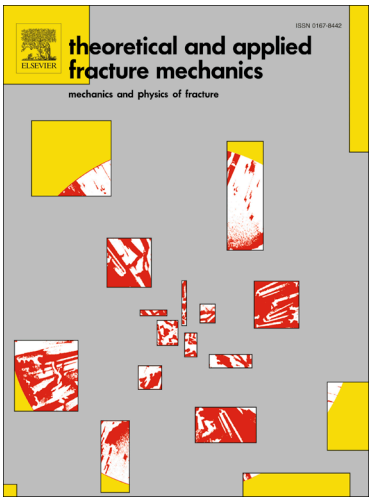

Finite element implementation of the coupled criterion for numerical simulations of crack initiation and propagation in brittle materials

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Highlighted version

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Abstract

The proposed numerical model for simulating two-dimensional cracking process in brittle materials is based on the coupled criterion (CC) which enters in the general framework of Finite Fracture Mechanics. It states that both the energy and stress conditions should be fulfilled to predict the crack creation in brittle solids. Special numerical approaches were developed in drawing correctly the potential crack paths and to minimize the potential energy with respect to all predicted crack paths. The originality of this work lies in the ability to describe both the initiation and the growth of one or more cracks. Moreover, statistical distributions of flaws can be accounted for. The efficiency and accuracy of the proposed approach were approved by means of several numerical examples for which the solutions are well-known or well-studied in the literature.

Keywords: Crack initiation, crack growth, multiple cracking, finite element analysis, brittle or quasi-brittle materials.

1. Introduction

Numerical prediction of fracture in solids is a classical challenge for mechanics and computational sciences. Developing efficient and accurate numerical models to simulate fracture behavior has been extensively studied in the last two decades. Even though numerous theoretical and numerical studies exist in the literature in predicting the crack growth, few numerical models are available to predict both the crack initiation and crack growth.