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Modeling dynamic fracture of solids with a phase-field regularized cohesive zone model

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Abstract

Being able to seamlessly deal with complex crack patterns like branching, merging and even fragmentation, the phase-field model, amongst several alternatives, is promising in the computational modeling of dynamic fracture in solids. This paper presents an extension of our recently introduced phase-field cohesive zone model for static fracture to dynamic fracture in brittle and quasi-brittle solids. The model performance is tested with several benchmarks for dynamic brittle and cohesive fracture. Good agreement is achieved with existing findings and experimental results; and particularly the results are independent to the discretization resolution and the incorporated length scale parameter. The latter is in contrast to existing phase-field models.

Keywords:
Phase-field model; cohesive zone model; dynamic fracture; damage; concrete.

Highlights:

- Dynamic fracture is modeled by a phase-field regularized cohesive zone model.
- Both brittle fracture and quasi-brittle failure under dynamic loadings are considered;
- The results are independent of the length scale parameter regularizing the sharp cracks;
- Numerical results are in good agreement with existing computational/experimental findings.

1. Introduction

Fracture is one of the most commonly encountered failure modes of engineering materials and structures. The prevention of fracture-induced failure is, therefore, a major concern in engineering designs. As with many other physical phenomena, computational modeling of the crack initiation and propagation in solids constitutes an indispensable tool not only to predict he failure of cracked structures but also to shed insights into the mechanism of the fracture processes of many materials such as concrete, rock, ceramic, metals, biological soft tissues etc. As mentioned in

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