gui Documentation

Release 1

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FaT-Foward Modelling

A Graphical user interface for interpretation and forward modelling of geophysical profile data

FaT-FM is a Graphical user interface (GUI) for 2D forward modelling of gravity and magnetic potential field data. Seismic Reflection (SEGY), Well (Tops and LAS logs) and Point data can also be loaded, enabling the integrated geological/geophysical interpretation of profile data.

FaT-FM is written in python 2.7 and uses wxPython for GUI implementation. FaT-FM makes use of several other open source python packages to preform various tasks (see References for a details).

Tip: Following the steps listed below should ensure everything that is required to run FaT-FM is installed on your system correctly.

Part I

Operating System

Note: FaT-FM is (for the time being) is only tested and supported on the Ubuntu 14.04 LINUX operating system. Issues may arise when trying to install on other distributions.

Part II

Dependencies

GMG depends on several other packages to run. These are:

- numpy
- scipy
- matplotlib
- fatiando a terra
- wxpython
- ObsPy

Each dependency needs to be installed in the correct directory in order for GMG to run. Following the steps below is the simplest way to compete the installation.

Part III

Step 1:

The simplest way to get started is to follow the instructions for installing fatiando via the Anaconda python package manager as described here:

Install fatiando

As explained in the link above, Anaconda is a compilation of python packages/package managing tool that can be used to install additional packages including fatiando, numpy, scipy and matplotlib.

Part IV

Step 2:

Install wxPython. On Ubuntu linux the simplest way to ensure you have everything that is required is to copy the command below and paste in the command line of a terminal:

```
sudo apt-get install python-wxgtk2.8 python-wxtools wx2.8-i18n libwxgtk2.8-dev l
```

Part V

Step 3:

Unzip the FaT-FM package into any directory e.g. *~/Downloads*

Open a terminal and navigate to the directory that contains your fatiando installation. This is likely to be:

```
cd ~/anaconda/lib/python2.7/site-packages/fatiando
```

Move the gui directory from FaT-FM into the fatiando directory e.g.:

```
mv ~/Downloads/FaT-FM/gui .
```

This directory should contain:

- 1. The script: forward.py (which contains the FaT-FM package)
- 2. The script: plot_model.py
- 3. The script: model_stats.py
- 3. A directory called icons

Navigate to the fatiando gravmag directory using the command:

```
cd gravmag
```

From the FaT-FM directory *FaT-FM/gravmag* copy the following into the *fatiando/gravmag* directory e.g.:

```
cp ~/Downloads/FaT-FM/gravmag/*.py .
```

This will copy:

- 1. The script: talwani.py (NOTE: This will overwrite the default fatiando talwani.py script with some edits)
- 2. The script: won_and_bevis_mag2d.py

Part VI

Step 4:

In the FaT-FM directory make the *GMG.py* script executable using the command:

```
chmod 777 FaT-FM.py
```

Now move FaT-FM.py into you */bin* directory or any other directory that is within your *$PATH* variable e.g.:

```
sudo mv GMG.py /bin/GMG.py
```

Part VII

DONE!

You should now be able to launch FaT-FM from a terminal by typing *GMG*

Tip: You can also edit your .bashrc file and create a custom launch command for GMG by adding an alias such as:

```
alias GMG='python /bin/GMG.py'
```

Part VIII

Manual

CHAPTER

ONE

1.0 FAT-FM MODELS

1.1 1.1 Creating a New Model

Before creating a new model, it is recommended that you create a directory structure in which you will store and save all of the data related to a given model. This can be structured in any way the user wishes but it is recommended that you create a new master directory such as:

```
mkdir FaT-FM_MODEL
```

Then open the master directory:

```
cd FaT-FM_MODEL
```

and create the following directory structure:

```
mkdir MODELS GRAVITY_DATA MAGNETIC_DATA SEGY_DATA WELL_DATA GEOLOGICAL_DATA POIN
```

Now you are ready to create your model. Launch FaT-FM and navigate to:

File -> New Model...

You will be prompted by a window in which to enter the new models dimensions and the spacing increment at which potential field data is to be calculated (all units are km).

Tip: The model dimensions and spacing at which potential field data is calculated can be modified later by using the Model View -> Modify current Model Dimensions... option.

Tip: If a very high spatial resolution is required for predicted anomalies, it may be computationally beneficial to set the spacing at which potential field data is to be calculated as a relatively coarse value for initial modelling and later reduce this to the dense spacing that is required for the final model. This will prevent unnecessarily slowing the software down during initial modelling.

1.2 1.2 Saving a Model

To save a model navigate to Files -> Save Model... This is prompt a save file menu from which you can navigate to the directory where you would like to dave your model, for example FaT-FM_MODEL/MODELS/

FaT-FM models are saved as python Pickle files and must have a ".model" suffix, for example, FaT-FM_MODEL/MODELS/FaT_model_1.model

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Tip: It is recommended that the user incrementally saves updated models with a new suffix such as model_1.model, model_2.model...etc

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This will ensure you can revert back to previous models if your current model becomes corrupted.

1.3 1.2 Loading a Model

To load a model navigate to Files -> Load Model... Navigate to your required .model and select Open.

Your model will be loaded into the current FaT-FM window.

CHAPTER

TWO

2.0 POTENTIAL FIELD DATA

2.1 2.1 Potential field calculations

The Menubar contains buttons labelled *G* and *M*. These are used for switching the calculations of the potential fields on and off. Turing off the predicted anomalies can help speed up the GUI response time if the model becomes complex (many layers and nodes).

Note: You must set the magnetic inclination and Earth Field value under the *Magnetic Field* menu before

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the predicted anomaly can be calculated.

2.2 2.2 Loading observed potential field data

To load observed potential field data click on the *Observed* menu in the Menubar and select either *Load observed Gravity anomaly* or *Load observed Magnetic anomaly*. Next Navigate to the file you want to load and select it. The file will automatically be loaded into the canvas.

Note: These files should be ASCII text files with X values in the first column and the anomaly value

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in the second column. These files may have any suffix.

CHAPTER

THREE

3.0 MODEL LAYERS

3.1 3.1 Adding a layer

To add a new layer to the model navigate to the *'Layers'* menu and select *'New Layer'*.

Tip: the *n* key is the keyboard shortcut for adding a new layer.

You will be prompted with the option of adding a *'New fixed layer'* or a *'New floating layer'*.

Floating layers:

Floating layers are polygons that are fully contained within the model space.

Warning: Care must be taken to ensure the start and end nodes of floating layers remain to the left and right of each other respectively. It is possible to cross these nodes over. If this occurs, the calculated potential fields will be erroneous and the sign may be flipped.

Fixed layers:

Fixed layers span the entire width of the model and are useful for modelling features such as sedimentary basins. Fixed layers have fixed boundary nodes that **can only** be moved vertically along the model edges. These layers are padded out horizontally from the boundary nodes to 400 km either side of the model in order to avoid edge effects.

3.2 3.2 Adding a New Node to a Layer

To add a node to a layer place the mouse cursor at the position where you would like to add the new node and press the *'i'* key to insert the new node.

3.3 3.3 Deleting a Node From a Layer

To delete a node from a layer place the mouse cursor over the node you would like to delete and press the *'d'* key to delete the new node.

3.4 3.4 Pinching nodes

To pinch a node onto a node of another layer: Press the *p* key to activate pinch mode. Now left click to select the node you wish to pinch to another layer, then select the layer which you would like to pinch to for editing and then click on the node to pinch to.

Alternatively, multiple nodes can be pinched or depinched simultaneously to either the layer above or layer below (as defined in the layer order list) by selecting *'pinch layer'* in the Menubar. A distance range over which to pinch/depinch nodes is then required.

CHAPTER

FOUR

4.0 LAYER ATTRIBUTES

4.1 4.1 Density

In FaT-FM gravity modelling is achieved using *density contrasts* relative to a *reference density* model see XX for details related to choosing a reference model.

Each layer requires:

- 1. An absolute bulk density
- 2. A reference density

All densities must be supplied using units kg/m^3.

These are input using the attribute side bar or within the *Attribute table*.

This enables gravity anomalies relative to say an upper crust of 2670 kg/m^3, lower crust 2900 kg/m^3 and upper mantle of 3330 kg/m^3.

For each layer both the bulk absolute density and the reference density must be set. For example:

To model a sedimentary unit it may have a density set as 2300 kg/m^3 and reference crustal density of 2670 kg/m^3.

To model crustal thickened from a reference crustal thickness of 32 km to 36 km, a lower crustal density of 2800 kg/m^3 maybe be modelled against a upper most mantle reference density of 3330 kg/m^3.

Tip: To set all layer reference densities as a single value (e.g. when only modelling upper crustal structure)

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use the *gravity Field -> Set background density* tool.

4.2 4.2 Magnetic Susceptibility

Susceptibility must be input using SI units.

A '*strike*' must also be assigned for each unit.

Important: *Strike* is the angle (in degrees) that the strike of the unit in map view makes with respect to magnetic north (the angle is positive when measured counterclockwise) See Won and Bevis (1987) for a diagram and further details. The strike of the unit is assumed to be orthogonal to the model transect (striking into and out of the screen).

For example:

If the model is orientated West-East and magnetic north is -22 deg the strike of the unit is -22 deg.

If the model was orientated North-South the angle would be 68 deg.

4.3 4.3 Remenant Magnetism

CHAPTER

FIVE

5.0 SEGY DATA

5.1 5.1 Loading SEGY data

To load observed SEGY data select the *'SEGY'* menu in the Menubar and select either *'Load observed Gravity anomaly'* or *'Load observed Magnetic anomaly'*. Next Navigate to the file you want to load and select it. The file will automatically be loaded into the canvas.

Note: SEGY data is loaded using the obspy.SEGY.core routine. This requires that all time/date SEGY headers have values, so these may need to be set using seismic processing software or obspy if they are not present in your data.

The SEGY file will be plotted as a pyplot image.

CHAPTER

SIX

6.0 WELL DATA

6.1 6.1 Loading well data

To load observed Well horizons select the *Well* menu in the Menubar and select *Load..*.*. Or select the load well icon. Navigate to the file you wish to load.

Note: These files should be ASCII text files formatted as shown in the *example1.well* well file.

Once well horizons are loaded into your model, you can increase and decrease the label text size using the slider in the left hand menu. Each well can be hidden/shown by selecting the well name under *Well...* in the *Wells* menu.

CHAPTER

SEVEN

7.0 GEOLOGIC DATA

7.1 7.1 Loading geologic data

CHAPTER

EIGHT

KEYBOARD SHORTCUTS

i Insert Node

d Delete Node

p Pinch Node Left click to select the node to pinch, then change layer and click the node to pinch onto.

> Next Layer

< Previous Layer

z Zoom

a Show All (1:1 aspect of model)

shift Pan

CHAPTER

NINE

ICON SHORTCUTS

 Save model		 Load model
 Compute gravity anomaly		 Compute magnetic anomaly
 Capture Coordinates		Start fault picking
 Increase aspect		 Decrease aspect
 Increase aspect x2		 Decrease aspect x2
 Zoom in		 Zoom out
 Full extent		|fig14|Pan
Segy gain up		Segy gain down
Transparency increase		Transparency decrease
 Load well data		**|fig20|**

Part IX

Tutorial

Part X

References

Fatiando a Terra

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Icons

Icons designed using: https://freeiconmaker.com/

Part XI

Licencing

CHAPTER

TEN

FAT-FM LICENCE

CHAPTER

ELEVEN

FATIANDO A TERRA LICENCE

Version: Beta-0.1

Urgent bugs:

- 101: New node positions get tangled when there are many nodes in close proximity.

Please send comments, feature requests and report all bugs to: bookt@earth.ox.ac.uk