3D MODELLING OF GEOID, GRAVITY AND GRAVITY GRADIENTS USING GIS-FUNCTIONS

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Three-dimensional (3-D) interactive modelling permits integrated processing and interpretation of potential data, yielding an improved geologic interpretation. Generally 3-D models are constructed by polyhedra of suitable geometry and constant density and/or induced and remanent susceptibility.

In general it is to be assumed, that the interpretation of gravity or magnetic anomalies is based on determining plausible shapes, positions, and physical parameters for the geologic structures which cause that field. This problem of data inversion in its broadest sense requires conversion of the information which has been obtained by measurements into geologic models. Basically, an indirect modelling process is the calculation of the effect of elementary bodies which approximate the geological situation in the investigated area, followed by matching the model curve with the observed curve by trial and error or graphic-interactive tools.

Rather than the actual mathematical formula of a polyhedron's gravity and magnetic field, the organization of the data structure behind the program, the interactive control of model matching and the integration of constraining additional data are major parts of the software.

This paper describes the application of computer graphics to geophysical interpretation problems in connection with three-dimensional modelling of potential field data. Interactive modification of model parameters, e.g. geometry, density and susceptibility, access to the numerical modelling process and direct visualization of both, calculated and measured fields of gravity and magnetics. This enables the interpreter to design the model as realistic as possible. 'Trial and error' methods became more and more important because of the fast development of computer hardware. In this context, a 'realistic' model means, that inconsistencies of existing information have been restricted to a minimum. A basic requirement for modelling is the existence of ideas and hypothesis on the investigated area, i.e. the availability of quantitative or qualitative boundary conditions (constraints). Towards this end, geophysical modelling aims in the combination and compilation of (all) existing information. The lack of information, which always exist, has to be filled by inter- or extrapolation, and contradictions of different data sources have to be clearly identified, e.g. by means of statistical methods.

The outlined procedure applied to complex interpretation tools requires a synoptical visualization of the necessary boundary conditions, which have to be selected and activated by the user. Modern GeoInformationSystems (GIS) handle this task. Today these systems are based frequently on relational data banks, and will be replaced by object orientated systems (OOS) in the near future. The advantage of OOS is an increasing effectivity, because of direct access to data and information by the definition of 'geo-objects'.