Gridding (T22a)

Top

This chapter refers to the current Gridding tool (Gridding). For information about the old gridding tool, see Old Gridding (T22).

You can use INTREPID Gridding to convert point and line data to a grid suitable for image processing and contouring, enhancing it using local gradients of the data field. The tool adapts to the datatype of the field you have chosen to grid. (Scalar, Vector, Tensor), setting more appropriate defaults as you progress. INTREPID divides the region being processed into a grid of square cells. Each grid cell will contain a value derived from an original data point (an **original data cell**) or interpolated from neighbouring cells or nearby points (an **interpolated cell**).

The Pro-version of this tool also supports multi-dataset gridding, allowing you to choose a great many individual survey datasets and dynamically create a grid from the selected channel in each dataset. The current best effort exceeds 7000 datasets.

INTREPID has two other special grid dataset processing tools.

- The Grid Operations tool can resample the grid, change the cell size and rotate the grid. See Grid Operations (T25) for information about this tool.
- The INTREPID GridMerge tool can combine overlapping or adjacent grid datasets, correcting for differences between them. See GridMerge—merging multiple grids (T24) for a full description.

In this chapter:

How to use this chapter

Parent topic: **Gridding (T22a)**

This chapter describes the operation of the Gridding tool. You can use the Gridding both interactively and in INTREPID batch processing mode, using INTREPID task specification (**`.job`**) files.

Where needed in this chapter, there are separate Interactive and Task files sections. Some sections are marked *Interactive only* or *Task files only*.

You can find out how to use the tool and also get background information as follows:

- For instructions on using the tool interactively see Using the Gridding tool.
- For details about task specification (.job) files, see Task specification (`.job`) files in Gridding

Summary of the gridding process

Parent topic: **Gridding (T22a)**

1 If you are gridding line or point data, you specify the data field for gridding in one or more datasets.

If you are enhancing an existing grid, you specify the grid dataset name and go to step 6.

2 You specify the processes and parameters that you require.

3 INTREPID performs pre-processing.

4 INTREPID calculates the number of cells in the grid, based on the extent of the line or point data.

5 INTREPID calculates centroid values for original data cells.

6 INTREPID calculates centroid values for interpolated cells (that do not contain original data), using the Nearest Neighbours, Bi-Cubic Spline, Variable data density or Box Filter methods.

7 INTREPID performs LaPlace smoothing as required.

8 INTREPID performs the Minimum Curvature smoothing process as required.

9 INTREPID performs the Masking or Clipping process as required.

10 INTREPID saves the grid if required, or saves the current tile and goes back to repeat the process for the next selected tile.

Using the Gridding tool

Parent topic: **Gridding (T22a)**

In this section:

- Gridding tool—Overview of steps (interactive only)
- Gridding scalar data
- Gridding vector data
- Gridding tensor data
- Gridding of potential field data with observed gradients
- Enhanced potential field gridding—further notes

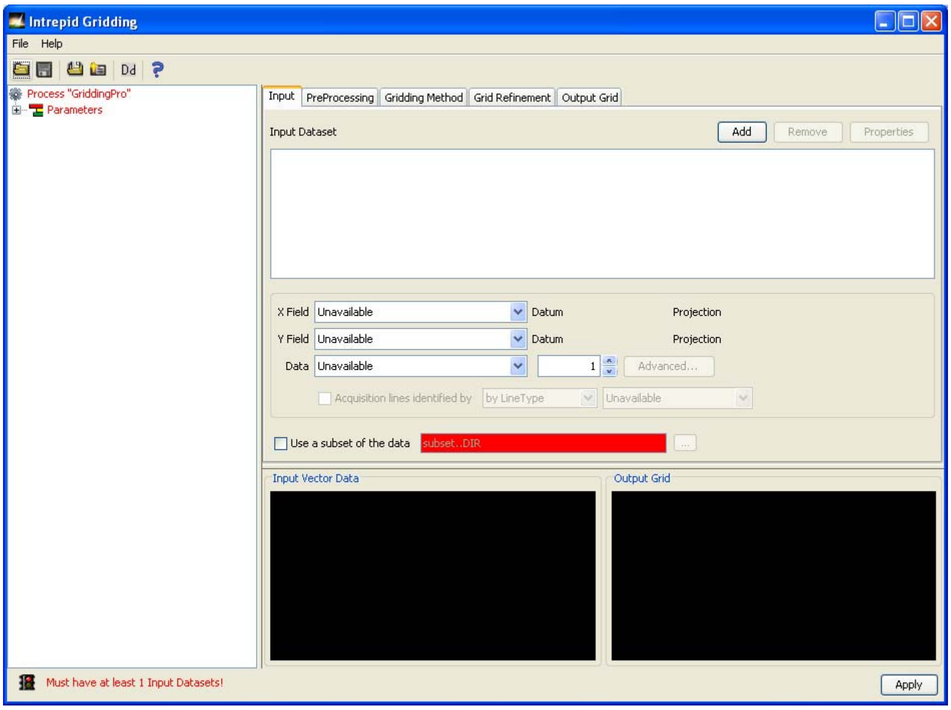
Gridding tool—Overview of steps *(interactive only)*

Parent topic: Using the Gridding tool

>> To use Gridding with the INTREPID graphic user interface

1 *(If you are launching Gridding from the Project Manager and know which dataset you want to process)* Select the dataset for gridding.

2 Choose Gridding from the Grid menu in the Project Manager, or use the command **`jgridding.exe`**. INTREPID displays the Gridding Main window.



3 If you have a task specification file, load it using Load Options from the File menu. (See Specifying input and output files below for detailed instructions.) If all of the specifications are correct in this file, go to step 10. If you want to modify any settings, carry out the following steps as required.

4 Choose the input datasets. See Specifying input and output files and Input tab.

5 Specify the data field for gridding and the geolocation fields. See:

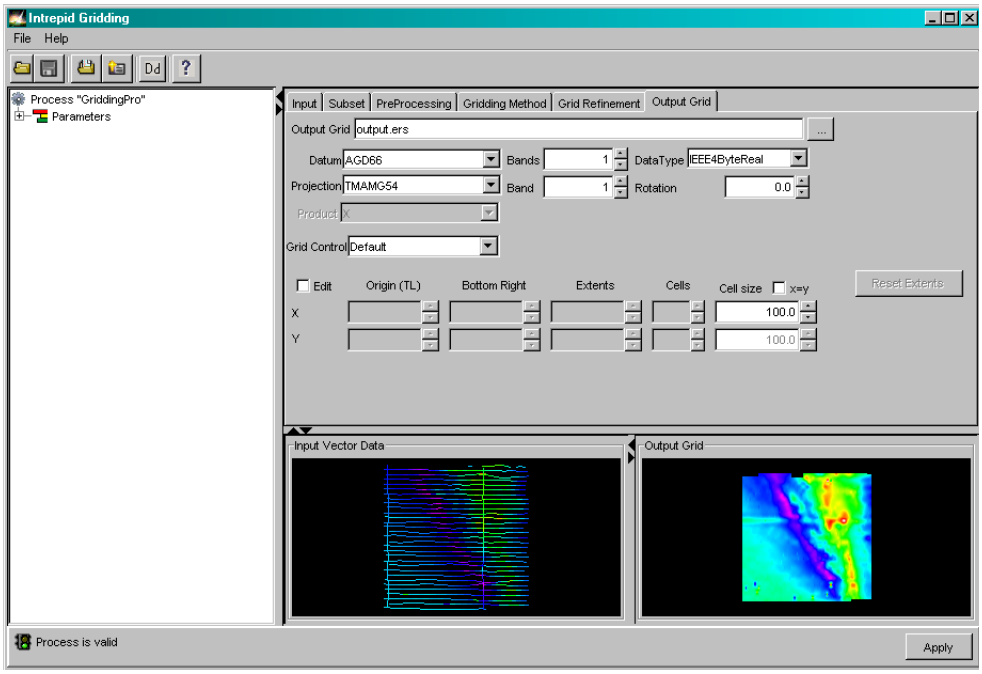
- Input tab for general information about this step
- Gridding vector data
- Gridding tensor data
- Gridding of potential field data with observed gradients

6 If you are producing the grid from line data, ensure that INTREPID can adequately identify the acquisition lines. See Input tab.

7 If you are producing a grid from a line or point dataset, specify

- Pre-processing—see Preprocessing tab
- Gridding method—see Gridding Method tab
- Grid refinement—see Grid Refinement tab
- Output grid—see:
  - Output Grid tab for general information
  - Gridding vector data
  - Gridding tensor data
  - Gridding of potential field data with observed gradients

8 Choose Apply. INTREPID performs the gridding process, saves the output dataset and displays the results graphically in the Output Grid panel.



9 If you want to record the specifications for this process in a task specification (**`.job`**) file so that you can repeat a similar task later, use Save Options from the file menu. (See Specifying input and output files for detailed instructions.)

10 If you want to repeat the process, repeat steps 2–9, varying the parameters and/or data files as required.

11 To exit Gridding, choose Exit from the File menu.

To view the current set of specifications and a list of the process and files involved, expand the task specification tree in the Process panel on the left.

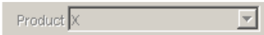
After Gridding you can carry out a more detailed inspection of the grid using INTREPID Visualisation (see Visualisation (T26)).

You can execute Gridding as a batch task using a task specification file that you have previously prepared. See Task specification (`.job`) files in Gridding for details.

Gridding scalar data

***Parent topic:* Using the Gridding tool**

If you specify a scalar field as the **Data** field for gridding (see Input tab—Overview of controls), and you do not specify a gradient field, INTREPID produces a grid of this data. The illustration shows the **Product** drop-down list in the **Output grid** tab.



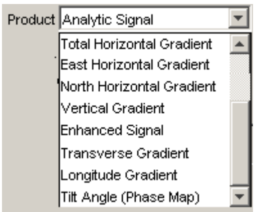
See also:

- Gridding vector data
- Gridding tensor data
- Gridding of potential field data with observed gradients

Gridding vector data

***Parent topic:* Using the Gridding tool**

You can specify a vector field (see "Compound data types" in INTREPID database, file and data structures (R05)) as part of the input for gridding. You can specify it either as the **Data** (see Input tab—Overview of controls) or as the gradient of the data (see Gridding of potential field data with observed gradients).



You can choose the following derived grid products. The illustration shows the **Product** drop-down list in the **Output grid** tab (see Output Grid tab).

The default product is an Enhanced Signal grid. The tool will automatically choose this option, if you use the **Advanced** button to add an **Across** gradient field, to addition to the scalar signal field you have already chosen

To produce directly any of the other grid products listed below, you must add, via the **Advanced** button, the appropriate sets of observed gradient fields.

With the object oriented data types now available in INTREPID, you can also use the Single Field (intelligent) to add all vector components via the one field.

The option of having each gradient as a separate field in your database is provided to preserve Canadian thinking, even though users may lose track of what processes have been applied to each component in prior levelling and other data conditioning. .

Product	Details
Analytic signal	"Analytic signal filter (reference)" in INTREPID spectral domain operations reference (R14)
Total horizontal gradient	"Total horizontal derivative filter (reference)" in INTREPID spectral domain operations reference (R14)
East horizontal gradient	Horizontal derivative in the X direction. See "Generalised horizontal derivative filter (reference)" in INTREPID spectral domain operations reference (R14)
North horizontal gradient	Horizontal derivative in the Y direction. See "Generalised horizontal derivative filter (reference)" in INTREPID spectral domain operations reference (R14)
Vertical gradient	"Vertical derivative filter (including fractional vertical derivative) (reference)" in INTREPID spectral domain operations reference (R14)
Enhanced signal	Use this option if you are gridding a scalar field with gradient enhancement. See Gridding of potential field data with observed gradients. This option is not available if you specify only a vector field of components or gradients as the main data for gridding.
Calculate diurnal	This is experimental - beta only
Transverse gradient	Transverse gradient is the Across gradient component
Longitude gradient	Longitudinal gradient is the Along gradient component (nothing to do with geodetic longitudes)
Tilt angle (phase map)	If you select Tilt angle, INTREPID uses the measured gradients to compute atan(dZ/(total_horizontal_derivative)) It is similar to the analytic signal, except it has the character of the phase of the signal. It varies from –90 to +90 degrees.

See also:

- Gridding scalar data
- Gridding tensor data
- Gridding of potential field data with observed gradients

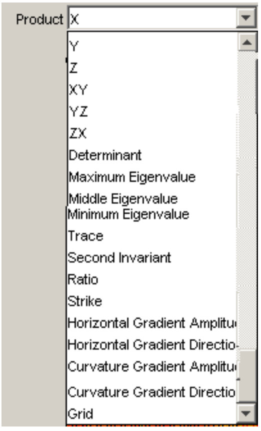
Gridding tensor data

Parent topic: **Using the Gridding tool**

You can specify a tensor field (see "Compound data types" in INTREPID database, file and data structures (R05)) as the **Data** field for gridding (see Input tab—Overview of controls).

INTREPID can produce grids of the following products. The illustration shows the **Product** drop-down list in the **Output grid** tab (see Output Grid tab).

To access this functionality, you must have created a tensor field in your database, either on import, or via the dbedit tool. Generally, it is assumed you would have a normal fully populated tensor, though there is some support for what we call the Horizontal tensor, as observed by the Falcon system. This consists of the Txx-Tyy and the Txy components.



You can choose to produce either a range of one-band scalar grids, or a full tensor grid.

Product	Description
X,Y, Z, XY, YZ, ZX	Individual tensor components
Determinant - I1	First invariant of the tensor
Maximum, Middle, Minimum Eigenvalue	
Trace	Txx+Tyy+Tzz
Second invariant - I2	
Ratio	see Peterson
Strike	atan(I2/I1)
Horizontal gradient amplitude, direction	
Curvature gradient amplitude, direction	
Grid	This is the default and it means create a Fully interpolated 6 band BIL Ermapper grid, with each component stacked band by band. Note, geosoft does not support the notion of multi-band geophysical grids, so do not use a ".grd" output grid extension.

The most important innovation here is the use of the patented SLERP or Spherical Linear interpolation method to allow a Full tensor interpolation. This is used for all of the above options, and the calculation from the interpolated tensor is done at the point of populating the cell with an output value.

See also:

- Gridding scalar data
- Gridding vector data
- Gridding of potential field data with observed gradients

Gridding of potential field data with observed gradients

Parent topic: Using the Gridding tool

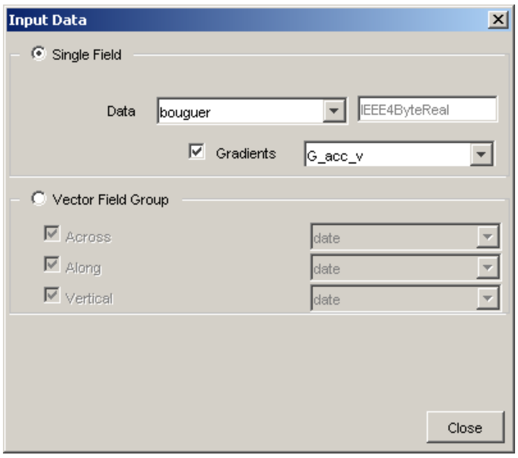
INTREPID can produce superior results if you supplement a scalar input field with observed gradients.

Specifying gradients as a vector field

If you have a set of gradients stored in a field of vector type (see "Compound data types" in INTREPID database, file and data structures (R05)), follow these steps.

>> *To specify gradients as a vector field*

1. Ensure that you have specified and selected the input dataset (see Specifying input and output files and Specifying several input datasets)
2. Specify the scalar field that you are gridding. Use the **Data** drop-down list in the Input tab (see Input tab).
3. Choose **Advanced**. INTREPID displays the **Input gradients** dialog box.



4. Select **Single Field**.
5. Check the **Gradients** check box and select the gradient vector field from the Gradients drop-down list.
6. Choose **Close**.
7. In the **Output grid** tab, from the **Product** drop-down list, select **Enhanced `Signal`**.

Specifying gradients as scalar components

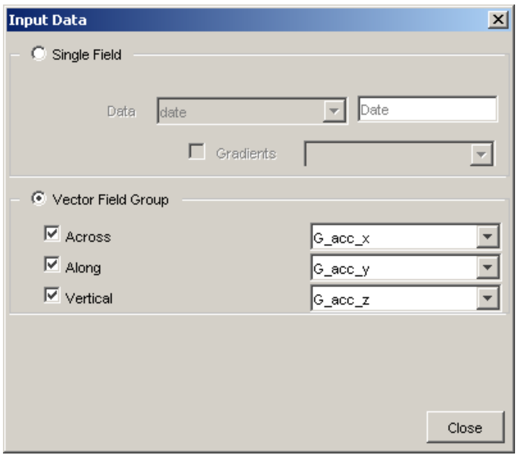
If you have a set of gradients stored in a field of vector type (see "Compound data types" in INTREPID database, file and data structures (R05)), follow these steps.

>> To specify gradients as a vector field

1 Ensure that you have specified and selected the input dataset (see Specifying input and output files and Specifying several input datasets)

2 Specify the scalar field that you are gridding. Use the **Data** drop-down list in the Input tab (see Input tab).

3 Choose **Advanced**. INTREPID displays the **Input gradients** dialog box.



4 Select **Vector Field Group**.

5 Check the **Across**, **Along**, **Vertical** check boxes according to the gradient fields you have available.

6 For each gradient field, select a field from the corresponding drop-down list.

7 Choose **Close**.

8 In the **Output grid** tab, from the **Product** drop-down list, select **Enhanced `Signal`**.

The minimum you must specify is one gradient or component of the field. The Bi-Spline method is choosen by default as the appropriate gridding method in this case. It is recommended you not use any Grid refinements such as Laplace or MINQ as these tend to negate the subtle contributions made by the observed gradients.

Enhanced potential field gridding—further notes

Parent topic: Using the Gridding tool

Sign convention for gradients from an aircraft

There is a local coordinate convention associated with acquisition. Since we are dealing with vector components of the potential field, this convention must be applied.

Assuming a moving platform for the acquisition vehicle such as an aeroplane:

- The local Y positive or length component is tail to tip positive.
- The cross component is left to right positive.
- The vertical component is upwards positive.

Storage of gradients in the source dataset

The gridding algorithm accepts any or all of these vector gradients.

Before gridding, convert the differences between readings to nT/m. Divide the difference by the distance between instruments

The local heading of the observation is also computed from the X, Y data and the components are stored with each scalar field observation as vector components in the E, N & Vertical projection system. That is, the observations are stored in a normalized coordinate frame for internal use.

Opportunities for using this extra gradient data

- Direct gridding of observed analytical signal

$$\sqrt{\left(\frac{\delta T}{\delta x}\right)^2 + \left(\frac{\delta T}{\delta y}\right)^2 + \left(\frac{\delta T}{\delta z}\right)^2}$$

- Direct gridding of observed total horizontal gradient, i.e.

$$\sqrt{\left(\frac{\delta T}{\delta x}\right)^2 + \left(\frac{\delta T}{\delta y}\right)^2}$$

- Enhanced potential (TMI / Gravity) field grid, honouring observed gradients. (see Enhanced potential field gridding—further notes)
- For TMI, calculation of a short wavelength diurnal variation.

Akima splines

These are able to take an observed gradient along the spline direction. The line direction gradient component is calculated for each observation point as required.

Minimum Curvature algorithm

Brigg's formulation is a first order finite difference approximation of La Place condition (13 point kernel). This went to considerable trouble to remove any observed horizontal gradient components.

This traditional formulation is revisited and redone as a second order finite difference approximation (25 point kernel). Provision for observed gradients has also been made.

Variable Density gridding

This alternative method also allows for observed gradients. No implementation, supporting observed gradients, is available as yet.

The Gridding window

Parent topic: **Gridding (T22a)**

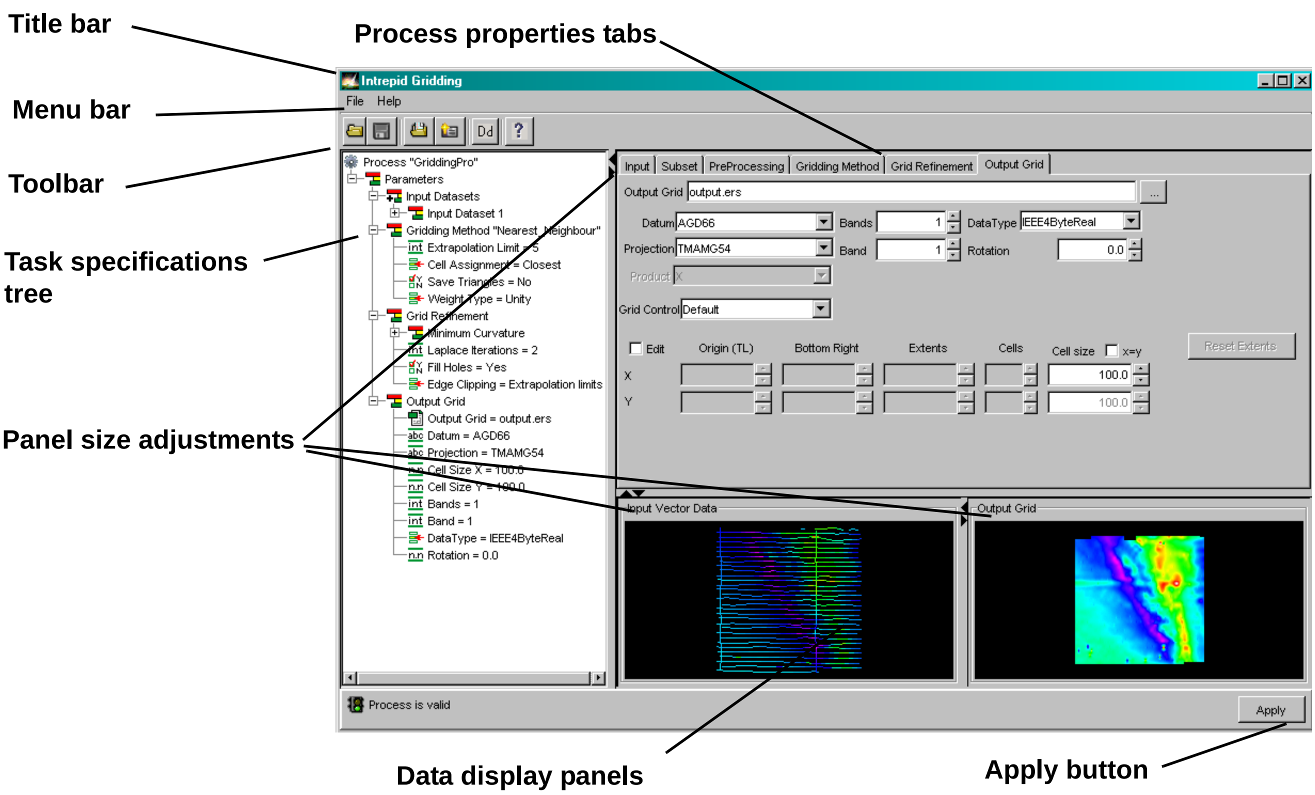
In this section:

- Gridding window diagram
- Changing display panel size
- File menu options
- Toolbar
- Degrees display style

Gridding window diagram

Parent topic: **The Gridding window**

Here is a diagram of the Gridding window. The table below the diagram has more information about the window elements.



The following table describes the screen elements.

Element	Purpose
Title bar	Shows the name of the tool.
Menu bar	Enables you to specify input datasets, output datesets, job files and to view on-line help.
Toolbar	Buttons for specifying input and output datasets as well as units of measurement for the gridding parameters.
Task specifications tree	A list of current set of specifications for the process and files involved. To browse the tree use the + and - buttons to expand and contract the sections.

Element	Purpose
Available filters list	A list of filters available. You can select filters from this list.
Process properties tabs	Properties of the currently selected Gridding process step
Apply button	Click this button to run the filtering process
Panel size adjustment	Use this to change the relative size of the data display area and the lists and properties area

Changing display panel size

Parent topic: **The Gridding window**

Use the panel size control to change the relative size of the data display area and the task control area.

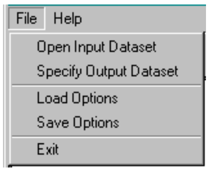
>> To adjust the size of the data display and task specification areas

- Drag the panel size control up or down OR
- Click the up and down arrow icons to make the data display or task specification area occupy the whole window. Click the icons again to restore the display so that both areas are visible.

File menu options

Parent topic: **The Gridding window**

See Specifying input and output files for more information.



Open Input Dataset Use this option to specify the input vector dataset.

Specify Output Dataset Use this option to specify the grid name. The output grid may be a new or existing grid.

Load Options If you want to use an existing task specification file to specify the Gridding process, use this menu option to specify the task specification file required. INTREPID will load the file and use its contents to set all of the parameters for the Gridding process. (See Task specification (`.job`) files in Gridding for more information).

Save Options If you want to save the current Gridding file specifications and parameter settings as an task specification file, use this menu option to specify the filename and save the file. (See Task specification (`.job`) files in Gridding).

Exit Use this option to exit from the tool.

Toolbar

Parent topic: **The Gridding window**

The toolbar has the following buttons:

- Specify input dataset
- Specify output dataset
- Load options
- Save options
- Degrees display selector
- Help

Degrees display style

Parent topic: **The Gridding window**

For latitude and longitude data you can select degrees minutes seconds or decimal degrees using the Degrees display selector button on the toolbar.

Specifying input and output files

Parent topic: **Gridding (T22a)**

INTREPID has controls for specifying the input and output datasets at logical places in the tool, as well as some controls in the **File** menu and toolbar.

You can enter the path and **`..DIR`** or **`.gdb`** file name of the datasets in the dataset text boxes or browse using the **[...]** buttons.

If the grid is in the workng directory (see "Working directory" in Introduction to INTREPID (R02)), there is no need to enter a path. Paths can be:

- Relative to the working directory OR
- Absolute

If you browse, INTREPID displays an **Open** or **Save As** dialog box. Use the directory and file selector to locate the file you require. (See "Specifying input and output files" in Introduction to INTREPID (R02) for information about specifying files).

In this section:

- Overview of input and output files
- Aliases

Overview of input and output files

Parent topic: **Specifying input and output files**

This section is a summary of the input and output files, with cross references to the instructions about them.

- Input files
  - Input vector dataset
    - Aliases (aliases that this tool uses)
    - File menu options
    - Toolbar
    - Input tab
  - Subsection polygon - a many-sided polygon that can clip the area to be gridded.
  - Input task specification file
    - File menu options
    - Toolbar
  - Grid for alignment of output grid
    - Specifying grid alignment
- Output files
  - Intermediate output files
    - Original data points from gridding methods—see Gridding Method tab
    - Coarse grids from variable density gridding method—see Gridding Method—Variable density
    - Trend points from trend spline gridding method—see Gridding Method—Trend Spline
    - Curvature grid from grid refinement—see Grid Refinement tab
  - Output task specification file
    - File menu options
    - Toolbar
  - Output grid
    - File menu options
    - Toolbar
    - Output Grid tab

Aliases

Parent topic: Specifying input and output files

If possible, INTREPID identifies the X, Y and line or point type fields from the dataset aliases. Use the following aliases to identify appropriate fields:

Alias	Field
X	East–West geographic location coordinate
Y	North–South geographic location coordinate
LineType	Line type
PointType	Point quality

See "Vector dataset field aliases" in INTREPID database, file and data structures (R05) for more information about aliases.

Input tab

Parent topic: Gridding (T22a)

The Input tab has controls for specifying input datasets and selecting fields to use in the gridding.

In this section:

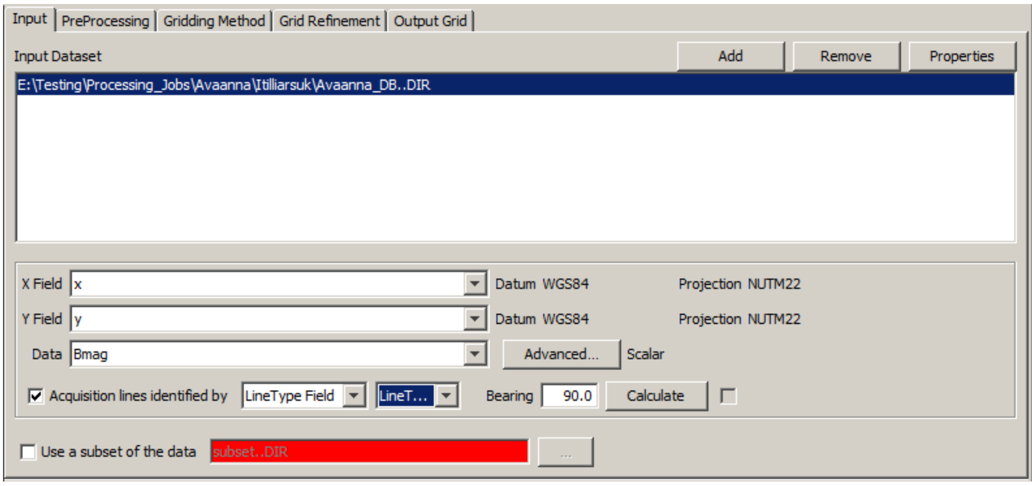
- Input tab—Overview of controls
- Specifying several input datasets
- Identifying acquisition lines
- Point quality
- Nominal Bearing

See also Specifying input and output files.

Input tab—Overview of controls

Parent topic: **Input tab**

This section gives an overview of the controls in the **Input** tab.



Add, Remove

Use these buttons to add or remove datasets from the **Input dataset** list. See Specifying input and output files.

Properties

Choose **Properties** to view information about the selected input dataset (see Specifying several input datasets). INTREPID displays the same information as the Project Manager shows. See "Dataset preview and information display" in INTREPID Project Manager (T02).

Input dataset

The **Input dataset** list shows the input datasets currently loaded for gridding. You can select a dataset to view its information and select options for it. See Specifying several input datasets.

X Field, Y Field

These drop-down lists show the selected geolocation fields of the selected input dataset. INTREPID uses the dataset **X** and **Y** aliases to make default selections. You can choose different geolocation fields from the lists. See Specifying several input datasets.

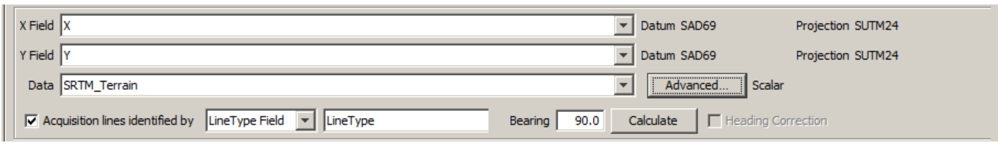
Data

This drop-down list shows the data field selected for gridding in the selected input dataset. You can select a different field from the list. See Specifying several input datasets.

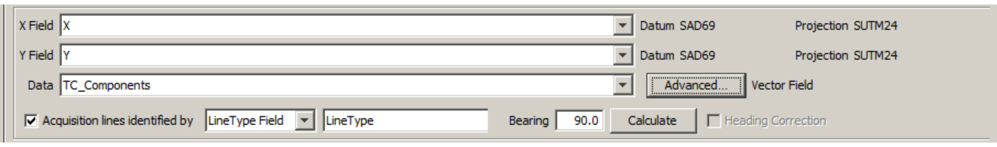
Advanced

Use **Advanced** to specify the gradient fields for gradient-enhanced gridding. See Gridding of potential field data with observed gradients. The selected data type appears immediately to the right of the Advanced button as a hint to the user. The three possible types are illustrated below.

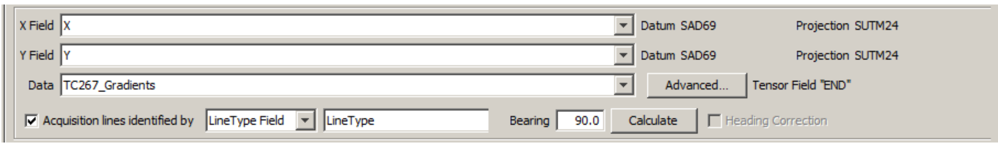
Scalar



Vector

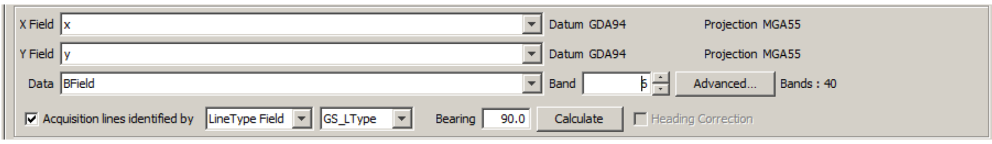


Tensor “Coord System”



For multiband datasets the Advanced button changes to a band selector with the total number of bands available shown to the right

Multiband



Acquisition lines identified by (check box)

(Line datasets only) Use this check box to specify whether you want to distinguish acquisition lines from other lines in the selected dataset. See Identifying acquisition lines and Specifying several input datasets.

Acquisition lines identified by (drop-down list)

(Line datasets only) Use this drop-down list to select the method of identifying acquisition lines in the selected dataset. See Identifying acquisition lines and Specifying several input datasets.

- **LineType Field** *(Line datasets only, acquisition lines identified by line type)*

  When this option is chosen a list box appears to the right allowing the user to choose the appropriate Linetype field name. See Acquisition lines identified by a line type field

- **Nominal bearing** *(Line datasets only, acquisition lines identifid by nominal bearing)*

  Nominal bearing for acqusition lines. See Acquisition lines identified by Nominal Bearing and Nominal Bearing.

  - Calculate.

    Choose **Calculate** to automatically calculate the nominal bearing of the dataset. See Acquisition lines identified by Nominal Bearing and Nominal Bearing.

Heading correction

See Acquisition lines identified by Nominal Bearing and Nominal Bearing.

Specifying several input datasets

***Parent topic:* Input tab**

INTREPID can combine several datasets in one grid. The **Input dataset** list shows the currently loaded input datasets.

The highlighted dataset is the currently selected dataset. INTREPID displays information about this dataset in the **Gridding** window Input **Tab**. You can set input options for this dataset.

To select a different input dataset, click it so that it is highlighted.

Identifying acquisition lines

***Parent topic:* Input tab**

This section is for line dataset gridding only. It is normal practice to use only acquisition lines in the gridding process for line data.

Acquisition lines identified by a line type field

If there is a **LineType** alias or if you specify a line type field in response to a prompt, INTREPID will use it to automatically exclude non-acquisition line data, processing types 2 and 3 only See "Traverse line numbers and types" in INTREPID database, file and data structures (R05) for a complete list of traverse line types and numbers.

If your dataset does not have a line type field but does have line numbers from which you can derive a line type field, you can use the INTREPID Spreadsheet Editor facility to create it. See "Create new field example—Line Type field" in Spreadsheet Editor (T15)) for details about creating line type fields.

Acquisition lines identified by Nominal Bearing

If you do not specify a line type field, but you do specify a Nominal Bearing (estimate of the strike (orientation) of the acquisition lines), INTREPID will identify the traverse lines oriented within ±22½° of the Nominal Bearing as acquisition lines. INTREPID uses the start and end points of a traverse line to calculate its strike.

If you want to use the **Nominal Bearing** setting to identify the acquisition lines, but do not know their strike, INTREPID can calculate the average strike of the dataset for you. See Nominal Bearing for instructions.

If you do not identify acquisition lines

If you deselect the tick box next to **Acquisition lines identified by**, INTREPID will grid all traverse line data.

Point quality

***Parent topic:* Input tab**

This section is for point dataset gridding only. If there is a **PointType** alias or you have specified a point type field, INTREPID will grid only those points for which the point type = 1. If you have not specified a point type field, INTREPID will grid using all points.

Nominal Bearing

***Parent topic:* Input tab**

This section is for line dataset gridding only. If you are gridding a field from a line dataset using Bi-Cubic Spline , INTREPID needs to know the orientation of the acquisition lines.

If you are gridding a field from a line dataset using Nearest Neighbours, Variable Density or Box Filter, you can specify the orientation of the acquisition lines for the purposes of quality control (i.e., rejecting lines that have different orientation) or to specify rotation for the grid.

INTREPID compares the Nominal Bearing parameter with acquisition line orientation. It uses the parameter for the following purposes:

- Determining the line direction for Bi-Cubic Spline and Trend Spline initial gridding. See Gridding Method—Bi-Cubic Spline and Gridding Method—Trend Spline below.
- Identifying acquisition lines if there is no line type field. See Acquisition lines identified by Nominal Bearing for more information.
- Acquisition line quality control: INTREPID will only process traverse lines whose direction is within ±22½° of the specified Nominal Bearing. This rule applies irrespective of the acquisition line identification method (See Identifying acquisition lines).
- Specifying the required angle for a rotated grid if you have acquisition lines that do not lie North–South or East–West. See Producing a rotated grid.

To calculate the Nominal Bearing

Set the '**Acquisition lines identified by**' to '**Nominal Bearing**'. Press the **Calculate** button. INTREPID automatically calculates the bearing of the traverse lines in the dataset for you, and writes the entry into the nominal bearing box.

Subset tab

Parent topic: **Gridding (T22a)**

You can specify a region of interest for the Gridding process usinga polygon dataset. INTREPID will only grid data within the region defined.

You can use the Subsection tool to define a polygon (See Subsections of datasets (T21) for full instructions).

>> To specify a region of interest using a polygon dataset

Select the Polygon option on the Subset tab and specify the polygon dataset required (see Specifying input and output files).

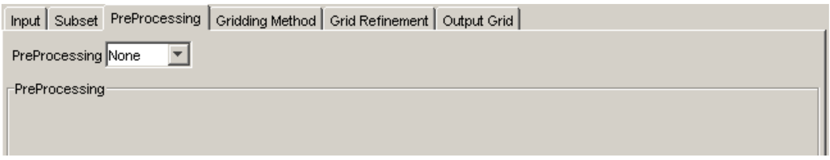
Preprocessing tab

Parent topic: **Gridding (T22a)**

You can choose one of the following

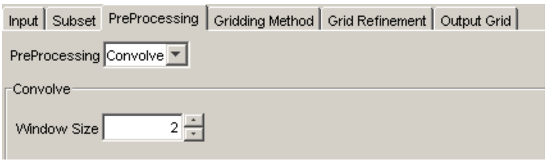
- No preprocessing
- A Convolution filter for smoothing the data (see Convolution preprocessing)
- A Naudy filter for noise reduction (see Naudy preprocessing)

  Select the process you require from the Preprocessing drop-down list on the Preprocessing tab. The default process is None.



Convolution preprocessing

Parent topic: **Preprocessing tab**



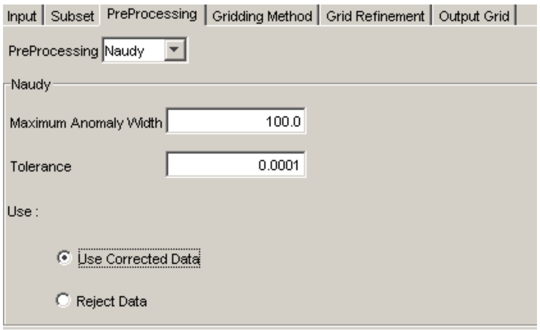
1 If you have selected Convolve, specify the size of the convolution window in data points, using the Window Size (data points) text box. See Convolution preprocessing for an explanation.

This is a filter for smoothing the data. For each point, INTREPID will compare each data value with neighbouring values along the line. If there are sudden changes, INTREPID will adjust the current data value to make the changes smooth. You need to specify the following:

Window Size (data points) Use this to specify the number of data points to be compared around the point being adjusted. For example, if you set the window to 4, INTREPID will examine two points on each side of the current point to calculate any adjustment. The default value of this parameter is 2.

Naudy preprocessing

Parent topic: **Preprocessing tab**



1 If you have chosen the Naudy filter, specify

- The filter wavelength (in data points) using the Maximum Anomaly Width text box
- The filter tolerance (in data units) using the Tolerance text box,
- Whether you want to produce the grid from the corrected data or from the data rejected by the filter (i.e., the noise).
- See Naudy preprocessing for an explanation.

This filter reduces noise in your data by detecting sudden changes or spikes that are not characteristic of potential field data. You need to specify the following:

Maximum Anomaly Width (data points) Use this to specify the wavelength (in data points) for the Naudy filter. The wavelength corresponds to the maximum width of noise anomalies to be removed. INTREPID will remove anomalies shorter than the wavelength you specify. The default value is 2.

Tolerance Use this to specify the filter tolerance (in Z units). The tolerance corresponds to the minimum amplitude of suspected noise anomalies to be removed. INTREPID will remove spikes with a amplitude higher than the tolerance you specify. The default value 0.1 corresponds to 0.1nT, the current documented accuracy of magnetometers. This ensures that INTREPID will only remove noise, and not waste time attempting to smooth out the normal fluctuations associated with the precision limits of the instrument.

Naudy Filter Options Select Use Corrected Data to produce the grid from the corrected data. Select Use Rejected Data (Noise) to produce the grid from data rejected by the filter (the 'noise').

Gridding Method tab

Parent topic: Gridding (T22a)

Gridding uses a mathematical interpolation and extrapolation process to calculate values for the cells within the edge regions and also within enclosed gaps (fully enclosed by but outside the edge regions). INTREPID ofers a number of methods for this process. You can select and specify parameters for tehm in the **Gridding Method** tab. In this section:

Grid initialisation

See Grid initialisation for a description of the initialisation process, common to all gridding methods

General parameters

General parameters are common to all gridding methods. See Gridding method general parameters.

Gridding method—Nearest neighbours

This is our recommended general purpose method. It works well for a wide range of datasets. It uses two-point and three-point planar interpolation (triangulation). See Gridding Method—Nearest Neighbours.

Gridding method—Bi-cubic spline

(Line datasets only) This method uses splining to assign cell centroid values. See Gridding Method—Bi-Cubic Spline.

Gridding method—Box filter

This method is also successful with a wide range of datasets. It does not take account of gradients in the process, and will tend to reduce the magnitude and size of features in your results, compared with the other methods. It uses local averaging to assign cell centroid values (assuming that the original data point is at the centroid of the cell). If you use Nearest Neighbours or one of the Spline methods, INTREPID uses the Box Filter to fill any gaps in the grid after your chosen process is complete. See Gridding Method—Box Filter.

Gridding method—Variable density

This method was designed especially for gravity data acquired at variable sampling densities, over the region you wish to create a gridded representation of the field. The basic intent of the method, is to estimate various wavelength contents optimimally, and to combine them into one, final grid that has the best assemblage of observed wavelengths from the datasets provided.

To illustrate the above discussion further, take the case of regional gravity data being collected on a regular grid at say 4 km spacings. Added to that, you may also have observations taken along roads that criss-cross the area. Added to that again, you may also have some small areas where detailed gravity observations have been carried out on a grid at say 200m spacings.

See Gridding Method—Variable density.

Grid initialisation

Parent topic: Gridding Method tab

The first stage of gridding involves three processes.

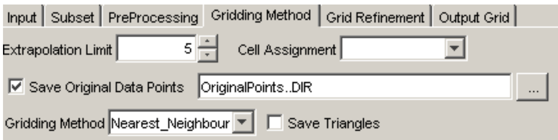
1. INTREPID reads the input data. If it is a vector dataset, INTREPID creates a grid data structure and aligns it with the source dataset.
2. INTREPID identifies the grid cells that contain one or more original data points. It finds the nearest data point to the cell centroid and assigns its Z value to the cell. It also records the 'exact'[16] position of the original data point within the cell for 'honour original points' processes.
3. INTREPID determines the row and column limits for the grid. INTREPID uses the cell extrapolation limit and the original data cells at the ends of each row and column in this process.

Note: The origin of a grid is the centroid of the cell in the top left hand corner.

Gridding method general parameters

Parent topic: Gridding Method tab

These parameters apply to the gridding process no matter what method you select.



Extrapolation limit

Cell Assignment

Save Original Data Points

Save triangles

Gridding method

Gridding parameters summary

The various Gridding processes require different selections of these parameters. The following tables show Gridding parameters that are required for each method.

'Yes' means that you must specify a value.

Blank means that INTREPID does not use or require the parameter in the process at this stage, although its effect on the data may be carried through from a previous stage.

'ON' means that the option must be turned on for the process.

1. [16] To be more precise, the coordinates of the sub-cell containing the original data point. (There are 128 x 128 sub-cells in a grid cell.)

Gridding parameters for line datasets

Process	Grid Cell Size	Extrapolate Cell	Nominal Bearing	Rotate Line Data	Search Radius	Box Iterations
Grid initialisation	yes	yes	if required for acquisition line identification			
Nearest Neighbours	yes	yes				
Bi-Cubic Spline	yes	yes	yes	ON*	yes	
Variable Density	yes	yes	no		yes	
Box Filter	yes	yes	if required for acquisition line identification			yes

* for 'oblique' line datasets

Gridding parameters for point datasets

Process	Grid Cell Size	Extrapolate Cell	Box Iterations
Grid initialisation	yes	yes	
Nearest Neighbours	yes	yes	
Variable Density	yes	yes	yes

Recording the cell centroid and original data point positions

You can save the cell centroids and the 'exact' positions of original data points selected for use (the **sample points**). We have provided this option for technical auditing of the gridding process.

>> *To save the cell centroid and sample point exact positions*

Assign a value to the system parameter INTREPID_HONOUR_ORIGINAL before processing. INTREPID will save a point dataset called **honour** containing a record of each sample point. Each data point recorded will have two sets of coordinates:

- The coordinates of the corresponding cell centroid and
- The 'exact' coordinates of the original data.

If you are examining **honour**, edit its aliases to select the set of coordinates you require.

See INTREPID system parameters and `install.cfg` (R07) for further information about system parameters in INTREPID and "Vector dataset field aliases" in INTREPID database, file and data structures (R05) for more information about aliases.

Recording the original data points used

You can save a record of the data points selected for use by this gridding process (the sample points– selected because they were closest to the cell centroids).

>> *To save the sample points used by Bi-Cubic Spline gridding*

Assign a value to the system parameter INTREPID_FAST_POINTS before processing. INTREPID will save the sample points for the process as a point dataset called **`fast`**.

See INTREPID system parameters and `install.cfg` (R07) for further information about system parameters in INTREPID.

Extrapolation limit

You need to specify cell extrapolation limits for a number of Gridding processes:

- At the start of the gridding process INTREPID creates **edge regions** around the original data cells. These regions will contain extrapolated / interpolated data. The edge regions should ideally meet or overlap to satisfactorily fill gaps between original data points (e.g., the gap between traverse lines, or the gap between points of a point dataset). You need to specify appropriate cell extrapolation limits for filling these gaps.
- The image refinement processes also require an edge region containing data around the whole grid. See Grid Refinement tab for details.
- The data in the edge region around the outside of the grid may be discarded after the image refinement processes. This process is called Clipping.
- INTREPID interpolates values for all cells within regions fully enclosed by but outside the edge regions. The Masking process deletes (sets to ***null***) these regions if required. Masking needs to know the extent of the edge regions. (See Setting grid nulls for details).

>> *To specify the cell extrapolation limit*

Enter the limit (number of cells away from an original data point) into the Extrapolate Cell parameter.

You should normally use an extrapolate cell value of at least 2. The default value is 2.

Cell Assignment

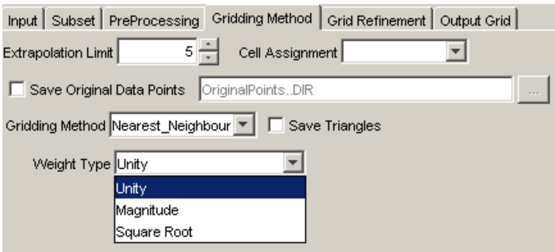
Use this to specify the assignment strategy of observations that fall into the same initial grid cell. This applies only to grids that are created, not reprocessed.

The options are:

- Nearest Pick the nearest observation to the cell centroid
- First Use the first observation encountered from the database
- Last Use the last observation encountered from the database
- Average Take a running average of all observations in the cell
- Count Grid up the count of the number of observations in the grid.
- Minimum Take the smallest observation value as the cell value.
- Maximum Take the largest observation value as the cell value.

Gridding Method—Nearest Neighbours

Parent topic: Gridding Method tab



You can produce grids from line and point dataset fields using this method. It has three stages.

1 **Triangulation:**

INTREPID makes a number of passes through the grid. It works along the rows of the grid one by one starting alternately at the most Northerly row working South and the most Southerly row working North.

For blank cells, INTREPID locates nearby original data cells and uses a triangulation process to calculate values.

When it locates a neighbouring original data cell, it records this for the blank cell. On the first pass through the grid, INTREPID searches for original data cells that are immediate neighbours. On subsequent passes, INTREPID searches for original data cells one cell further away each time from the blank cell. This process is called **shelling**. INTREPID searches a minimum of 20 shells around each cell.

When INTREPID has recorded three neighbouring original data cells for a blank cell, it immediately locates all blank cells whose centroids lie within the triangle formed by the three original data points.

INTREPID interpolates values for all cells within the triangle and marks all of the cells in the triangle as processed. INTREPID uses an 'honour original data' process for this interpolation, since it uses the actual positions of the original data points rather than their cell centroids.

Note: The honour original data process described here uses the same information but is otherwise not related to the honour original data options provided with minimum curvature image refinement.

After completing a pass in which it is unable to perform any interpolation, INTREPID moves to stage 2.

2 **Linear interpolation:**

INTREPID then passes through the grid examining all of the blank cells for which it has found only two nearby original data points.

INTREPID interpolates values for all blank cells on the line between the two original data points, once again using the position of the points rather than their cell centroids.

3 **Box filtering:**

INTREPID passes through the grid using the Box Filter method (See Gridding Method—Box Filter) and creates values for all remaining blank cells.

Tensor Interpolation using SLERP

A recent invention of Intrepid is to extend the nearest neighbour technique when you are wanting to grid a Full tensor Data field. The Spherical Linear interpolation of the rotations (quaternions) part of the signal is automatically invoked at this stage. The Eigenvalues of the tensor are interpolated using the above Nearest neighbour methods for the current triangle.

In this way, an estimate of the curvature gradients of the Potential field can be made smoothly at any point in the near distance to actual observations.

As this constitutes a major extension to the concept of gradient enhanced gridding, the ability to grid to a finer cell size is also present. Studies show that instead of the normal 4 cells between flight lines, up to 8 cells can be supported without significant aliasing. The testing with the Full Magnetic tensor has not been as extensive, as with the Full Gravity gradient tensor.

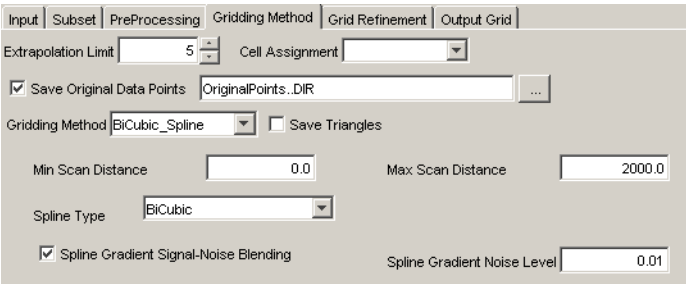
Gridding Method—Bi-Cubic Spline

Parent topic: **Gridding Method tab**

This section is for line dataset gridding only. You can produce grids from line dataset fields using this method, which is sometimes called 'fast grid'.

Note: The jGridding tool is able to use tiling with this method.

Also note, with lines at an angle, it is normal to produce a rotated grid, with either rows or columns in the same orientation as the acquisition lines.



While using this method of calculating values for interpolated cells, INTREPID creates a located line structure that is closely related to the columns and rows of the grid being created. There are three stages of gridding with this method.

1 **Pass along acquisition lines**

INTREPID uses spline curves along the acquisition lines to calculate values that will correspond to all grid cells.

2 **Pass across acquisition lines**

In the second pass INTREPID examines each column or row of the located line structure perpendicular to the acquisition line direction. It notes the values obtained in the first pass (**nodes**) and uses them to calculate a spline curve perpendicular to the acquisition line direction. It uses the spline curve to calculate values in between the traverse lines. The following diagram illustrates the process.

3 **Box filtering**

INTREPID passes through the grid using the Box Filter method (See Gridding Method—Box Filter) and creates values for any remaining blank cells.

Bi-Cubic Spline parameters

Minimum, Maximum Scan Distance When interpolating a value for a group of cells during the second pass of the Bi-Cubic Spline process, INTREPID searches in both directions for nodes so that it can calculate a spline curve. It requires two nodes on each side of the cells. This parameter specifies a distance limit for this search. If INTREPID cannot find the nodes within this distance, it will not interpolate the cells.

Specify the Search Radius (in distance units) in the corresponding text box. We recommend a Search Radius larger than twice the line spacing, or 10 times the cell size (The recommended number of cells from one line to the next is 4).

Note: If your dataset is geodetic (latitude and longitude) you need to specify the Search Radius in degrees.

Nominal Bearing, Rotate Line Data, **Spline Type**

Spline Gradient Signal-Noise Blending.

Spline Gradient Noise Level.

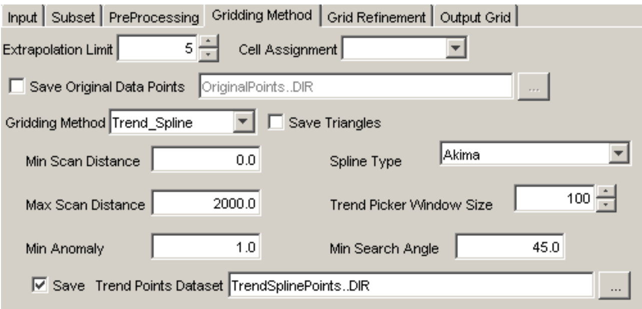
Gridding Method—Trend Spline

Note: This method is retired and no longer available!!

Parent topic: **Gridding Method tab**

This section is for line dataset gridding only. You can produce grids from line dataset fields using this method. This method is retired and no longer available!! Sorry, but it was not worth the effort of keeping it going, and also, with the new intelligent data type fields, quite tricky to support. For instance, how do you define a trend for a tensor field? (DJF Dec. 2007)

Trend spline uses Bi-Cubic Spline gridding but includes a preliminary process which examines groups of lines together to find directional trends. Using this information in the gridding process can enhance the appearance of anomalies that lie at oblique angles to the traverse lines.



Note: We recommend that you only use this method with surveys that have regularly spaced lines.

The Trend Spline direction finding process involves two basic steps

1 INTREPID examines changes in all directions along groups of lines and calculates a trend direction for each data point (the direction in which there is the least change).

2 INTREPID uses this data to create sets of additional data points between the acquisition lines.

—

After the direction process, INTREPID creates the grid using the Bi-Cubic Spline method (See Gridding Method—Bi-Cubic Spline)

—

The process finds maxima and minima in adjacent lines and associates them.

For full details of these process see articles by Brindt and Hauska (1985)[17] and Fitzgerald, Yassi and Dart (1997)[28].

It is possible to 'tune' Trend Spline gridding to accept or reject solutions based upon reliability of data in one direction versus another. If this capability is of interest to you, please contact our technical support service.

Trend spline parameters

Minimum, Maximum Scan Distance See Gridding Method—Bi-Cubic Spline for an explanation of this parameter.

Nominal Bearing See Gridding Method—Bi-Cubic Spline for comments about this parameter.

Rotate Line Data See Gridding Method—Bi-Cubic Spline for comments about this parameter.

Spline Type See Gridding Method—Bi-Cubic Spline for an explanation of this parameter.

(Trend Variance Factor)

The trend variance factor is the minimum level for significance of local variations. The number of trend points generated is very sensitive to the value of this parameter. Its default value is 1 (Z unit) You can change the value of the trend variance factor if you are using a task specification file for your gridding process. Edit the task specification (**`.job`**) file, changing the value in the **`Trend_Variance_Factor =`** line according to your requirements, e.g., **`Trend_Variance_Factor = 2`**. See Task specification (`.job`) files in Gridding for further information.Recording the additional trend points

Trend picker window size INTREPID applies a high pass filter to the data before examining trends. This filter is in the form of a moving average. INTREPID uses the residual values from this moving average filter. You can specify the size (in grid cells) of the window for the filter.

Minimum Anomaly INTREPID will not process maxima or minima with amplitude less than the value[3] you specify here

1.[7] Brindt, L. and Hauska, H., 1985, Direction dependent interpolation of aeromagnetic data *Eleventh International Symposium on Machine Processing of Remotely Sensed Data*, Purdue University, Indiana, USA.

2.[8]Fitzgerald, D., Yassi, N. and Dart, P., 1997, A case study on geophysical gridding techniques: INTREPID perspective: *Exploration Geophysics*, **28**, 1–

Minimum Search Angle INTREPID will not record trends at angles closer to the line direction than the angle you specify here. Trends close to the line direction are too hard to follow using the trend gridding method because of the oblique distances between the lines. Trends in the line direction do not need enhancement, in any case.

Save Trend Points Dataset To save the additional trend points, turn on this check box and specify the name for the additional trend points dataset.

This option replaces the use of the INTREPID_TREND_POINTS system parameter and the procedure described in (Trend Variance Factor).

You can save a record of the additional data points created between the acquisition lines (the additional trend points).

>> *To save the additional trend points*

Assign a value to the system parameter INTREPID_TREND_POINTS before processing. INTREPID will save the additional trend points as a point dataset called **`trend`**.

See INTREPID system parameters and `install.cfg` (R07) for further information about system parameters in INTREPID.

Process reports for the Trend Spline method

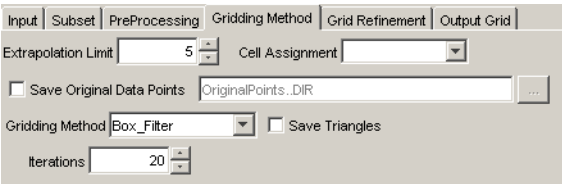
You can inspect a report of the aspect ratio between line spacing and cell size during the gridding process. Under Unix this appears in the background window. Under *Windows* it is written to an **`ntout`** report file. See "Diagnostic reporting options" in Configuring and using INTREPID (R04) for more information.

3. in Z units, for example, nT

Gridding Method—Box Filter

***Parent topic:* Gridding Method tab**

You can produce grids from line and point dataset fields using this method. The Box filter progressively examines each empty cell in the grid in relation to its immediate neighbours and calculates a value for it based on an average value of its neighbours. The Box Filter process repeats until all cells have a value or until it has completed the maximum number of iterations you have specified.



The Box Filter assumes that the original data points are at the cell centroids. It does not take account of the actual position of data points within the cell (i.e., it has no 'honour original points' process) and therefor may not be as accurate as other methods.

Box Filter as a finishing process for other methods

If you use Nearest Neighbours or one of the Spline initial gridding methods, INTREPID uses the Box Filter after the process to fill any remaining gaps in the grid.

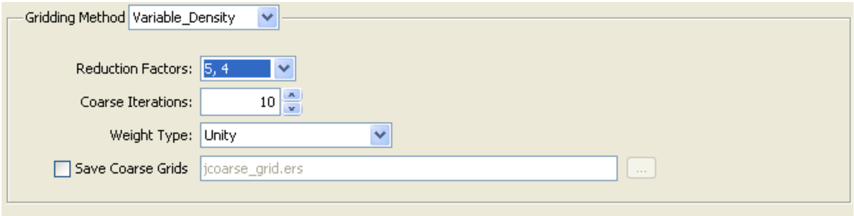
Box Filter parameters

Box iterations You can use this text box to specify the maximum number of Box filter iterations you want INTREPID to perform before moving to the image refinement stage.

You do not need to specify Box Iterations if Box Filter is operating only as a final stage of another initial gridding method.

Gridding Method—Variable density

Parent topic: Gridding Method tab



This method was designed especially for gravity data acquired at variable sampling densities, over the region you wish to create a gridded representation of the field. The basic intent of the method, is to estimate various wavelength contents optimimally, and to combine them into one, final grid that has the best assemblage of observed wavelengths from the datasets provided.

To illustrate the above discussion further, take the case of regional gravity data being collected on a regular grid at say 4 km spacings. Added to that, you may also have observations taken along roads that criss-cross the area. Added to that again, you may also have some small areas where detailed gravity observations have been carried out on a grid at say 200m spacings.

The method is implemented using a multi-grid approach. Working back from the required final cell size, a series of 2 or 3 extra, coarser grids are produced, using the Nearest neighbour technology.

These coarse grids are designed to properly capture the longer wavelength data, at an appropriate cell size. eg for 4 km data, a 1 km cell size would not be aliased, and properly represents this aspect of the signal.

The final cell size might well be 50m, with the aim of capturing the higher frequency, shorter-wavelength field information from the 200m data.

To progress down to this finer cell size, a resampling from the coarsest grid to the next intermediate grid is made, lets say 200m cell size. This intermediate grid is then immediately “weeded” around those cells that fall near an observation of gravity, opening up the gridded representaion of the field for further interpolation and local estimation.

Finally, in the scenario from above, a jump to the 50 m cell size is made.

Notes about implementation detail

1.Low prime number ratios between cell sizes are used to minimise resampling artifacts. You are asked to choose from a limited set of factors that range through combinations of 2,3,4,5,7 and 11.

2.Weeding goes out around any observation a distance of 2 cells sizes at each stage.

3. At least 10 iterations of Minimum Curvature are applied to the coarse grids, to ensure a good representation of the smoothed long-wave content is created and can be handed on to the next stage.

4. Persistence of longer wavelength features can be clearly seen in the output grids, following application of this method.

5. The method was devised at Geoscience Australia, by several workers, including Alice Murray, in an effort to create a best possible gravity grid from extremely irregularly sampled field data.

Pass list

Reduction factor

This is the list of prime number factors to reduce from a coarse cell size to the final cell size using a multi-grid approach.

Cell Size

Final cell size required

Coarse Iterations

You can influence the number of iterations of coarse MIN. Curvature smoothing.

Save Coarse Grids

Good idea to have a look at these, to confirm you can see the longer wavelengths.

Weight Type

The normal option here is Unity. This means give each point/observation equal weighting during the gridding process. The other options are Magnitude - give more weighting to the observation with the largest positive value eg Depth, and Square Root - give a weighting to the Square Root of the magnitude of the signal during 3 point interpolations.

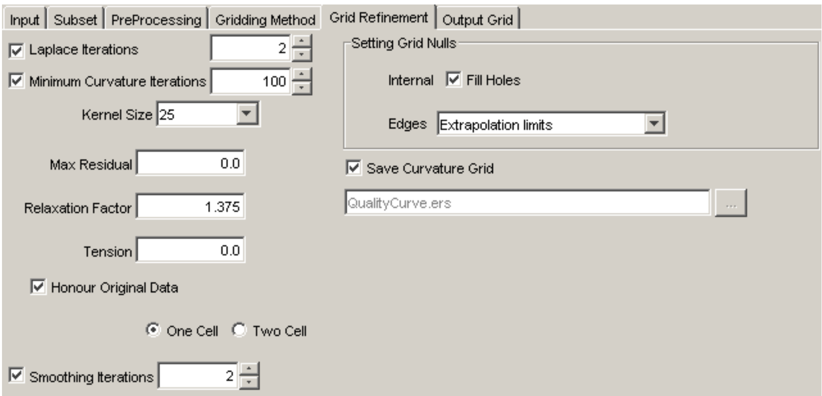
Grid Refinement tab

Parent topic: Gridding (T22a)

After the initial gridding process, INTREPID can perform LaPlace convolution and Minimum Curvature grid refinement, then restore interpolated grid cells to null as required.

If you are refining an existing grid, INTREPID can perform LaPlace convolution and Minimum Curvature Smoothing refinement. The Minimum Curvature process will not use the honour originals method in this case, since no original data is available. <>

Specify grid refinement processes in the **Grid Refinement** tab.



In this section:

- LaPlace iterations
- Minimum Curvature
- Setting grid nulls

LaPlace iterations

Parent topic:
Grid
Refinement tab

This is a heavy smoothing convolution filter that INTREPID applies to all initial grid estimates. It leaves the original points alone. The process improves the condition of the grid for the Minimum Curvature process. If you perform LaPlace convolution, Minimum Curvature will require fewer iterations to achieve a satisfactory result.

The LaPlace formula appears below.

Where

Z_0 is the value in the cell being processed before the adjustment,

Z_0^1 is the value in the cell being processed after the adjustment,

R is the relaxation factor,

Z_1, Z_2, Z_3, Z_4 are the values in the surrounding cells as shown,

	Z_1	
Z_2	Z_0	Z_3
	Z_4	

If Z_0 does not contain original data, then

$$Z_0^1 = \left(\frac{Z_1 + Z_2 + Z_3 + Z_4}{4} - Z_0\right) \times R + Z_0$$

Laplace iterations

Contact our technical support service for information about this parameter.

Relaxation factor

See Minimum Curvature for more information about this parameter.

Minimum Curvature

Parent topic:
Grid
Refinement tab

The Minimum Curvature method progressively examines each interpolated cell in the grid in relation to its immediate neighbours and changes its value based on the value of the neighbours.

The aim of the minimum curvature method is to produce a smooth surface of grid values. Working in both directions, it adjusts cell values using a second derivative calculation based on the differences between the values of the adjacent cells. It does not modify the original data points.

A note about this method and the new Spherical Linear Interpolation method for Full tensor data.

These two methods are largely incompatible with each other. Minimum Curvature is designed to calculate from a scalar measure of a potential field the curvature gradients, in particular Txx,Tyy, Tzz and to use a finite difference method to force the residual of the Trace (Txx+Tyy+Tzz) to zero in all parts of the grid. A Full Tensor grid already contains these curvature gradients and so the above ideas no longer hold. An alternative formulation based on forcing incremental derivatives of the horizontal components into a compliant relationship is in preparation and will be released in Intrepid shortly.

INTREPID uses a **relaxation factor** to accelerate the interpolation process. As INTREPID calculates a new value for each interpolated cell, it multiplies the difference between the old and adjusted value by the relaxation factor. The default value of the relaxation factor is 1.375.

Where

Z_0 is the value in the cell being processed before the Minimum Curvature adjustment,

Z_A is the adjusted value in the cell after the Minimum Curvature process has been applied,

R is the relaxation factor,

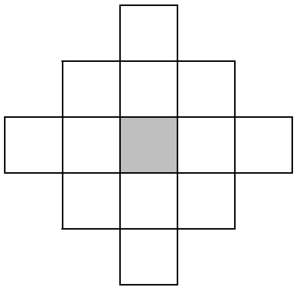
Z_1 is the new value in the cell being processed after the minimum curvature process and relaxation factor adjustment have been applied,

If Z_0 does not contain original data, then

$$Z_1 = (Z_A - Z_0) \times R + Z_0$$

INTREPID will repeat the process until it has completed the number of iterations you specify in the Maximum Iterations text box, or the maximum residual change for all cells is less than the value you specified in the Maximum Residual text box, whichever occurs first.

INTREPID normally uses a kernel of cells immediately surrounding the target cell as comparison values in the Minimum Curvature process, as shown below.



The Minimum Curvature process can use an 'honour original data' system if required. If you choose this method, INTREPID allows for the actual position of the original data point in an original data cell (rather than the cell centroid) when calculating the weight (influence) of the cell in an adjustment of a neighbouring cell. If you are using the Gridding tool to enhance an existing grid, the grid will have no link with its original data, and therefore INTREPID cannot use any honour originals method. See below for additional explanation of the honour originals process.

At the end of the Minimum Curvature process, INTREPID can perform several further passes through the grid where it adjusts original data cells values in the same way as it has been adjusting interpolated cells. This process is called **smoothing**, and has the effect of further smoothing the grid near original data cells.

If you are using the Gridding tool to enhance an existing grid, INTREPID will only perform the Minimum Curvature process in Smoothing mode, since the original data can not be distinguished.

Iterations

Use this spinner to specify the maximum number of times that INTREPID may scan through the grid (number of iterations) during the minimum curvature process.

Kernel size

Use this drop-down list to specify the kernel size for the minimum curvature process.

Maximum Residual

Each time INTREPID scans the grid in its attempt to smooth the grid, it may cause a change in the value of each interpolated cell. As it completes each progressive scan, the change in each cell becomes smaller—the interpolated values are becoming 'settled'.

Use this text box to specify the stage at which you consider that the interpolated values are sufficiently 'settled' (subsequent **residual** changes will be ignored).

Specify the Maximum Residual in the same units as your signal data.

If you are gridding magnetic data we recommend a value of 0.1nT to produce the best print quality.

The Minimum Curvature process will stop when:

- Every cell has changed during the last scan by less than the value that you specify (the **maximum residual** change), or
- The maximum iterations have been performed.

Relaxation factor

See above in this section for an explanation of the function of the relaxation factor.

(Task files) You can change the value of the relaxation factor if you are using a task specification (`.job`) file for your gridding process. Edit the `.job` file, changing the value in the **`Relaxation_Factor =`** line according to your requirements. Example: **`Relaxation_Factor = 1.325`**. See Task specification (`.job`) files in Gridding for information about batch mode.

Tension

Contact our technical support service for information about this parameter.

Honour Original Data

If you turn off Honour Original Data, INTREPID will assume that the original data points are located at the centroids of all original data cells, and calculate the same weight (influence) for the cell in all directions.

If you turn on Honour Original Data, INTREPID will allow for the actual position of the original data point in an original data cell (rather than the cell centroid) when calculating the weight (influence) of the cell in an adjustment of a neighbouring cell. This can improve the accuracy of the image refinement process. An original data point can have up to 128 x 128 different positions in a cell.

If you are using the Gridding tool to enhance an existing grid, original data is not available and INTREPID will automatically turn Honour Original Data off.

The Honour Original Data method has two variants: 1 cell and 2 cell. See the section immediately following for an explanation.

Note: The honour original data process described here uses the same information but is otherwise independent of the honour original data process used in Nearest Neighbours initial gridding (See Gridding Method—Nearest Neighbours).

Honour Original Data—1 or 2 cell

Choose the option button according to your requirements. The default option is 2 cell.

For 1 cell Honour Original Data, INTREPID simply calculates the weight (influence) of each original data cell on neighbouring cells based on the location of the original data point rather than the cell centroid, as explained above.

For 2 cell Honour Original Data, for each original data cell, INTREPID

1. Locates the quadrant of the original data cell in which the original data point lies;
2. Treats the 3 cells surrounding this quadrant as original data cells;
3. Locates the nearest original data points to the respective centroids of the 3 cells;
4. For each of the 3 cells, uses the value of its chosen data point and its position to calculate the weight (influence) of the cell for adjusting neighbouring cells.

Smoothing

If you turn on Smoothing, after INTREPID has completed the Minimum Curvature process, it will perform several further Minimum Curvature passes through the grid. During these passes it will adjust original data cell values in the same way as it has been adjusting interpolated cell values. This has the effect of further smoothing the grid.

Smoothing Iterations

Use this spin box to specify the number of smoothing iterations to perform.

Save curvature grid

Contact our technical support service for information about this parameter.

Setting grid nulls

Parent topic: Grid Refinement tab

Depending on the density of your original data, the cell size, and the value of the Extrapolate Cell parameter, INTREPID will fill gaps in the grid during the gridding process.

You may, on one hand, require a grid with no undefined regions, and require the Gridding tool to fill all gaps as best it can by interpolation.

On the other hand, you may

- Have one or more regions which have no observed data at all, and for which interpolated data would be meaningless, or
- Require that the grid contain only data that is close to original data points.

INTREPID uses a masking process to make the grid conform to these requirements. It sets to ***null*** all interpolated cells that are too far from an original data cell.

INTREPID can use the value of the Extrapolate Cell parameter as the limit for retaining or removing interpolated cells. For example, if Extrapolate Cell=2, then it can set to ***null*** all interpolated cells that are more than 2 cells away from an original data cell.

Internal—fill holes

If you want INTREPID to fill all holes, check this check box. INTREPID fills all holes regardless of:

- The value of **Extrapolate Cell**
- Your selected **Setting grid nulls** option for **Edges**

Edges

Use this drop-down list to specify masking for the edges of the grid.

Setting	Descriptions
Original data limits	INTREPID sets to null all extrapolated edge cells (non-original data cells)
Extrapolation limits	INTREPID sets to null all extrapolated edge cells that are further from an original data cell than the **Extrapolate Cell** value
Strict Extrapolate cells	A new more robust version of Extrapolation limits which uses a moving window and is sensitive to internal holes; also better for random point data of variable spacing. Three further tuning options are available for this method in batch mode (see below).

- Strict Extrapolate Cells tuning options (batch only)
  - Minimum Quadrants

  - Only keep an interpolated cell if the minimum number of quadrants were populated with original data (default is 0).
- Minimum Within
  - Only keep an interpolated cell if the minimum number of original data cells are within the extrapolate limit (default is 1).
- Quadrant Extension
  - Make quadrants larger so that they overlap (defaults is 0)

Example job file syntax:

```
INTREPID_QUADRANT_EXTENSION = 4
INTREPID_MINIMUM_QUADRANTS = 2
INTREPID_MINIMUM_WITHIN = 8
Process Begin
    Name = GriddingPro
    Parameters Begin
        Input_Datasets_Begin
            Input_Dataset_1 Begin
                Input_Daataset = $(dataset)..DIR
                Input_X = lon
                Input_Y = lat
                .....
                .....
```

Output Grid tab

***Parent topic:* Gridding (T22a)**

The Output tab has controls for specifying the output dataset, its content, datum and projection, rotation, alignment and constraints.

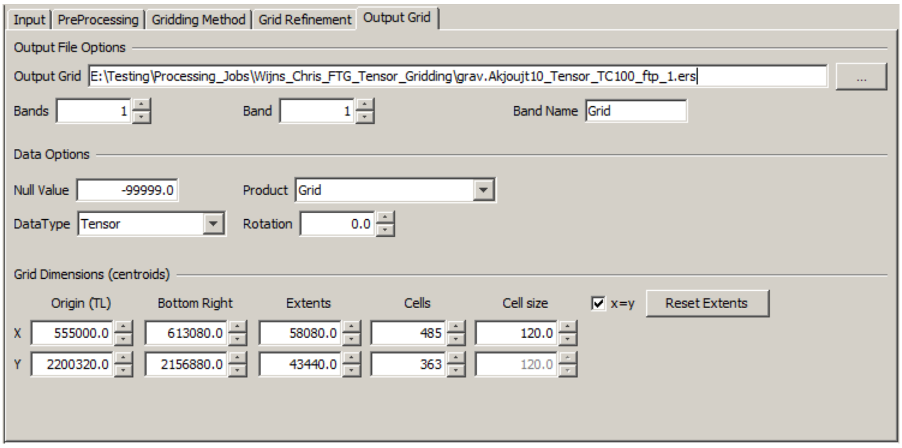
In this section:

- Output grid tab—Overview of controls
- Producing a rotated grid
- Note: Calculation of the row and column limits
- Specifying grid alignment
- Specifying the cell size
- Note: Calculation of the row and column limits

Output grid tab—Overview of controls

Parent topic: **Output Grid tab**

This section gives an overview of the controls in the **Output grid** tab.



Output File Options

Output grid

Use this text box or browse button to enter the name and path of the output grid. See Specifying input and output files.

Bands

Use this spin box to specify the number of bands for the output dataset.

Band

(For datasets with more than one band) Specify the number of the band that you want this gridding operation to create.

Band Name

Set the output grid band name. It defaults to the input Data field name.

Data Options

Null Value

Set the value to be used to represent a null value in the output grid.

DataType

Use this drop-down list to specify the precision of the grid that you are creating. See "Data Types in INTREPID datasets" in INTREPID database, file and data structures (R05).

Product

Use this drop-down list to specify the data product that you want to grid.

If you have specified a scalar field with no gradient enhancement, INTREPID disables this list, because it simply grids the data in the data field. See Gridding scalar data.

(If you have specified a vector or tensor field for gridding, or gradient fields (separate components or vector) to enhance a scalar field) Use this drop-down list to select the product for INTREPID to grid. Each type of input data has its own set of entries in this list. For details, see:

- Gridding vector data
- Gridding tensor data
- Gridding of potential field data with observed gradients (same options as Gridding vector data)

Rotation

Use this spin box to specify the number of degrees of rotation for the output grid. See Producing a rotated grid for details.

Grid Dimensions (centroids)

Origin (TL), Bottom Right

Use these spin boxes to specify the X and Y coordinates of the top left (origin) and bottom right points of the output grid. If you set these values, INTREPID automatically adjusts **Extents** and (number of) **Cells**.

Note that the coordinates defined are for the centre of the cells at the top left and bottom right of the output grid. They do not define the outside bounding box of the grid ie they are half a cell inside the box limits.

Extents

Use these spin boxes to specify the size in distance units of the grid in the X and Y directions. If you set these values, INTREPID automatically adjusts **Bottom Right** and (number of) **Cells**.

Cells

Use these spin boxes to specify the number of cells in the grid in the X and Y directions. If you set these values, INTREPID automatically adjusts **Bottom Right** and **Extents**.

Cell size

Use these spin boxes to specify the size in distance units of the cells in the grid in the X and Y directions. If you set these values, INTREPID automatically adjusts **Bottom Right**, **Extents** and (number of) **Cells**. You can specify equal size in both directions using the **x=y** checkbox. See Specifying the cell size for more information.

If you click and type the required cell size into these boxes rather than use the spinners then you must hit return before INTREPID will update the **Bottom Right**, **Extents** and (number of) **Cells**.

x=y

Use this check box to specify whether cells are of the same size in both directions. If you check this box, INTREPID uses the **X Cell size** for both cell dimensions.

Reset extents

Choose Reset extents to automatically recalculate the default extents for the output grid.

Producing a rotated grid

Parent topic: **Output Grid tab**

You may be gridding a field from a line dataset with 'oblique' acquisition lines (that do not lie North–South or East–West). The survey may have been created like this, for example, so that the data is perpendicular to the strike of a feature of interest.

You may want to produce a rotated grid from 'oblique' data with its rows or columns in the direction of the acquisition lines. After producing the grid you can rotate it so that the rows lie East–West. See "Rotating a grid" in Grid Operations (T25) for instructions.

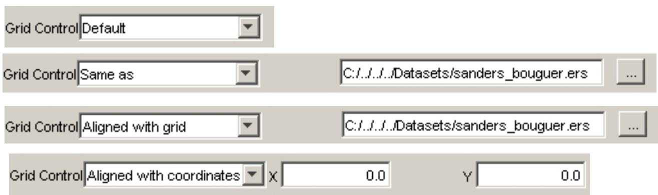
If you are gridding an 'oblique' line dataset using the Bi-Cubic Spline or Trend Spline method in the gridding process, you must produce a rotated grid.

With the Nearest Neighbours and Box Filter methods producing a rotated grid from an 'oblique' line dataset is not compulsory. (See Gridding Method tab.)

Specifying grid alignment

Parent topic: **Output Grid tab**

Note: This feature is not supported in Intrepid V4.2.3.



Default

Same as another grid

Use the text box or browse button to enter the name and path of the control grid. See Specifying input and output files.

Aligned with (another) grid

Use the text box or browse button to enter the name and path of the control grid. See Specifying input and output files.

Aligned with coordinates (X, Y)

Specify the coordinates of the alignment point in the **X** and **Y** text boxes, using distance units of the output grid.

Specifying the cell size

Parent topic: **Output Grid tab**

Use the **Cell Size** spin boxes and the **x=y** checkbox to specify the size of one grid cell in the distance units of the dataset.

Setting an appropriate cell size is a balance between having a fine 'mesh' grid and having gaps or excessive interpolation between cells which may lead to inaccuracies.

If you are gridding from a line dataset we recommend a cell size not greater than one quarter to one fifth of the line spacing.

If you have a smaller cell size than recommended, we suggest that you increase the cell extrapolation limit (See Extrapolation limit for details).

Note: If your dataset is geodetic (latitude and longitude) you need to specify the grid cell size in degrees.

Note: Calculation of the row and column limits

The row and column limits of the grid are lists of the locations of the outermost cells in each row and column which are to contain data.

In this discussion we will use the following notation

EC	= value of the Extrapolate Cell parameter
L_O	= cell position of the outermost original data cell at the current end of the current row or column
L_E	= cell position EC cells further out than L_O for the current end of the current row or column
$\{L_E^{\pm EC}\}$	= the set of L_E cell positions for the current end of the EC rows or columns before and EC rows/columns after the current row/column
$Max\{L_E^{\pm EC}\}$	= the outermost L_E position in the $L_E^{\pm EC}$ set
L	= row or column limit finally recorded

INTREPID calculates the row and column limits as follows.

For the left hand end of each row, INTREPID

1. Locates the leftmost original data cell (L_O);
2. Locates the cell EC cells further left than L_O (L_E);
3. Locates the L_E positions for the previous EC rows and the next EC rows $\{L_E^{\pm EC}\}$;
4. Finds the leftmost cell of the set $L_E^{\pm EC}$ ($Max\{L_E^{\pm EC}\}$)
5. Records the X coordinate of $Max\{L_E^{\pm EC}\}$ as the X coordinate of the left hand row limit for the current row (X coordinate of L). (The Y coordinate is, of course, the row number.)

INTREPID performs this process correspondingly for the right end of each row and for each end of the columns.

The overall effect of this process is to

- Produce a 'square ended' effect for groups of rows and columns, and
- Fill out rows/columns with 'inadequate' original data cells to a common grid edge.

Apply

Parent topic: **Gridding (T22a)**

When you choose Apply INTREPID carries out the Gridding process that you have specified.

Task specification (.job) files in Gridding

Parent topic: **Gridding (T22a)**

This section gives an overview, example and describes the syntax of Gridding task specification files.

A Gridding task specification (**.job**) file specifies:

- Input and output grid filenames
- Griddng parameters

Notes

You can modify the following operations or parameters only by editing a task specification file:

- You can modify the relaxation factor in the minimum curvature process (See Minimum Curvature for details). Change the value in the **Relaxation_Factor =** line according to your requirements, e.g., **Relaxation_Factor = 1.325**.
- You can modify the **Trend_Variance_Factor**. See Gridding Method—Trend Spline for details. Note: The Trend Spline method is no longer supported in the gridding tool.

Finding out more about task files and batch processing mode

Use the following references:

Introduction to INTREPID auxiliary files, such as task files	"INTREPID Auxiliary files" in INTREPID database, file and data structures (R05)
Structure, syntax and use of INTREPID task files	INTREPID task specification (.job) files (R06)
Running INTREPID in batch processing mode	"How to start INTREPID—Overview" in Introduction to INTREPID (R02)

Main block structure of a Gridding task file

The following table shows the main block structure of a Gridding task file. See for more details.

Block definition	Contents
`Process Begin`	Task file outer block
`...`	—Tool name and date stamp
`Parameters Begin`	—Parameters block
`...`	——Filenames
`...`	——Parameters
`Parameters End`	—End
`Process End`	End

Sample Gridding task specification (.job) file

Here is an example of a Gridding task.

```
Process Begin
     Name  = GriddingPro
     Parameters Begin
          Grid_Refinement Begin
               Fill_Holes= yes
               Edge_Clipping= Extrapolation_limits
               Laplace_Iterations= 2
               Smoothing_Iterations= 2
               Curvature_Grid= QualityCurve.ers
               Minimum_Curvature Begin
                    Iterations= 100
                    Max_Residual= 0.0
                    Tension= 0.0
                    Relaxation_Factor= 1.375
                    Kernel_Size= 25
                    Honour_Original_Data= 1
               Minimum_Curvature End
          Grid_Refinement End
          Output_Grid Begin
               Output_Grid= output.ers
               Datum = NAD83
               Projection= NUTM17
               Cell_Size_X= 75.000000
               Cell_Size_Y= 75.000000
               Band  = 1
               Bands = 1
               DataType= IEEE4ByteReal
               Rotation= 0.0
               Origin_X= 451950.000000
               Origin_Y= 5395575.000000
               Columns= 481
               Rows  = 301
          Output_Grid End
          PreProcessing Begin
               Name  = Naudy
               Maximum_Anomaly_Width= 100.0
               Tolerance= 0.0001
               Use_Corrected_Data= yes
          PreProcessing End
          Gridding_Method Begin
               Extrapolation_Limit= 5
               Cell_Assignment= Closest
               Save_Triangles= no
               Name  = Variable_Density
               Coarse_Iterations= 10
               Reduction_Factors= 5,4,3
               Coarse_Grid= coarse_grid.ers
               Orig_Pts_Dataset= OriginalPoints..DIR
          Gridding_Method End
```

```
                    Vector_Subset Begin
                         Name  = Rectangle
                         BottomLeft_X= 0.0
                         BottomLeft_Y= 0.0
                         TopRight_X= 0.0
                         TopRight_Y= 0.0
                         Rotation= 0.0
                    Vector_Subset End
               Parameters End
          Process End
```

Syntax table

This table contains the following sections:

- A complete task specification file outline with all possible statements and blocks, including:
  - File specifications
  - Parameters

The table wil be available in the next edition of this manual.

Using task specification files

You can store sets of file specifications and parameter settings for Gridding in task specification (**.job**) files.

>> ***To create a task specification file with the Gridding tool***

1. Specify all files and parameters.
2. If possible, execute the task (choose Apply) to ensure that it will work.
3. Choose Save Options from the File menu. Specify a task specification file (INTREPID will add the extension **.job**) INTREPID will create the file with the settings current at the time of the Save Options operation.

For full instructions on creating and editing task specification files see INTREPID task specification (.job) files (R06).

>> ***To use a task specification file in an interactive Gridding session***

Load the task specification (**.job**) file (File menu, Load Options), modify any settings as required, then choose Apply.

>> ***To use a task specification file for a batch mode Gridding task***

Using Project Manager

This method enables you to use the extended task specification language available to the Project Manager.

For instructions, see "Executing batch mode tasks with the Project Manager" in INTREPID Old Project Manager (T01).

For information about the Project Manager task specification language extensions, see "Special Project Manager batch task operations" in INTREPID task specification (.job) files (R06).

Using Gridding directly

Type the command **jgridding.exe** with the switch **–batch** followed by the name (and path if necessary) of the task specification file.

For example, if you had a task specification file called **surv329.job** in the current directory you would use the command

```
jgridding.exe –batch surv329.job
```

Frequently asked questions

Parent topic: Gridding (T22a)

Q : Why doesn't Bispline gridding appear to fill the grid properly on a dataset with angled lines?

Splining only works in the NS or EW direction. It depends on the bearing entered. If you enter a bearing of 90, it will spline (NS) for lines which have a bearing within 70º–110º (±20º from 90º), or if you enter 0 it will spline EW for lines bearing 340º–20º. If you enter 45 you will need to select **Rotate dataset** or else it will try and spline NS (as if lines were bearing 90º) and not find many node points, outputting a generally blank grid.

Q : What should I make the coarse grid Maximum scan distance for variable density gridding?

The coarse grid search radius (Max scan distance) should default to something very large in order to effectively scan the entire area.

It is in the same units as the X and Y coordinates.

Q : I want to grid the tie lines as well as the traverse lines. How do I do that?

Use the Nearest Neighbours option if you want to grid all the lines. If you have a Linetype field defined, re-number it to 2 for all lines, then grid.

Another way is to comment out the **Linetype** alias in the **.isi** file, then grid. The Nominal Bearing entry will then control what lines get gridded. If you leave it blank all lines get gridded.

Bi-splining won't grid all the lines because it ignores lines > 22º from the required nominal bearing.

Q : How can I change the null value in an INTREPID grid?

Edit the grid using the Spreadsheet Editor, and replace the ***null***s with the new value.

Then edit the grid header file, and change **NullCellValue** to the new value.