

Accepted Manuscript

A multi-cracked particle method for complex fracture problems in 2D

Weilong Ai, Charles E. Augarde

PII: S0378-4754(18)30045-4

DOI: <https://doi.org/10.1016/j.matcom.2018.02.005>

Reference: MATCOM 4543

To appear in: *Mathematics and Computers in Simulation*

Received date: 21 October 2016

Revised date: 9 February 2018

Accepted date: 13 February 2018

Please cite this article as: W. Ai, C.E. Augarde, A multi-cracked particle method for complex fracture problems in 2D, *Math. Comput. Simulation* (2018), <https://doi.org/10.1016/j.matcom.2018.02.005>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



A multi-cracked particle method for complex fracture problems in 2D

Weilong Ai^{a,*}, Charles E. Augarde^a

^a*Department of Engineering, Durham University, South Road, Durham, DH1 3LE, UK*

Abstract

Practical fracture problems are characterised by complex patterns of multiple and branching cracks, somewhat far removed from the fracture problems used for validation of numerical methods, involving single cracks, and the simulation of complex multi-tipped cracks brings many challenges to current numerical methods. The cracking particle method (CPM) incorporates the description of a crack path into the meshless nodes or particles used to discretise a domain. The CPM has recently been improved to make the crack paths continuous and to include adaptivity. In this paper we take this improved CPM further and introduce new crack particles which can model multiple fractures to handle crack branches and crack junctions without the need for any specialised techniques such as enrichment. Some examples with complex crack patterns are tested to show the performance of the proposed methodology and good results are obtained which agree well with previous papers.

Keywords: Cracking particle method, meshless, multiple cracks, adaptivity

1. Introduction

Fracture is a common phenomenon affecting materials such as soil, bone and concrete, however theoretical work to study this problem is difficult to carry out since fracture is a highly non-linear behaviour. In recent decades, several numerical methods have been used for fracture simulation, such as the finite element method (FEM) [33, 46, 52], the extended FEM (XFEM) [6, 18], the element-free Galerkin method (EFGM) [9–11], the numerical manifold method (NMM) [27, 40, 48] and the cracking particle method (CPM) [35, 38, 39], and many good predictions have been obtained for standard test cases [8, 31]. However, there are limitations to the use of some of these numerical methods when applied to more complex examples. Specifically, in the FEM, a crack path is confined to mesh edges perhaps with the use of interface elements [46]. In the XFEM and the EFGM, an explicit description of the crack path is required, which is usually fulfilled using level set functions, and when the number of cracks increases, the expense of updating the level set functions becomes very high [17, 50]. In the NMM, the discontinuities along crack paths are handled by dividing the problem domain into “mathematical covers” and “physical covers”, but

*Corresponding author
Email address: weilong.ai@durham.ac.uk (Weilong Ai)

Download English Version:

<https://daneshyari.com/en/article/7543136>

Download Persian Version:

<https://daneshyari.com/article/7543136>

[Daneshyari.com](https://daneshyari.com)