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Multi-source three-dimension geological complex structural modelling

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Three dimensional geological structural modelling encounters a bottleneck in recent years [1, 2]. Although several modelling methods [3-5] are proposed and even prototype systems are developed, the data problem still exists. Modelling methods with high precision and automation are strict with raw data, compared with some methods that can deal with sparse data while needing much human interaction. It makes the availability of the geological modelling difficult to break through. In most geology research areas, because of the shortcomings associated with data collecting, the geological data is sparse for geological modelling. To study the modelling methods for sparse geological data is therefore necessary. This paper presents a modelling approach for sparse data, called multi-source 3D geological complex structural modelling, which completes the automated modelling process for sparse data through the steps of data management, geological interpretation and model building.

Data management includes geological data integration and geological conceptual modelling. Geological field data needs to be transformed to geometry information of point, line and surface by geological data integration methods. Some scholars have put forward corresponding theoretical methods on this issue. However, the sparse messy data for modelling after integration often loses geological information and has uncertainty. These data needs to be classified and the geological information such as geological concepts and geological topological relationships need to be managed and stored in data management. This process, named geological conceptual modelling, classifies data, manages geological information and can provide more information for geological modelling.

Geological interpretation is the regeneration of data for geological modelling by combining multi-source data and geological concepts. Although data management process integrates multi-source data and stores geological information, the data that can be used for geological modelling is not enough most of time, so that geological interpretation is necessary in 3D geological structural modelling. According to the geometry information, the interpretation generates new data from geological information to describe the geological concepts that are stored by data management, such as pitch, fault throw and fault attitude. This process makes an effective supplement for raw data.

Model building is only a geometric modelling process, when the raw data and the interpreted data are generated. This process includes fault modelling, horizon modelling and geological-body modelling. Many scholars have studied this issue and constructed some corresponding models. We mainly describe the application of geological conceptual modelling which can automatically complete the entire modelling process with the raw data and the interpreted data in the whole process, then discuss the automatic updating of model.

This paper proposes a geological modelling method to solve the sparse data problem. Based on the method proposed in this paper, a prototype system is developed and is used in some practical applications.

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