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PROCEEDINGS

Oscillations of Rapid Fracture in Phase Field Modeling

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ABSTRACT

Instability in dynamic fracture suppresses crack velocity from reaching theoretical limit predicted by the classical linear elastic fracture mechanics (LEFM). In thin systems, crack can accelerate to near the theoretical limiting velocity without micro-branching instability. A dynamic oscillatory instability is observed at such extreme crack speed. This sinusoidal oscillation was further found to be governed by intrinsic nonlinear scale. Using a dynamic phase-field model (PFM) with no attenuation of wave speed, we successfully reproduce the oscillations in the framework of non-linear deformation. The used PFM model based on Griffith's theory and derived from the nonconservative Lagrange's equation. To deal with the large deformation rapid fractures, a distorted mesh removal scheme is also employed in numerical implementation. However, rapid fractures with oscillating crack path exhibit susceptibility to meshed grids. For correctly capture the oscillation characteristics, we test the oscillations in phase-field modeling with different mesh strategies. Three adaptive mesh strategies are considered in this work, which discretize the special domain with full triangular elements, full quadrilateral elements and hybrid elements. Besides, we also consider effects of the element mesh size and the refinement domain. Ascertaining the mesh requirements for rapid fracture instability is also necessary for adaptive mesh strategies, due to the high spatial resolution required for PFM.

KEYWORDS

Phase-field model; oscillations; rapid fracture; mesh strategy

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