8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

ADAPTIVE DYNAMIC COHESIVE FRACTURE SIMULATION USING EDGE-SWAP AND NODE PERTURBATION OPERATORS

Kyoungsoo Park[1], Glaucio H. Paulino[2] and Waldemar Celes[3]

[1] University of Illinois at Urbana-Champaign
205N. Mathews Ave. Urbana, IL 61801, USA
kpark16@uiuc.edu

[2] University of Illinois at Urbana-Champaign
205N. Mathews Ave. Urbana, IL 61801, USA
paulino@uiuc.edu

[3] Pontifical Catholic University of Rio de Janeiro
Rua Marquês de São Vicente, 225 Gávea - Rio de Janeiro
22453-900, Brazil
celes@inf.puc-rio.br

Key Words: *Dynamic Fracture, Edge-Swap, Node Perturbation, CCS test.*

ABSTRACT

Mesh orientation dependence is a problem in simulation of cohesive zone models of fracture. For instance, in 4K structured meshes, crack lengths and angles are biased according to the mesh configuration. Furthermore, some nodes allow eight potential directions for crack propagation while others have only four directions. Then, computational errors can be accumulated or zigzag crack patterns may be observed. In this paper, we propose the use of node perturbation and edge-swap topological operation in order to eliminate the undesirable (zigzag) patterns and to alleviate mesh orientation dependence in 4K structured meshes. Mathematical and probabilistic arguments are used as proof-of-concept. For adaptive dynamic cohesive fracture simulations, the recently proposed topological data structure (TopS) [1], based on topological entities (node, element, vertex, edge and facet), is utilized so that it is possible to access adjacency information in time proportional to the number of retrieved entities [2]. In particular, the data structure allows the edge-swap operation to be done in constant time. The strip dynamic fracture test and the compact compression specimen (CCS) test of PMMA are investigated in conjunction with the edge-swap and node perturbation operators.

REFERENCES

[1] W. Celes, G.H. Paulino, R. Espinha R, "A compact adjacency-based topological data structure for finite element mesh representation," *Int. J. Numer. Methods Eng.* Vol. **64**, 1529-1556, (2005).

[2] G.H. Paulino, W. Celes, R. Espinha, and Z. Zhang, "A general topology-based framework for adaptive insertion of cohesive elements in finite element meshes," *Eng. Comput.* (in press).