Accepted Manuscript

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PII: S0045-7825(16)31649-8
DOI: http://dx.doi.org/10.1016/j.cma.2016.11.029
Reference: CMA 11239

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 1 October 2015
Revised date: 14 November 2016
Accepted date: 18 November 2016

Please cite this article as: X. Li, J. Chen, An extended cohesive damage model for simulating arbitrary damage propagation in engineering materials, *Comput. Methods Appl. Mech. Engrg.* (2016), http://dx.doi.org/10.1016/j.cma.2016.11.029

An extended cohesive damage model for simulating arbitrary damage propagation in engineering materials

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Abstract

This paper introduces the extended cohesive damage model (ECDM) for simulating arbitrary damage propagation in engineering materials. By embedding the micromechanical cohesive damage model (CDM) into the eXtended Finite Element Method (XFEM) and eliminating the enriched degree of freedoms (DoFs), the ECDM defines the cohesive crack path at a low scale in the condensed equilibrium equations and enables the local enrichments of approximation spaces without enriched DoFs. In this developed ECDM, a new equivalent damage scalar as a function of strain field is introduced to avoid the appearance of enriched DoFs, and to substitute the conventional characterization in the approximation of displacement jump. The embedment of CDM is no longer required by the ECDM, which allows discontinuities to exist within a finite element rather than the element boundaries. This feature enables the ECDM to simulate the reality of arbitrary cracks. Initial applications of the ECDM in simulation of arbitrary cracks shows that the developed ECDM works very well when compared to experiment work and XFEM analysis.

Keywords: Extended cohesive damage model; XFEM; CDM; Fracture; Arbitrary crack propagation

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