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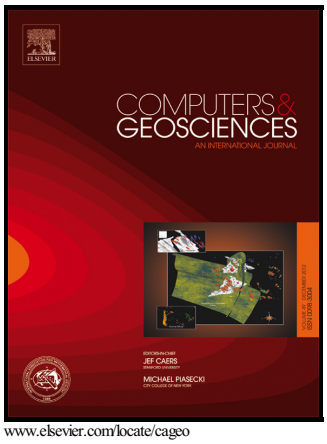

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Two Interacting Ellipsoidal Inhomogeneities: Applications in Geoscience

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Abstract

We developed a method and presented it as a *Mathematica* code to calculate the stress and strain fields inside and outside of two interacting ellipsoidal inhomogeneities with arbitrary orientation with respect to each other, using the Eshelby technique. The Eshelby technique can be used to determine the elastic fields in and around these inhomogeneities. Assuming same material properties for one of the inclusions and the surrounding matrix, this code can be also used for the single inhomogeneity problem. Different geological features like faults and aquifers can be modeled as inhomogeneous inclusions.

We start by reviewing Eshelby's solution for a single inclusion, a single inhomogeneity and double inhomogeneity problem with the required formulation to calculate Eshelby tensors. Then, we describe our code structure and validate it with existing solutions in the literature and present numerical solutions.

Keywords: Eshelby, Stress, Inclusion, Inhomogeneity, Source code, Interaction

1. Introduction

Determining the elastic fields inside and outside of inhomogeneities has many applications in the geoscience, material science, and biomechanics. In geomechanics, the stress distribution in and around reservoirs, aquifers, intrusions, fault zones, caverns, dikes, compaction bands, and underground structures has been calculated using the Eshelby technique (Rudnicki, 2011). These geological structures may have different material properties and different strain conditions (e.g. different pressure, temperature, or inelastic deformations) rather than that of their surroundings. Rudnicki (2002a,b); Walsh (2002); Soltanzadeh et al. (2007); Chen (2011); Soltanzadeh and Hawkes (2012); Bedayat and Dahi Taleghani (2013, 2014, 2015) are some examples of using Eshelby technique to calculate stress changes due to fluid injection or withdrawal. See Safari et al. (2013) for the discussion on the advantages and limitations of this method.

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