Stability and error estimate of a cohesive zone model implemented using the augmented lagrangian method.

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ABSTRACT

Since the origins of cohesive zone model (CZM) proposed by Dugdale [1] and later by Bareblatt [2], the approach has been increasingly used and studied in computational mechanics community and several traction-separation criteria have been proposed to analyse damage in different kinds of materials. The classical way to implement those CZM is straightforward considering a fracture equilibrium term in the global solid equilibrium equation as an intrinsic behaviour. In recent years new approaches like enrichment-embedded kinematics, discontinuous Galerkin methods, isogeometric analysis, lagrange multipliers based formulations have been successfully used for quasi-static and dynamic fracture simulation.
A CZM implemented in an augmented lagrangian formulation based on the model proposed by Lorentz [3] is developed and analyzed in this paper. This method is able to deal with unilateral contact and cohesive forces via a supplementary variable that enforces the jump displacement in so-called collocation points. It represents a suitable tool to study the debonding phenomena in composites with strongly different stiffness, avoiding ill-conditioning problems associated with penalty methods. The model stability and an error estimation following Brezzi theorem [4] and Babuska lemma [5] are discussed. Some numerical examples that show ability of this approach to capture inclusions debonding are included in the paper.

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