Improved XFEM: algorithms, software and applications

Rong Tian, Longfei Wen

Software center for high performance numerical simulation, Institute of Applied Physics and Computational Mathematics, Beijing 100088, China

Abstract. The extended finite element method (XFEM) [1-3] is widely accepted in academy as the major technique for crack analysis. Starting from 2009, commercial codes started to use this technique for crack analysis, singling the mature and acceptance of the technique in industries. However, the direct extension of the singular tip enrichment of XFEM, the core of the method, to dynamic crack growth simulation has long been a difficulty due to: (a) elevated bad conditioning as crack propagating, (b) extra-dof dynamics and energy inconsistency, and (c) "null" critical time step size and optimal mass lumping at crack tip. Based on an extra-dof-free partition of unity enrichment technique [4], we have improved XFEM through a crack tip enrichment without extra dof [5][6], demonstrated whether the improved XFEM can be easily extended to dynamic problems [7], and investigated its performance in three dimensional crack growth simulation [8]. Numerical tests show that the new XFEM is not only straightforward in implementation in dynamic problems, also provides the most accurate *dynamic* SIF in the benchmark problems and is orders of magnitude faster with an iterative solver.

In this talk, we will present an overview of the new technique, including the details of algorithms, parallel code development [9], and several applications (as well as one of the conference's fracture benchmarks if our code works).

Keywords: XFEM, extra-dof free enrichment, dynamic crack growth, partition of unity

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