3D Dynamic Crack Simulation with Extended Finite Element Method

Tengfei Lyu*, Stefan Löhnert† and Peter Wriggers*

* Institute of Continuum Mechanics
Leibniz University Hannover
Appelstr.11, 30167 Hannover, Germany
e-mail: lyu@ikm.uni-hannover.de, web page: https://www.ikm.uni-hannover.de

† Institute of Mechanics and Shell Structures
Technical University Dresden
August-Bebel-Str.30, 01219 Dresden, Germany
e-mail: stefan.loehnert@tu-dresden.de, web page:https://tu-dresden.de/bu/bauingenieurwesen/imf

ABSTRACT

The Extended finite element method (XFEM) is a special numerical method to handle arbitrary discontinuities in the displacement field independent of the finite element mesh. This is advantageous during crack initiation, growth and propagation processes. In the range of continuum damage mechanics, gradient-enhanced damage models [1] can be used to model damage and fracture without spurious mesh dependencies. Gradient-enhanced damage models have been investigated extensively in the context of quasi-brittle and elasto-plastic materials.

To avoid fracture and failure of metallic materials in industrial engineering, modelling the component under cyclical loading is significant for fatigue life-time prediction [2]. Fatigue damage increases in a cumulative manner, along with the number of applied loading/displacement cycles, resulting in crack formation and final failure of the component.

In this paper, a three-dimensional dynamic crack problem under cyclical loading is studied on a mesoscale. Finite deformation elastoplasticity is coupled with gradient-enhanced damage. The domain is discretized with 2nd-order ten-node tetrahedral elements. Discrete cracks are captured using the XFEM. The crack geometry is updated by level set methods. The focus of this contribution is set on algorithmic issues.

REFERENCES

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