Geosoft Technical Note
Microlevelling using Bi-directional Gridding

Introduction

When working with complex datasets, such as airborne magnetics or radiometrics, a key data processing objective is to eliminate subtle levelling problems, which were not removed during regular data processing (such as lag corrections, tie line levelling, base level corrections, etc.).

One definition of “microlevelling” might be “filtering a gridded dataset to reduce or remove non-geological effects caused by long-wavelength noise along survey lines”. Such noise manifests itself as apparent data shifts from one survey line to the next, often creating very streaky looking images. Normally microlevelling is applied only after other corrections such as diurnal removal and tie-line levelling have already been applied to the data. See the ***Geosoft Levelling System Tutorial and User Manual*** for details on these types of operations.

There are a number of methods for microlevelling datasets collected along survey lines. The method described in this Technical Note uses the **Oasis montaj**™ Bi-directional line gridding method. You can apply the procedure to a gridded dataset alone, however for optimum results you will require a database of the original located data. The success of this method is largely data dependant, however it works in the following manner. A grid of levelling errors is derived from a magnetic grid; this data is then subtracted from the original located data if available, or from the grid if not available.

The Bi-directional microlevelling method derives the error grid by assuming that the gridded data consists of geology, a regional field, and levelling errors. These are separated out at various stages by low pass filtering during the gridding process.

Overview of Bi-directional Microlevelling

As an example, given a magnetic grid surveyed with a nominal east-west survey line spacing of 200 metres and has a line-to-line levelling problem (**Mag_data.gdb**). Note that, if your survey lines are not E-W or N-S you will need to rotate the data using the *Coordinates/Rotate* menu option.

Initially we will create a low-pass filtered grid that contains the levelling errors plus a regional field (g2.grd). We will then re-grid the (g2.grd) using the same low-pass filtering parameters, creating a grid that contains the regional field plus some high frequency noise (g3.grd). A Hanning (3x3 convolution) smoothing filter will then be applied to the (g3.grd) to remove the high frequency noise and create grid (g4.grd). We will the subtract grid (g4.grd) from grid (g2.grd) creating a levelled error grid (g5.grd). We will then extract the resultant levelling error grid values (g5.grd) into the original database using the *Grid/Utilities/Sample a grid* menu item.

We will then create a microlevelled (maglev) channel in the database (Mag_data.gdb) by applying a math formula that subtracts the (lev) channel from the (mag) channel. The result is a levelled magnetic data channel in your database. In the final step, we will grid the (maglev) channel to create the final microlevelled grid. You can use this grid for further processing or interpretation.

Note: If the original located database is not available you can subtract the levelling error grid (g5.grd) from the original grid (g1.grd) to produce a final micro-levelled grid. See ***Steps to Perform Bigrid Microlevelling from a Grid***.

Steps to Perform Bi-directional Microlevelling from a Database

1. Open the database (**Mag_Data.gdb**) in your current workspace.
2. On the *Grid* menu, select *Gridding|Bi-directional line gridding|Dialog controls*. The *Bi-directional gridding of line data* dialog will be displayed.

3 Select the *Channel to grid* (**mag**), specify the output grid (**g1.grd**), and specify the *Cell size* to be 1/4 of the mean line spacing. You can leave the rest of the parameters to the default values; click **[OK]** to create the first grid.

4 On the *Grid* menu, select *Gridding*|*Bi-directional line gridding*|*Dialog controls*. The *Bi-directional gridding of line data* dialog will be again displayed.

5 Select the *Channel to grid* (**mag**) and this time specify the output grid as (**g2.grd**) and click the **[Advanced]** button. The *Advanced Gridding options* dialog will be displayed.

6 In the *Low-pass filter wavelength box*, set the low-pass filter parameter to (**4-10**) times the line spacing. You can leave the rest of the parameters to their default values; click **[OK]** to create the second grid. The grid (**g2.grd**) is a grid of the levelling errors plus a regional field.

7 On the *Grid* menu, select *Gridding*|*Re-grid a grid*. The *Regrid a grid* dialog will be displayed.

8 Select the *Input grid* (**g2.grd**) and specify the output grid (**g3.grd**). In the *Low-pass filter wavelength* box, use the same low-pass parameter value used in step 6. You can leave the rest of the parameters to the default values; click **[OK]** to create the third grid. The grid (**g3.grd**) is a grid of the regional field plus some high frequency noise.

9 On the *Grid* menu, select *Gridding*|*Filters*|*3x3 convolution*. The *Grid Filters* dialog will be displayed.

10 Select the *Input Grid File* (**g3.grd**) and specify the *New resultant Grid* (**g4.grd**). In the *OPTION 1 – Select a Predefined Filter* box, select (Hanning) and in the *Number of passes to apply* box, specify (**3-5**) times. You can leave the rest of the parameters to the default values; click **[OK]** to create the fourth grid. The grid (**g4.grd**) is a grid of the regional field.

11 On the *Grid* menu, select *Expressions*|*Subtract grids*. The *Subtract one grid from another* dialog is displayed.

12 Select the *First input grid* (**g2.grd**) and select *Second input grid to subtract from first* (**g4.grd**), and then specify *Output difference grid* (**g5.grd**). Click **[OK]** to create the fifth grid. The grid (**g5.grd**) is a leveling error grid. The resultant leveling error grid should be analyzed to verify that no geological information would be removed from the data when we subtract the leveling error data from the original mag data in the database.

Note: If you receive an error with the following message "**Unable to proceed because the size of the two grids were not the same. One grid is (404,404) elements in size while another grid is (404,405) elements.**", please read the following:

In order to perform any mathematical expressions on grids the grid nodes must be georeferenced in the same place, and have the same physical dimensions. Regridding and filtering may cause the grids to differ slightly in physical size. If this happens:

1. On the *Grid* menu, select *X-Utilities/Boolean operations*. The *Mask One Grid Against Another* dialog is displayed.
2. Select the *Input Grid 1* (**g2.grd**), the *Input Grid 2* (**g4.grd**), and then specify the *Output Grid* (**g4a.grd**).
3. Using the dropdown, lists select the following parameters: *Boolean Logic Option* (**AND**), *Size of output Grid* (**Same s Grid 1**), and *Grid Values used in Overlap areas* (**Grid 2 Only**).
4. This procedure forces the size of grid (**g4a.grd**) to be the same size as grid (**g2.grd**). Grid (**g4a.grd**) can be used in the subtraction step (***see***

step 12 above) rather than the grid (**g4.grd**).

13 On the *Grid* menu, click *Utilities*|*Sample a grid*. The *Sample from a Grid* dialog box is displayed. This dialog uses the **X** and **Y** values in your current database (**Mag_Data.gdb**) to sample a selected grid. The grid values are then placed in a new channel in the database.

14 Select *X reference channel* (**X**) and the *Y reference channel* (**Y**) from your current database. In the *Grid sampled channel* box, specify the channel as (**lev**) and in the *Grid file* box, select the *Grid file* (**g5.grd**). Click **[OK]** to extract the grid values into the database.

15 Examine the (**lev**) channel in profile view to determine how much geology remains in the error level grid. You can remove this signal using either a low pass or non-linear filter (*X-Utility*|*Filters*| menu items).

In these final steps, you will create a microlevelled (**maglev**) channel by applying a math formula that subtracts the (**lev**) channel from the (**mag**) channel. The result is a levelled magnetic data channel in your database. You can then grid the levelled channel to create a final microlevelled grid.

16 To create a new channel, click the *right* mouse button on the header cell (the top cell) of a blank spreadsheet column. On the popup menu, click *New*.

17 Specify the channel name as **maglev**. Click the **[OK]** button. The new channel is created.

18 On the *X-Utility* menu, click *Expressions*|*Expression*. The *Apply Formula* dialog is displayed. In the *Expression* box, type: **maglev=mag – lev** and click the **[OK]** button. The equation is applied to the **maglev** channel and the values displayed in the spreadsheet column.

19 You can now grid the microlevelled data channel (**maglev**) using Bi-directional line gridding. On the *Grid* menu, click on *Gridding*, then click *Bi-directional line gridding*, and then click *Dialog controls*. The *Bi-directional gridding of line data* dialog will be displayed.

20 Select the *Channel to grid* (**maglev**) and specify the output grid (**maglev.grd**). You can leave the rest of the parameters to the default values; click **[OK]** to create the final microlevelled grid. You can use this grid for further processing or interpretation.

Since the low-pass filtering in the *Re-grid a grid* dialog is dependant on the storage configuration of the grid i.e. whether that data is stored by columns or rows, it may be necessary to check that the data will be filtered across the original lines. However, if the above processing steps are followed in order there will be no need to change this parameter since the default orientations give the correct result.

Steps to Perform Bigrid Microlevelling from a Grid

1 Open the grid (**g1.grd**) in your current workspace.

2 On the *Grid* menu, select *Gridding*|*Re-grid a grid*. The *Regrid a grid* dialog will be displayed.

3 Select the *Input grid* (**g1.grd**) and specify the output grid (**g2.grd**). In the *Low-pass filter wavelength box*, set the low-pass filter parameter to (**4-10**) times the line spacing. You can leave the rest of the parameters to the default values; click **[OK]** to create the second grid. The grid (**g2.grd**) is a grid of the levelling errors plus a regional field.

4 On the *Grid* menu, select *Gridding*|*Re-grid a grid*. The *Regrid a grid* dialog will be displayed.

5 Select the *Input grid* (**g2.grd**) and specify the output grid (**g3.grd**). In the *Low-pass filter wavelength box*, use the same low-pass parameter value used in step 3. You can leave

the rest of the parameters to the default values; click **[OK]** to create the third grid. The grid (**g3.grd**) is a grid of the regional field plus some high frequency noise.

6 On the *Grid* menu, select *Gridding*|*Filters*|*3x3 convolution*. The *Grid Filters* dialog will be displayed.

7 Select the *Input Grid File* (**g3.grd**) and specify the *New resultant Grid* (**g4.grd**). In the *OPTION 1 – Select a Predefined Filter* box, select (Hanning) and in the *Number of passes to apply* box, specify (**3-5**) times. You can leave the rest of the parameters to the default values; click **[OK]** to create the fourth grid. The grid (**g4.grd**) is a grid of the regional field.

8 On the *Grid* menu, select *Expressions*|*Subtract grids*. The *Subtract one grid from another* dialog is displayed.

9 Select the *First input grid* (**g2.grd**) and select *Second input grid to subtract from first* (**g4.grd**), and then specify *Output difference grid* (**g5.grd**). Click **[OK]** to create the fifth grid.

Note: If you receive an error with the following message "**Unable to proceed because the size of the two grids were not the same. One grid is (404,404) elements in size while another grid is (404,405) elements.**", please read the following:

In order to perform any mathematical expressions on grids the grid nodes must be georeferenced in the same place, and have the same physical dimensions. Regridding and filtering may cause the grids to differ slightly in physical size. If this happens:

1. On the *Grid* menu, select *X-Utilities/Boolean operations*. The *Mask One Grid Against Another* dialog is displayed.
2. Select the *Input Grid 1* (**g2.grd**), the *Input Grid 2* (**g4.grd**), and then specify the *Output Grid* (**g4a.grd**).
3. Using the dropdown, lists select the following parameters: *Boolean Logic Option* (**AND**), *Size of output Grid* (**Same s Grid 1**), and *Grid Values used in Overlap areas* (**Grid 2 Only**).
4. This procedure forces the size of grid (**g4a.grd**) to be the same size as grid (**g2.grd**). Grid (**g4a.grd**) can be used in the subtraction step (***see step 12 above***) rather than the grid (**g4.grd**).

10 The grid (**g5.grd**) is a levelling error grid. The resultant leveling error grid should be analyzed to verify that no geological information would be removed from the data in the next step.

11 On the *Grid* menu, select *Expressions*|*Subtract grids*. The *Subtract one grid from another* dialog is displayed.

12 Select the *First input grid* (**g1.grd**) and select *Second input grid to subtract from first* (**g5.grd**), and then specify *Output difference grid* (**maglev.grd**). Click **[OK]** to create the final grid. The grid (**maglev.grd**) is the final microlevelled grid. You can use this grid for further processing or interpretation.

For more information on Microlevelling, contact:

North America

Geosoft Inc.,
85 Richmond St. W., 8th Floor
Toronto, Ont.,
Canada
M5H 2C9

Tel. (416) 369-0111
Fax (416) 369-9599

Email: tech@geosoft.com

South America

Geosoft Latinoamerica Ltda.
Av. Rio Branco, 156 - Gr. 2615
CEP 20043-900, Centro
Rio de Janeiro, RJ, Brasil
CEP 22220-001

Tel: (55-21) 2532-0140
Fax: (55-21) 2532-7197

Email: tech.sa@geosoft.com

South and Central Africa

Geosoft Africa Ltd.
Buren Building, Second Floor
Kasteelpark Office Park
c/o Nossob & Jochemus Streets
Erasmuskloof X3, Pretoria

Tel: 2712 347 4519
Fax: 2712 347 6936

Email: tech.za@geosoft.com

Europe and North Africa

Geosoft Europe Ltd.
20/21 Market Place, First Floor
Wallingford, Oxfordshire
United Kingdom
OX10 OAD

Tel: +44 1491 835 231
Fax: +44 1491 835 281

Email: tech.eu@geosoft.com

Australia and Southeast Asia

Geosoft Australia Pty. Ltd
32 Richardson St.
West Perth WA 6005
Australia

Tel. 61 (8) 9322-8122
Fax 61 (8) 9322-8133

Email: tech.au@geosoft.com