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Storing and delivering numerical geological models on demand for everyday Earth Sciences applications

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3D Geological modelling is now a classical tool to better constrain geometries of complex geological systems and provide a continuous description of the subsurface out of sparse and indirect data. Therefore, results allow delivering and disseminating 3D geological information. Moreover, accurate geological models are increasingly needed as input to (multi)physics dynamic simulations in a wide range of applications: flow simulations, seismic waves propagation, subsurface resources exploration and exploitation… Since the early days of numerical geology, many methods have been developed and there exist several commercial solutions to build such geometrical models of geological systems. Yet, there is no clearly identified unified open and shared format allowing describing what should be such a "numerical geological model".

Based on that observation, we propose a pragmatic approach seeking operational solutions for our production needs at BRGM (French Geological Survey). BRGM develops and uses two geomodelling tools which rely on two different methods: *GDM Multilayer* [1][2] and *3DGeoModeller* [3]. On the one hand, *GDM Multilayer* is based on an explicit description of geological surfaces with vertical faults. It can handle a large amount of well data and is well suited to model "basin type geology". On the other hand, *3D GeoModeller* has been one of the first geomodelling software to use orientation data in implicit surfaces to describe subsurface geology in complex structural systems [4][5].

Geological models need to be discretized to enter the production workflow. 3D meshes enriched with topological and geological information are built from lower dimensional objects - points, contact lines, surfaces - with their respective connections, geological regions… A possible option to generate these meshes is to use this additional solid modelling information as a starting point and provide both the mesh and the model (*e.g.* [6]). Here, we propose to distinguish the storage of the model from the representation of the model. In our approach, models are stored using the native format of the tool used to generate with (software project files). This choice guarantees that there is neither loss of data nor loss of precision. Then, meshes are generated on demand, depending on representation purposes. This strategy requires that each tool has to implement a common interface. This abstract interface relies on the implicit domain description used in the CGAL library [7]. These algorithms can mesh and construct the topological information associated with an implicitly described domain using only two predicates related to (1) the domain that any point lie in and (2) the contact that an arbitrary ray might intersect. Hence, answering only these two *questions* allow retrieving all the topological information automatically from the model and to generate informed mesh at an arbitrary precision. Most of the interface has been designed independently from geomodelling softwares. It requires that geomodelling tools implement only the two aforementioned predicates. Then, common services have been designed and developed based on this interface to generate different model representations (voxels, unstructured meshes…).

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