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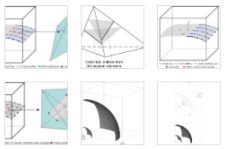

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A computational methodology for simulating quasi-brittle fracture problems

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Highlights

- A damage mechanics model is improved to predict the crack path.
- A local crack tracking algorithm is extended to three dimension.
- The concept of crack surface discretization is first suggested.
- Topological difficulties of local tracking is solved.
- The damage model is combined with the new tracking algorithm.

Abstract

The paper focuses on an efficient and simple methodologies for simulating the three dimensional (3D) quasi-brittle fracture problems. Strain-softening is performed on the elements by a developed anisotropic continuum damage model that has more effective capability in crack path prediction and is easily available in standard finite elements. In the present damage model, the damaged stiffness tensor is constructed to form a crack surface, and the energy dissipation in the damaged element is only allowed in the direction perpendicular to the crack plane. Crack surface is divided into crack lines and crack triangles based on the first introduced crack surface discretization, and the application scope of local tracking algorithm is extended from two dimension to 3D. The present tracking algorithm not only guarantees the continuity and stability of the predicted crack path by solving the topological problems but also has low computational cost, keeping the advantages of local tracking. The method does not identify the crack plane within each element, but it couples well with smeared crack method by identifying all the elements through which the crack surface passes. The high efficiency and stability of the present approach are verified by resolving several 3D benchmark problems in failure analysis.

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Keywords

Three-dimensional fracture; Crack tracking algorithm; Anisotropic damage; Crack surface discretization; Local tracking

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