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COMPUTATIONAL INVESTIGATION OF FATIGUE CRACK PROPAGATION UNDER MIXED-MODE LOADING CONDITIONS USING EXTENDD FINITE ELEMENT METHODS

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ABSTRACT

Predicting mixed-mode fatigue crack propagation confronts difficulties in computational analysis. In the present paper an extended finite element method (XFEM) containing strong discontinuity within an element is introduced and implemented in the commercial general purpose software ABAQUS. The algorithm allows introducing a new crack surface at arbitrary locations and directions in a finite element mesh under cyclic loading conditions.

With the extended finite element method the crack initiation and propagation under mixed-mode loading conditions are studies in this work. Both cyclic and monotonic loading cases are considered and the results are compared with known experimental results. The XFEM combined cohesive zone models allows to predict crack initiation and propagation in arbitrary directions without remeshing. The cohesive zone model has been extended to simulate mixed-mode cyclic damage processes. Our computations based on modified boundary layer formulations confirm that the crack path is slightly curved even under strong mode II loading conditions. The maximum tensile stress criterion gives the best prediction of crack propagation in all possible mode mixities if one determines the crack kinking angle after a small amount of crack propagation. The known multi-axial fatigue criteria do not provide reasonable agreement with experimental records, as our computations confirm.