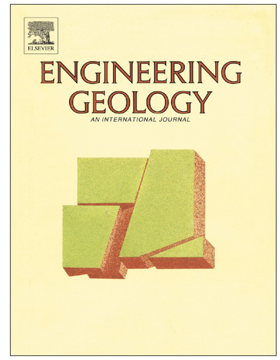

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A phase-field modeling approach of fracture propagation in poroelastic media

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Abstract

This paper proposes a phase field model for fracture in poroelastic media. The porous medium is modeled based on the classical Biot poroelasticity theory and the fracture behavior is controlled by the phase field model. Moreover, the fracture propagation is driven by the elastic energy where the phase field is used as an interpolation function to transit fluid property from the intact medium to the fully broken one. We use a segregated (staggered) scheme and implement our approach in Comsol Multiphysics. The proposed model is verified by a single-phase solid subjected to tension and a 2D specimen subjected to an increasing internal pressure. We also compare our results with analytical solutions. Finally, we show 2D and 3D examples of internal fluid injection to illustrate the capability of the proposed approach.

Keywords: Phase field, Hydraulic fractures, Poroelasticity, Comsol

1 Introduction

Fracture in poroelastic media is of major importance in mechanical, energy and environmental engineering [1, 2]. In particular, predicting fracture propagation during water injection is critical for hydraulic fracturing (fracking), an interesting technique used to extract petroleum and natural gas (e.g. shale gas). Fractures are created by fracking to connect wellbores with expected petroleum or gas. Thus, vast amounts of resources, which are inaccessible in previous