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Improvement of algorithm for numerical crack modelling

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For numerical simulation of crack modelling in fracture mechanics the eXtended finite element method (Xfem) has been recently accepted as a new powerful and efficiency methodology. In the paper we present the details of implementation of the Xfem algorithm in our in-house finite elements based software. Also, in this study, we investigated the impact of the node enrichment variations on results of the developed numerical procedure. In this study, objective was to examine the properties of standard Xfem algorithm without using of Near Tip enriching functions in order to create possibilities for future application Xfem in the zone of plasticity. In order to evaluate the computational accuracy, numerical results for the Stress Intensity Factors are compared with both theoretical and conventional finite element data. Obtained numerical results have shown a good agreement with the benchmark solutions. For calculation of the Stress Intensity Factors (SIF), we used the J-Equivalent Domain Integral (J-EDI) Method. Computational geometry issues, associated with the representation of the crack and the enrichment of the finite element approximation, are discussed in detail.

Keywords: *Xfem, node enrichment variations, SIF, J-EDI method*

1. Introduction

The extended finite element method, Xfem, attempts to alleviate the computational challenges associated with mesh generation by not requiring the finite element mesh to conform to cracks, and in addition, it provides using of higher-order elements or special finite elements without significant changes in the formulation. Basis of the method proposed by Belytchko and Black [1], were presented in [2] for the two-dimensional cracks.

The essence of the Xfem lies in sub-dividing a model problem into two distinct parts: mesh generation for the geometric domain (cracks not included), and enriching the finite element approximation by additional functions that model the flaw(s) and other geometric entities. Modelling crack growth in a traditional finite element framework is cumbersome due to need for the mesh to match the geometry of the discontinuity. Many methods require remeshing of the domain at each time step. In the Xfem there is no need for the remeshing, because the mesh is not changed as the crack grows and is completely independent of the location and geometry of the crack. The enriching