عنوان مقاله:

Solving ۲-D gravity inversion problems using a PDE model in geophysics exploration

محل انتشار:

مجله بین المللی معدن و مهندسی زمین, دوره 56, شماره 3 (سال: 1401)

تعداد صفحات اصل مقاله: 5

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خلاصه مقاله:

Inverse modeling is one of the useful solutions to create a logical model with relationships between observed and measured values. In geophysical and subsurface investigations such as cavities or mineral explorations, solving inverse problems using problem physics in a partial differential equation (PDE) system is very important. In this research, COMSOL multiphysics' optimization interface, combined with a PDE or physics interface, was used to solve inverse-modeling problems. Also, a framework is presented to solve undetermined inverse problems using COMSOL multiphysics' optimization. COMSOL multiphysics does not include a gravity calculation module. However, since Poisson's equation governs gravity and electrostatics, a gravity model can be created in the electrostatics module by changing the electrical permittivity value. We present a general adjoint state formulation that may be used in this framework and allows for faster calculation of sensitivity matrices in a variety of commonly encountered underdetermined problems. First of all, ۲D inversion of gravity data has been run and validated in COMSOL multiphysics software using one synthetic model and synthetic data in a forward modeling process. Afterward, using real gravity data surveyed along a cross-section of the sinkholes in the NW of Abarkuh, the lateral structure and subsurface cavities were estimated. The inverted gravitational acceleration values, then cross-correlated with observed gravity data and available surface pieces of evidence such as sinkholes and circular structures. The results indicated that our COMSOL-based routines for the solution of PDE-based inverse problems using adjoint states, while high in computational speed, can be used in modeling a wide range of physical systems governed by the partial differential equation laws and also can accurately discriminate between low-density contrast regions and background.

کلمات کلیدی:

۲D Gravity inversion, Geophysics, Comsol Multiphysics, adjoint operator, sinkhole