Floating Node Method with Domain-based Interaction Integral for Generic 2D Crack Growths

Sachin Kumar, Yihe Wang, Leong Hien Poh, Boyang Chen

PII: S0167-8442(18)30150-2
DOI: https://doi.org/10.1016/j.tafmec.2018.06.013
Reference: TAFMEC 2067

To appear in: *Theoretical and Applied Fracture Mechanics*

Received Date: 1 April 2018
Revised Date: 25 May 2018
Accepted Date: 24 June 2018

Please cite this article as: S. Kumar, Y. Wang, L. Hien Poh, B. Chen, Floating Node Method with Domain-based Interaction Integral for Generic 2D Crack Growths, *Theoretical and Applied Fracture Mechanics* (2018), doi: https://doi.org/10.1016/j.tafmec.2018.06.013

Floating Node Method with Domain-based Interaction Integral for Generic 2D Crack Growths

Sachin Kumar[#,$], Yihe Wang[#], Leong Hien Poh[#,*], Boyang Chen[+]

[#]Department of Civil and Environmental Engineering,
National University of Singapore, Singapore
[$]Department of Mechanical Engineering,
Indian Institute of Technology Ropar, Punjab, India
[+]Faculty of Aerospace Engineering, Delft University of Technology, Netherlands
*Email: *leonghien@nus.edu.sg*

ABSTRACT

The Floating Node Method (FNM), first developed for modeling the fracture behavior of laminate composites, is here combined with a domain-based interaction integral approach for the generic fracture modelling of quasi-brittle materials from crack nucleation, propagation to final failure. In this framework, FNM is used to represent the kinematics of cracks, crack tips and material interfaces in the mesh. The values of stress intensity factor are obtained from the FNM solution using domain-based interaction integral approach. To demonstrate the accuracy and effectiveness of the proposed method, four benchmark examples of fracture mechanics are considered. Predictions obtained with the current numerical framework compare well against literature/theoretical results.

Keywords: Floating Node Method, Discontinuous crack modeling, Bi-material interfacial fracture, Mixed mode fracture, Stress intensity factors

1. INTRODUCTION

Fracture is one of the most important failure phenomena of structural components. A reliable and efficient modeling of the fracture process plays a vital role in the safety assessment of the structural components. In the last few decades, several methodologies have been proposed for the robust and accurate modeling of evolving discontinuities in the structural domains. The Finite Element Method (FEM) has been widely used as a numerical tool for damage and fracture mechanics problems. However, the modeling of crack evolution process can be difficult with standard FEM, as such problems require conformal meshes with respect to the locations of discontinuities. Thus, in FEM, remeshing is required for each step of crack propagation, which needs to transfer the history variables from the old mesh to the newly generated one. A more robust framework for the prediction of progressive failure is thus desirable. In the last two decades, many methods have been proposed in the literature, such as boundary elements method (Portela *et al.*, 1991), meshfree method (Belytschko *et al.*, 1994;