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Computation of the gravity field and its gradient: Some applications

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Abstract:

New measuring instruments of Earth's gravity gradient tensors (GGT) have offered a fresh impetus to gravimetry and its application in subsurface exploration. Several efforts have been made to provide a thorough understanding of the complex properties of the gravity gradient tensor and its mathematical formulations to compute GGT. However, there is not much open source software available. Understanding of the tensor properties leads to important guidelines in the development of real three dimensional geological models. We present a MATLAB computational algorithm to calculate the gravity field and full gravity gradient tensor for an undulated surface followed by regular geometries like an infinite horizontal slab, a vertical sheet, a solid sphere, a vertical cylinder, a normal fault model and a rectangular lamina or conglomerations of such bodies and the results are compared with responses using professional software based on different computational schemes. Real subsurface geometries of complex geological structures of interest are approximated through arrangements of vertical rectangular laminas. The geological application of this algorithm is demonstrated over a horst-type structure of Oklahoma Aulacogen, USA and Vredefort Dome, South Africa, where measured GGT data are available

Key Words: Gravity, Gravity gradient, MATLAB, Rectangular body, Airborne gravity gradiometry