MULTIPLE CRACK GROWTH IN UNIT CELL WITH EXTENDED FINITE ELEMENT METHOD

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A method for multiple crack growth in a unit cell is presented to obtain the mechanical response of the cell. The cracks are grown until percolation. The method is based on crack length control and is applied to a brittle material. The cracks with the maximum stress intensity factors are grown and a load parameter is adjusted so that the stress intensity factors remain at the critical value. In the case of competitive crack tips, a stability analysis is performed by computing the second derivative of the potential energy for each crack. The load deflection behavior of the representative volume element is obtained until the point of complete failure. The discretization utilizes the extended finite element method with high order elements and does not require any remeshing as the cracks grow. The crack geometries are arbitrary with respect to the mesh, and are described by a vector level set. Multiple crack growth requires special treatment for the subelement integration and an increased number of blending elements. Special boundary conditions for crack interaction and touching have been developed and an algorithm to detect crack coalescence which allows the cracks to grow until percolation is also presented. This method is extended to nonlinear fracture mechanics using the R-curve approach . Although each crack is modelled by linear elastic fracture mechanics, the crack interaction, bridging and coalescence mechanics can exhibit features of a cohesive crack model.

References

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