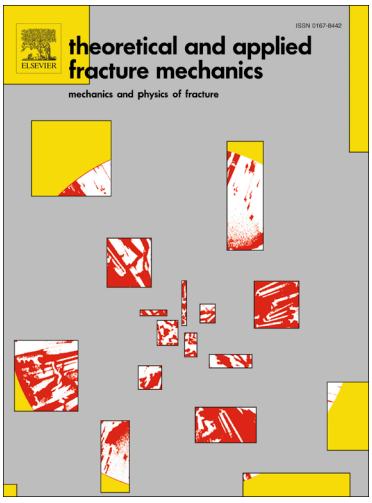

A review of the extended finite element method on macrocrack and microcrack growth simulations

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PII: S0167-8442(18)30293-3
DOI: https://doi.org/10.1016/j.tafmec.2018.08.008
Reference: TAFMEC 2087

To appear in: *Theoretical and Applied Fracture Mechanics*

Received Date: 20 June 2018
Accepted Date: 12 August 2018

Please cite this article as: H. Li, J. Li, H. Yuan, A review of the extended finite element method on macrocrack and microcrack growth simulations, *Theoretical and Applied Fracture Mechanics* (2018), doi: https://doi.org/10.1016/j.tafmec.2018.08.008

A review of the extended finite element method on macrocrack and microcrack growth simulations

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Abstract

During the latest 20 years, the extended finite element method (XFEM) has been gradually used to investigate the crack growth behaviors of different materials in combination with various mechanics models and became the most popular computational tool in analyzing crack problems. This paper classifies three typical theoretical frameworks of the XFEM, namely the linear elastic fracture mechanics, the cohesive zone model and the elastic-plastic fracture mechanics based XFEM. A review of brittle and ductile crack growth under both monotonic and cyclic loadings using the XFEM was given from both macro-scale and micro-scale after a systematic literature survey. In contrast, the framework of the XFEM for modeling brittle fracture is the most comprehensive and widely used theory, but the theory for the ductile crack growth has still to be developed. Additionally, the XFEM becomes more complicated in microcrack growth simulations than macrocrack by considering the effects of microstructures of materials. The XFEM can introduce an arbitrary discontinuity into the finite element and can be employed to analyze different crack growth problems in engineering materials and structures, this paper is served as a valuable reference for the future study in this field.

Keywords: Extended finite element method, Crack growth, Macrocrack and microcrack, Brittle and ductile crack, Fracture and fatigue

1. Introduction

The existence of cracks destroys the integrity of industrial components, which normally results in the serious fracture accidents. It is important to investigate the formation mechanism of cracks, such that the fracture-critical

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