

Inggeo-Tool, a web application for 3D-model based automated tunnel profile generation

Yvo Weidmann¹, Paul Gabriel², Dirk Arndt³, Marco Filipponi³

¹ GEOIDEE, Bellariastrasse 80, CH-8038 Zürich (yvo.weidmann@geoidee.ch)

² GiGa infosystems GmbH, Frauensteiner Strasse 59, D-09599 Freiberg (paul.gabriel@giga-infosystems.com)

³ Nagra - Nationale Genossenschaft für die Lagerung radioaktiver Abfälle, Hardstrasse 73, CH-5430 Wettingen

Automated extraction of complex geological information is required to provide the basics for investigations of tunnel designs for deep geological repositories. The Swiss National Cooperative for the Disposal of Radioactive Waste (Nagra) is responsible to identify the location for and construct a deep geological repository. Over the last years, Nagra has been conducting exploration campaigns with deep boreholes and 3D geophysical surveying to gather geological data for its planning purposes. The resulting information is compiled into 3D models.

The Engineering geological model consists of multiple units represented by tetrahedral objects and engineering geology key parameters. Both, geometry, and parameters are stored in a GST (Geosciences in Space and Time) database.

Variant studies of tunnel axis for planning engineering work require the extraction of specific geological information from the 3D model. In Switzerland, SIA-199 standard regulates the basics describing geological, hydrogeological, and geotechnical situations regarding the planning, implementation, and use of underground constructions. The standard stipulates the terms and unifies the presentation and contents of technical drawings and reports.

The aim of this project was to develop an automated tool for generating tunnel profiles consistent with SIA-199 standard allowing for efficient scenario analysis of projected tunnels and shafts.

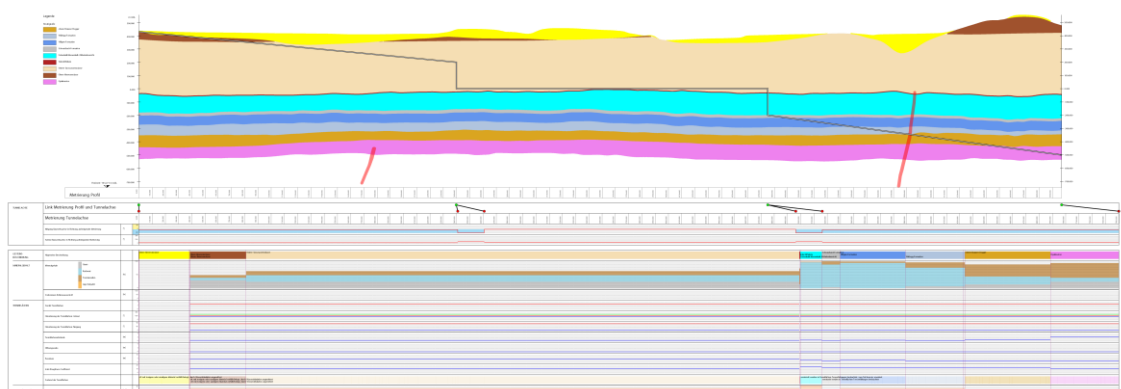


Figure 1. Subset of the automatically generated tunnel profile and extracted thematic attributes

The Inggeo-Tool is designed to retrieve information from the Engineering geological model for any user-defined tunnel axis from a provided file in ifc or GOCAD ASCII format. The tunnel designs may also include ramps and shafts. The tunnel axis is intersected with the model and the results unwrapped for graphical display. In the process of the intersection both the geological units as well as any number of attributes stored in the model will be retrieved. Model outputs include a datafile containing the entire dataset retrieved from the intersection process as well as a graphical presentation ready for print. Attributes are being extracted at a resolution corresponding to the resolution of the underlying 3D model.

The core of the Inggeo-Tool is facilitating machine-to-machine interaction. A set of rules has been elaborated for analysing and displaying any type of attributes stored in the 3D model. The Inggeo-Tool is set up as a webservice. A standard application of the Inggeo-Tool is available through a web interface. This one-click solution is ready for use after quality check by an engineering geologist. The Inggeo-Tool may also be used as a standalone webservice allowing individual script-based definition of data query and analysis. The advantage of a web based solution is simplicity of access to the Inggeo-Tool. No installation is necessary, and the Inggeo-Tool is always available to its user in its most updated version.

The Inggeo-Tool outputs are the results of an interdisciplinary approach to report geological conditions in terms of geometry, content and representation as defined by the SIA-199 standard. The graphical presentation meets the requirements concerning intelligible visual display, as needed by a wider circle of users including designers, planners and construction companies. Its strength is facilitating fast production of basic information needed when investigating alternative tunnel designs in underground construction. Inggeo-Tool outputs are generic products and cannot provide for the details of manually elaborated tunnel profiles. However, they adhere fully to terms and definitions as described by SIA-199 standard and contribute highly to everyday workflows due to their high availability. Output formats include pdf and webfriendly svg graphics. Configuration of outputs using templates is not only flexible but also straightforward.

It can be concluded that the Inggeo-Tool meets performance requirements when integrating construction designs for underground construction with complex geological 3D information. It is capable of displaying complex tunnel structures including combinations of ramps, shafts and tunnels. Additionally, the tool has been especially useful when running consistency checks of geological 3D models. The Inggeo-Tool is open to additional applications using the powerful 3D tetrahedral datastructure with any number of attributes which may be accessed using its interface. Thus, the tool is being used for data acquisition in the frame of the planning for a deep geological repository of radioactive waste, especially in the current planning phase of the engineering work.

REFERENCES

SIA. (2015). SIA 199: Erfassen des Gebirges im Untertagebau