Alignment of 2D geologic maps for 3D digital terrain modeling

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Three dimensional modeling of geological objects is fundamental to have a better understanding of their architecture and temporal evolution as well as the spatial distribution of related resources and/or issues (natural risks...). It is mainly based on classical geologic maps or cross-sections which depict geologists’ interpretations of a landscape, as is shown in the above figure. Indeed, through a rich set of symbols, 2D geologic maps are able to convey the 3D configuration and shape of geological structures by indicating, for instance, strikes and inclination of dipping rock layers. With practice, a geologist can picture how rocks are arranged in 3D beneath the surface and how they had been before erosion. Nowadays, the challenge is to combine or even synchronize the hand-made drawing of geologists including their professional interpretations with tools of 3D cartography and geo-modelers in an automatic and robust way.

This internship will be focused on the first crucial step of this process, called image alignment, allowing the optimal matching between experts drawing and corresponding landscape pictures (see the above figure). Based on existing image alignment methods, the goal of the internship is to develop and apply such a method to different geological contexts.

The key idea would be to extract visible geological interfaces in the picture and assign them to geometric elements of the drawing. Given that such hand-made drawings are often imprecise and rough, the algorithm will make the best use of the position of the geologist with respect to the landscape, in order to compute a 3D depth field and to efficiently solve inconsistencies between interpreted drawing and the picture or the current state of the model.

The result of such a preliminary alignment can be optimized and refined further interactively, by returning in the field to acquire new data at strategic places and/or by adding geologist’s new interpretation or corrections.
The geological modeling algorithms that will be used are described in the following references and are implemented in the GeoModeller software:


In the framework of the internship they will be used through a C++ library with a python API.