provides the necessary velocity information for differential moveout of the traces in each super gather to the average offset of that ensemble. It also defines the near surface velocity for computation of take-off angles. This is a seismic file in any format MARVEL can read, typically, SEG-Y. The units are m/s, or ft/s, but can be anything else, depending on the choice of units in the seismic data.
BaseTmapName	The base name of the traveltime file(s). This name is the tmap file name without the `.tmap` extension. **Note: This is a REQUIRED entry.**
True Amplitude	When set to YES, eyeBeam will use the amplitudes computed during the generation of traveltimes by rayShooter.
Flush Hours	The length of time between each output of backup information to the BackUpFile.
nblock	**Note: This parameter should not be set when using eyeBeam.**

The eyeBeam Input Panel in Figure 213 defines the header storage locations for the various indicated parameters.

Figure 213. eyeBeam Input Panel



The eyeBeam Computation Panel is shown in three forms in Figure 214, Figure 215, and Figure 216. The fields on these panels are the most important eyeBeam parameters, and are defined in Table 155.

Figure 214. eyeBeam Computation Panel, Application Range Utilization field set to All

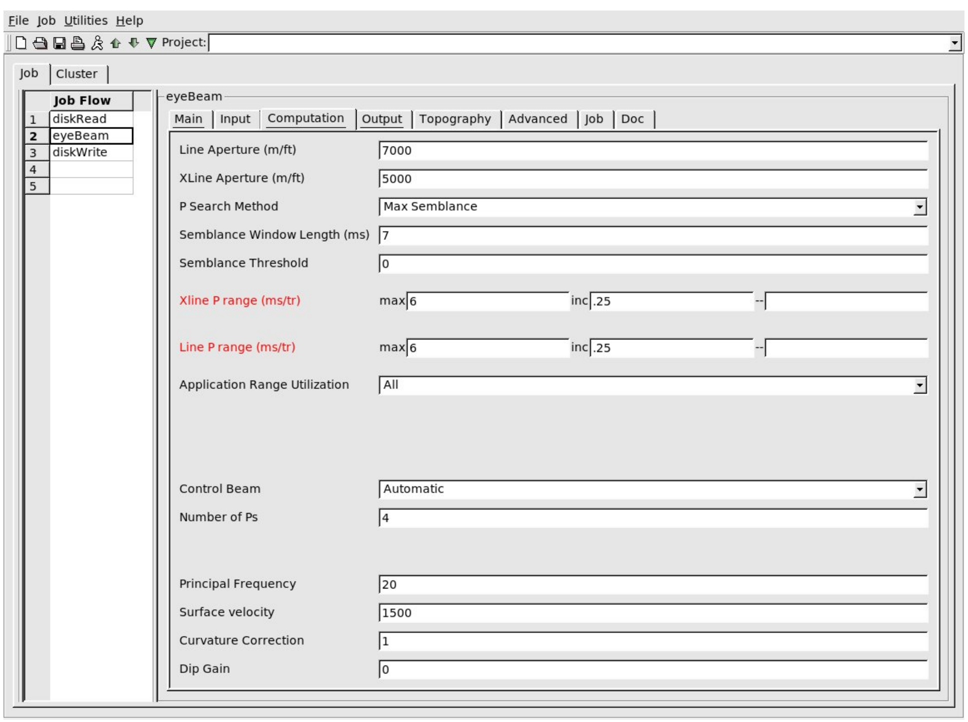


Figure 215. The eyeBeam Computation Panel, Application Range Utilization field set to Exclude

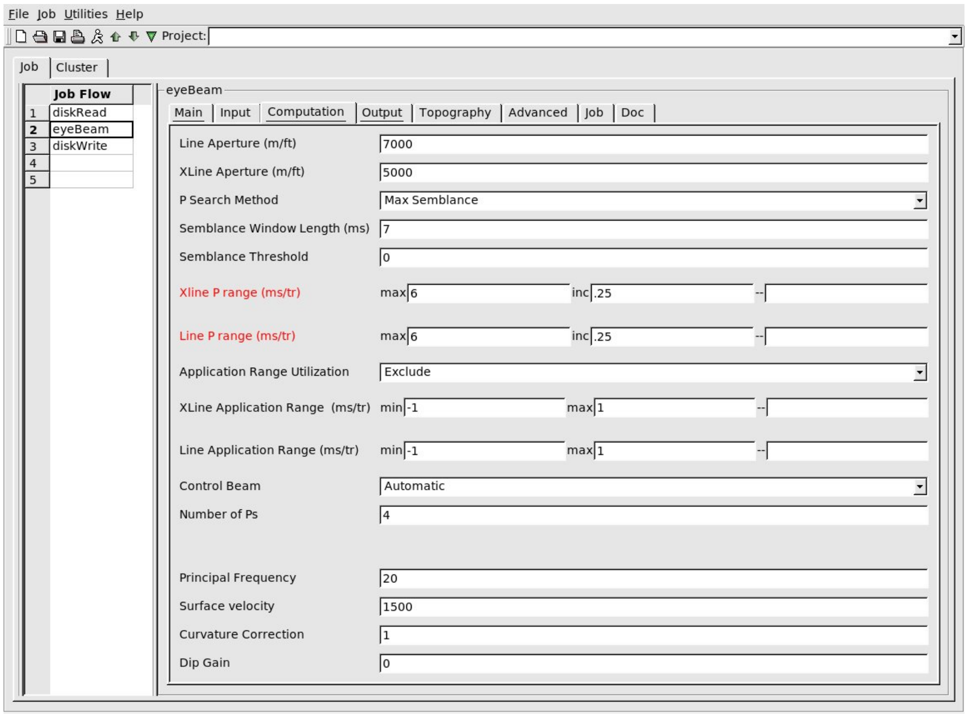


Figure 216. The eyeBeam Computation Panel, Application Range Utilization field set to Include

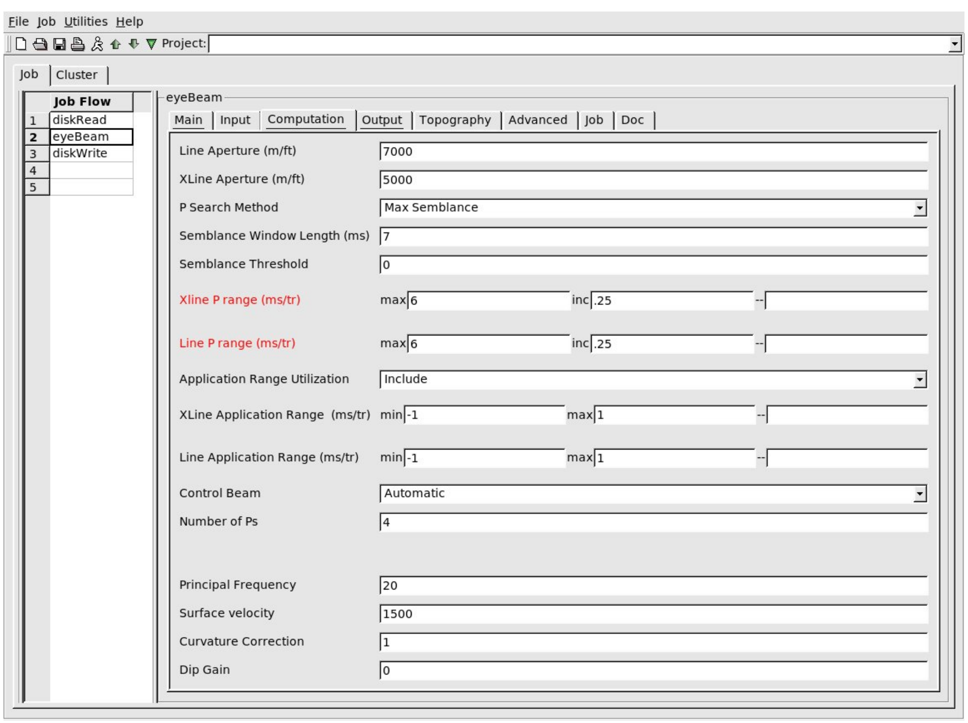


Table 155. eyeBeam Main Panel Fields

Module	Description
Line and Xline Aperture	These fields define the migration half-aperture for the migration
pSearch Method.	This field has two options. You can choose the p-values based on either the maximum semblance or maximum slant stack amplitudes. The recommendation is to set this field to Max Semblance. • When set to Max Semblance, the two parameters Semblance Window Length and Semblance Threshold appear. Semblance Window Length controls the length of the vertical window from which p-values are selected. Semblance Threshold provides a threshold for rejecting p-values whose semblance is below this value. • When set to Max Stack, p-values are determined from the slant stack volume or field. No other parameters need be set.
Xline P Range	The max value and increment. The range is the defined from negative max to max. **Note: This is a REQUIRED entry.**
Line P Range	The max value and increment. The range is then defined from negative max to max. **Note: This is a REQUIRED entry.**
Application Range Utilization	This field can be set to All, Exclude, or Include. • When set to All, the p-search is performed over the entire set of slant-stack p values. • When set to Exclude, the p-search is performed over those p-values outside the range defined by the Xline Application Range and Line Application Range fields. • When set to Include, the only allowable p-values are based on the range defined within the Xline and Line Application Ranges.
Control Beam	The three options are Fixed P Range, Automatic and No Control.
Number of Ps	The actual number of p-values to migrate when Control Beam is Automatic.

continues on next page

Table 155. eyeBeam Main Panel Fields–continued

Tab	Description
Principal Frequency	The Principal Frequency is used to define the Fresnel Zone.
Surface velocity	If no initial velocity volume is provided, this value defines the near surface velocity.
Curvature Correction	When set to 1, this flag causes the eyeBeam algorithm to correct for local curvature.
Dip Gain	When set, a linearly increasing scale factor will be applied to higher dips.

Figure 217 shows the eyeBeam Output Panel, which defines the range and limits of the desired output data volume. The meaning of these parameters are defined in Table 156.

Figure 217. eyeBeam Output Panel

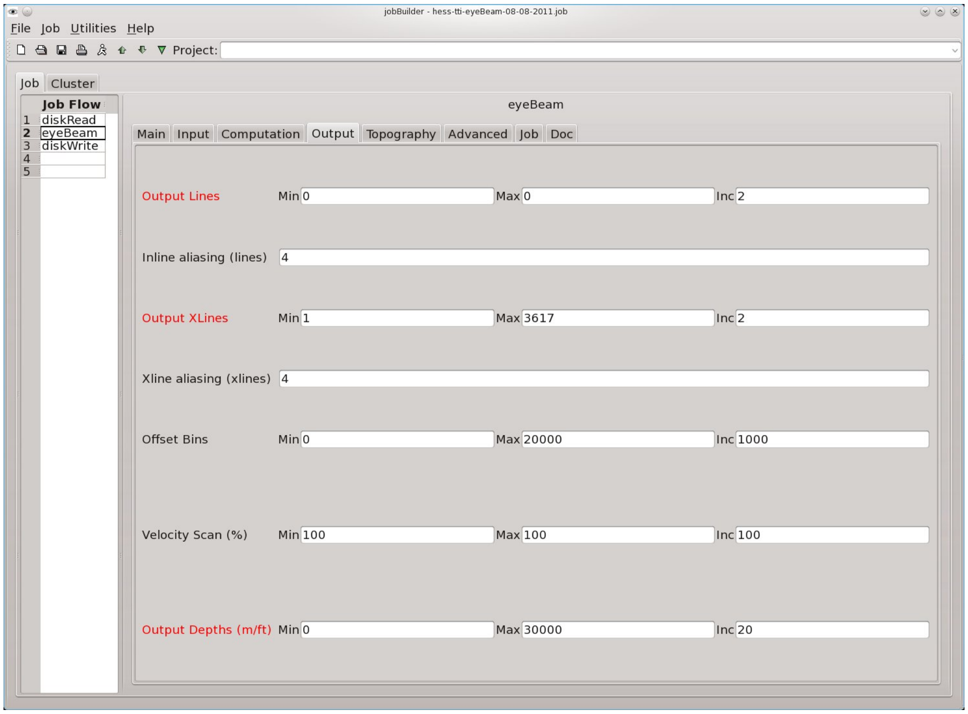


Table 156. eyeBeam Output Panel Fields

Module	Description
Output Lines	The output line range. **Note: This is a REQUIRED entry.**
Inline aliasing (lines)	Defines the desired spacing length for antialiasing. The larger this value is, the more anti-aliasing is applied.
Output XLines	The output xLine range. **Note: This is a REQUIRED entry.**
Crossline aliasing (xlines)	Defines the desired spacing length for antialiasing. The larger this value is, the more anti-aliasing is applied.
Offset Bins	Defines the endpoints of the desired output offset bins. For example, the values 0, 20,000, and 1000, define output offsets ranging from 500 to 19,500.

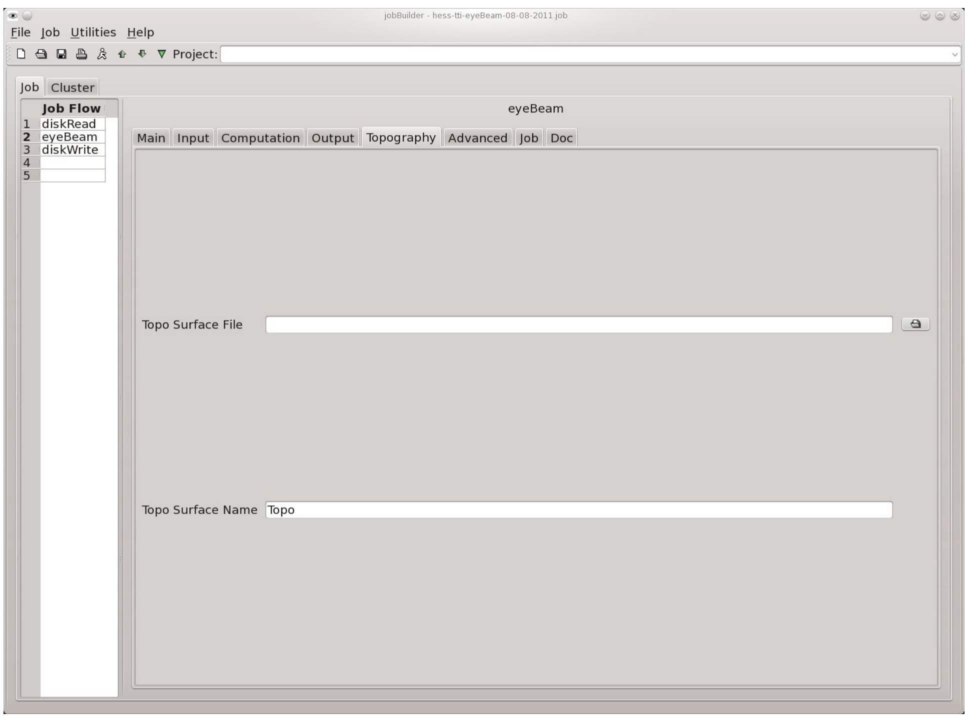
continues on next page

Table 156. eyeBeam Output Panel Fields–continued

Tab	Description
Velocity Scan (%)	Setting the minimum, maximum, and increment provide the percentage range over which migrations should be performed. For example, setting this range to 90, 110, 5 will produce output volumes using 90, 95, 100, 105, and 110 percent of the original velocity field.
Output Depths	Defines the minimum, maximum, and increment for the each output trace. **Note: This is a REQUIRED entry.**

The eyeBeam Topography Panel fields in Figure 218 define the topographic surface file and the surface name.

Figure 218. eyeBeam Topography Panel



The eyeBeam Advanced Panel in is shown in Figure 219. The fields are described in Table 157. It is best to simply use the default values for these fields.

Figure 219. eyeBeam Advanced Panel

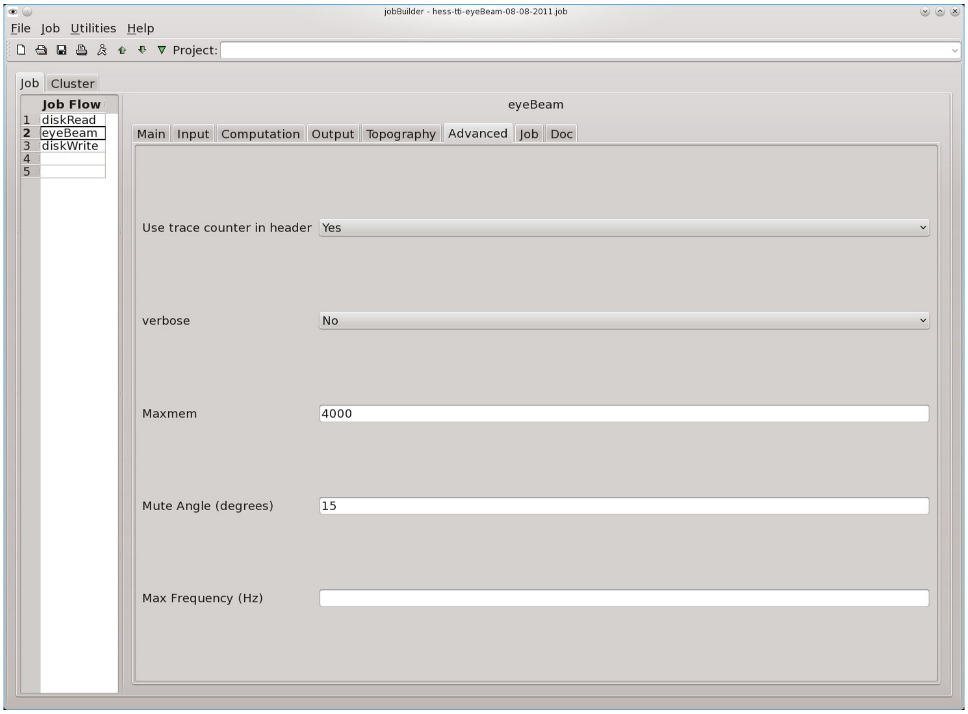


Table 157. eyeBeam Advanced Panel Fields

Module	Description
Use trace counter in header.	When set to YES, the trace counter is set.
Verbose	When set to YES, eyeBeam will print debug information to the log file.
Maxmem	The amount of memory, in megabytes, to allow for each process on each node.
Mute Angle (degrees)	The value here automatically applies a mute at this angle on each output cdp and line gather.
Max Frequency (Hz)	This field applies a low-pass filter to the input with this value as the highest frequency. It is best to use the default value and avoid the extra calculations. If you want to filter the data, it is better to do so before migration.

The eyeBeam Job Panel shown in Figure 220 defines computer based parameters related to how the process generates output. The terms are defined in Table 158.

Figure 220. eyeBeam Job Panel

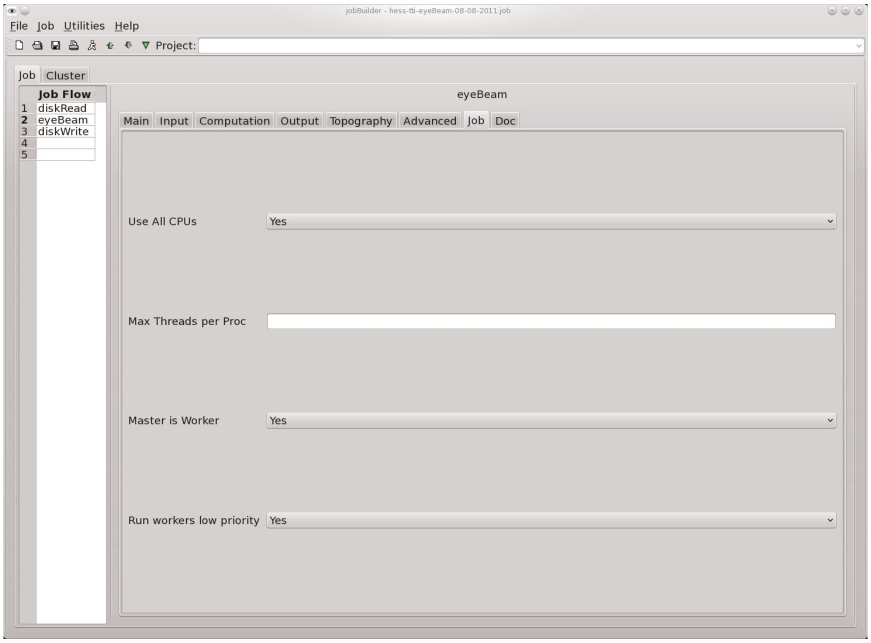


Table 158. eyeBeam Advanced Panel Fields

Module	Description
Use All CPUs	When this is set to YES, Marvel initializes eyeBeam as a single process utilizing all cores on the node. When set to NO, Marvel initializes eyeBeam as multiple processes, where each process uses a single core.
Max Threads per Proc	When Use All CPUs is set to NO, you can set this value to the number of cores per process. For example, when running on an 8 core node, setting Max Threads per Proc to 4 would cause two instances of eyeBeam slaves to each use exactly 4 cores during execution.
Master is Worker	When set to YES, the master node will also be used as a worker. In this case, the master node will have one master process and at least one slave process in execution. When set to NO, the master node does little or no actual computation. Its primary purpose is to send and receive parameters and monitor and handle input and output. The recommended setting is NO.
Run Workers Low Priority	When set to Yes, all processes, except the master, will be run in a reduced priority *nice* mode.

Index

Panorama Technologies

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