Genie documentation

Installation

Windows

Installation packages are available at https://geomop.nti.tul.cz/genie/packages/. Standard graphical instalator is available for Windows 10. To run the installation execute file genie_0.2.0_x86_64.exe and go through installation wizard. Individual tools are executable by their shortcuts or by batch files. Batch files are in default installation located in directory: c:\Users\UserName\AppData\Local\Genie\bin\.

Linux

build pygimli

```
curl -Ls install.pygimli.org | bash
```

For detailed description go to https://www.pygimli.org/compilation.html#sec-build. Add path to pygimli to PYTHONPATH.

download Meshlab Download Meshlab from https://github.com/cnr-isti-vclab/meshlab/releases/download/Meshlab-2020.02/MeshLab2020.02-linux.zip. We need exact version MeshLab-2020.02, due to script version which we use. Extract archive to some directory and add it to PATH.

clone project repository

```
git clone https://github.com/GeoMop/Genie.git
```

install python packages

```
pip install -r requirements.txt
```

Perform inversion

- from File menu choose New project
- enter project directory in dialog
- import xsl file
- import point cloud, region covered with points is shown with green color
- with Mesh cut tool sets area of interest
- on left bottom part check measurements, which will be used in inversion
- press Run inversion
- sets inversion parameters, parametrs are mostly taken from BERT/GIMLI
- press Start
- after successful inversion and closing Run inversion dialog, is shown tab Inversion 3D view with inversion results, in which is possible browse slices of 3D space

Inversion mesh options

Mesh from - Defines how it is created inversion mesh. “Gallery cloud” means that gallery mesh is created from imported point cloud and that mesh is subtracted from area of interest. “Surface cloud” means that surface is created from imported point cloud, this surface is cut and complete to form defined by area of interest. “Gallery mesh” means that imported gallery mesh is used instead point cloud. **Reconstruction depth** - In case that previous option is “Gallery cloud”, define how much details will be reconstructed from point cloud. Bigger value means more details. This value is integer from 4 to 10. **Edge length** - Reconstructed mesh is remeshed with this target edge length.

Electrode options

Snap distance - Electrodes are snapped to gallery surface, this parameter determine maximal snap distance.

Inversion parameters

Min resistivity, Max resistivity - Minimal resp. maximal value of resistivity allowed in model. **Lambda** - Float, global regularization parameter. Higher values leads to smoother result, lower values to overfitting. Default value is 20. **Optimize lambda** - If true lambda will be optimized by Lcurve. **Robust data** - Boolean, if set to 1, the L1 minimization scheme is used. Can be benefitial in the case of significant outliers in the data, but not used by defalut as it may cause deteriorated resolution. Default value 0 use L2 scheme assuming Gaussian error of the input data. **Z weight** Float, anisotropic regularization parameter. Default value 1 prescribes an isometric regularization. For the values less then 1 the regularization in the vertical direction (Z-axis) is diminished, which can lead to better result for verticaly layered geological structures. **Blocky model** Boolean, L1 minimization scheme for the regulaization term. Allow non-smooth transitions in the resistivity. **Constrant type** (? is it supported in PyGimli) 0,1,2 (1 is default), order of derivative used in the regularization term. TBD see PyGimli tutorial **Max iter** - maximal number of iterations **Data log** - Use logarithmic transformation in data.

Based on parameters of the inversion of the PyGimply library and on the related SW Bert Chapter 2.2.

Output options

p3d step - Inversion result is also saved in p3d format suitable for software Voxler. This parameter defines step between individual points.

Mesh cut tool

Mesh cut tool sets area of interest, either in text edits or using red shape on right side, position of shape in 3D space must be that, gallery cut was on shape faces, not on edges. Button "+" move origin point to center of area defined by points cloud, electrode positions and map. Button "L" sets gen vector perpendicular to other vector.

Analyse measurement

Analyse measurement dialog is activated by double clicking on measurement in left bottom part, it shows data from measurements files. Columns ca, cb, pa, pb, I, V, std, AppRes are from measurement files. **AppResGimli** is apparent resistivity computed from input values using Gimli geometric factor function, which use full 3d space not half space and use elecrode positions from input xls file, that apparent resistivity values are different. Lines not suitable for computation are marked with red color, this lines are not use in computation, they do not need to be deleted from the files.

Map file

It is posible to import a map. From file menu choose "Import map...". After image file is selected, dialog for map calibration is appeared. Move blue and red cross to two points with known positions and type this positions to edit box below, then click on import.

Import gallery mesh

Gallery mesh generated from point cloud can be replaced by own mesh. Mesh must be in .msh format. From file menu choose "Import gallery mesh...". Mesh is shown in blue color. In "Run inversion" dialog set parameter "meshFrom" to "Gallery mesh".

Surface from point cloud

Inversion mesh can be defined by point cloud on some surface. Other mesh faces are defined by Mesh cut tool area of interest. Area of interest must be positioned inside region defined by point cloud. From file menu choose "Import point cloud...". In "Run inversion" dialog set parameter "meshFrom" to "Surface cloud".

Measurements on model panel

After successful inversion is shown tab "Measurements on model" in which are displayed apparent resistivity on model obtained by inversion. Columns meas_number, ca, cb, pa, pb, I, V, AppRes, std are from measurement files.

AppResGimli is apparent resistivity computed from input values. **AppResModel** is apparent resistivity on model.

Tips

- cut of point cloud is time consuming operation, if we want to work with smaller area, after first inversion computation is possible to import to project file inversions/inversion_name/point_cloud_cut.xyz, which contains cut point cloud
- in installation are included softwares Meshlab and Gmsh, which can be used for showing and editing of point clouds and meshes

Description of files in inversion directory

- inv.conf - configuration of inversin
- point_cloud_cut.xyz - cut point cloud
- gallery_mesh.ply, gallery_mesh.msh - gallery mesh
- inv_mesh.msh - mesh for own inversion
- input.dat - file with electrode positions and list of individual measurements
- input_snapped.dat - like previous, but electrodes are snapped to gallery mesh
- resistivity.vtk - result of inversion .vtk file
- resistivity.vector - rezistivity vektor on individual elements
- resistivity.p3d - result in p3d format
- resistivity.q - second file of p3d format

Known issues

- dialog PointCloudReader is irresponsive until reading ends
- some measuremens have to small current, it may cause inaccuracy in computation, currently this is not solved in any way

Genie ST

Application Genie ST is similar to Genie RT. There is a “First arrival editor” dialog instead of “Analyse measurement”, in which are displayed signal waveforms from individual measurement files. It is possible to set actual first arrivals by blue vertical lines. Some receivers can be disabled by unchecking checkboxs in left column.