Fast Geological Modeling
Using Supervised Machine Learning

Fast modeling in GeoScene3D

Building a geological model within a short timeframe can be essential. GeoScene3D is a geological modeling software that allows users to build geological models from EM and borehole data in a fast way, using the intuitive machine learning (ML) method Smart Interpretation (SI).

Be time efficient with Machine Learning

Common practices for geological modeling are built upon a manual cognitive approach. Time spent will be relatively large. ML approaches can improve time efficiency while not necessarily compromising the concluding modeling results. GeoScene3D offers such an alternative.

The SI method is build on a supervised regression ML algorithm that can predict geological layer boundaries based on EM data and a few input points. By that, the method allows to use the geological expert knowledge as input. The SI will, based on these inputs, learn how to output, and predict geological layer boundaries for the full model. With the SI's intuitive semi-automated approach, keeping knowledge and data at the center, it's an obvious alternative to the manual approach, saving many hours of work while maintaining model quality.

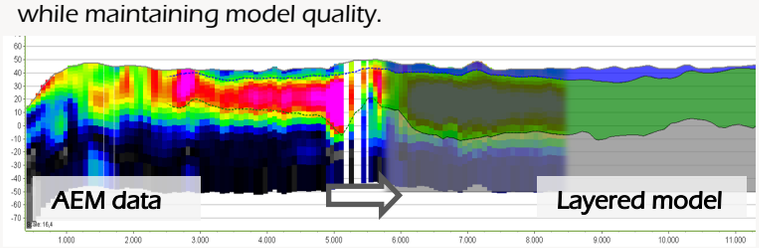

Figure 1: From SI to geological model.

Geological modeling

Geological modeling involves manual workflows with a gradual and slow progression. Conclusions are often based on a highly informed basis involving user experience and knowledge, and can lead to very detailed models involving many different data types, but the workflow has been tedious and time-consuming.

Fully automated modeling can be achieved by combining the SI approach with the "Locate Layer" tool in GeoScene3D.

Smart Interpretation Workflow

1. Import data (EM data and optionally borehole data)
2. Train the SI based on an iterative and intuitive workflow using 2D cross sections. Optionally, use borehole data as input using the "Locate Layer" tool
3. Apply training to predict the full EM data extent

The predicted geological model, for the full area, can be used as such, but GeoScene3D also allows inspection and adjustments of the predicted model.

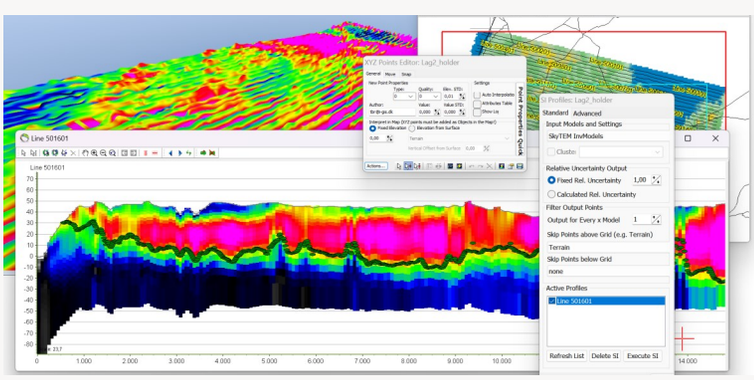

Figure 2: The intuitive UI used for the SI Workflow.

Info box: GeoScene3D

GeoScene3D is a geological modelling software that has its essential modelling efforts based on a manual cognitive approach. This comes with a lot of advantages such as an optimized data usage across multiple data formats and enabling geological expert knowledge to be incorporated into a fine and detailed model.

Using GeoScene3D the user has access to different modeling tools structured in a simple user interface.

Combine SI with other GeoScene3D tools

Smart interpretation (SI) can advantageously be combined with other tools available within GeoScene3D - for fully automated and unbiased modelling (Locate Layer), optimized use of the SI ML algorithm (Clustering) or as a quick preprocessor to create 3D voxel models (Voxel modeling).

Locate Layer

When quality borehole information is available the Locate Layer tool is an obvious choice. It allows to search out specific lithologies and automatically mark their positions in space by points. The points can be used directly by the SI as training. The SI will, based on these points, predict the layer boundaries. The method is fully automated and the results has no direct involvement from the modeler. This also demonstrates an approach for fully unbiased modeling. The results can be inspected and adjusted, if need be.

Clustering

As Smart Interpretation is a ML tool it assumes, by design, that your learning and predictions are done in geologically similar settings. This is however not always the case, where the nature and complexity of the geology might change throughout a geophysical survey. To meet this challenge, GeoScene3D allows combining the SI algorithm with an unsupervised ML approach called clustering.

The clustering algorithm will group 1D geophysical soundings into groups, where all models within a group are more alike than the neighboring group. The SI algorithm can use the clusters as a preprocessor to reduce complexity in the data, and to ensure that the learning and predictions are done in geologically similar settings. The clustering approach itself is also a very relevant procedure to identify general patterns in EM data, possibly allowing the modeler to get an initial impression of EM variabilities and geological structural characteristics/changes.

Other automated modeling approaches

GeoScene3D also allows for other automated modeling approaches. Multiple Point Statistics are available for statistical modeling—please see separate folder.

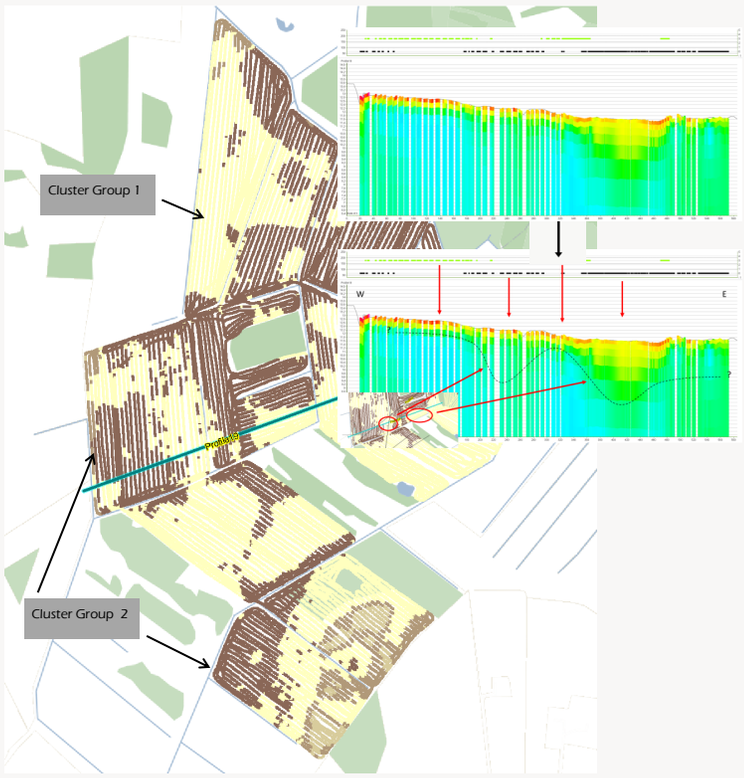

Figure 3: Unsupervised Clustering of EM data. Map shows how the clustering method have grouped the EM data into two groups . Green line is the profile location.

Voxel modeling

Creating a fast geological model using the semi-automated SI, will result in a model based on a layered modeling approach. The resulting surfaces, can easily be converted/transformed into a voxel model. With only a few hours of work the modeler would be able to create a full 3D voxel model based on EM data and optionally borehole data.

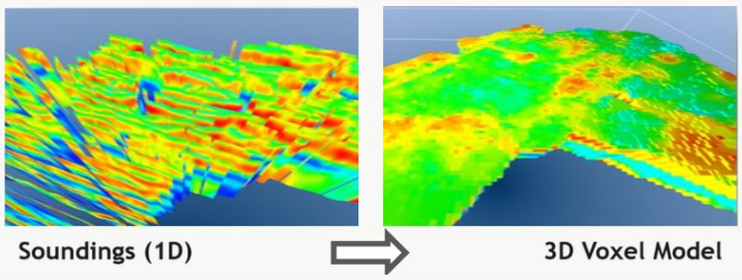

Figure 4: Creating a Voxel model using the SI workflow.

WANT TO KNOW MORE?

We are here to help you! Find our useful online tutorials and information about GeoScene3D on our homepage or on Vimeo: www.vimeo.com/geoscene3d