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Application of Scaled Boundary Polygons to Finite Fracture Mechanics

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Finite fracture mechanics employs a hybrid failure criterion that considers both the stress field and the energy balance in the structure for the formation of new crack surfaces. This study develops an accurate and efficient procedure, based on the scaled boundary polygons, for finite fracture mechanics analysis. The stress and displacement fields are accurately modeled by the scaled boundary polygons through semi-analytical expressions that resemble asymptotic expansions around cracks, notches and material junctions. The energy release rate can be accurately and conveniently computed from the solutions of stresses and displacements via analytical integration. The scaled boundary polygons are also flexible to accommodate changes in the mesh required in the computations. Any change in the location of the crack is easily adapted by shifting the crack tip within the cracked polygon without changing the global mesh structure. The efficiency of the developed framework is demonstrated using two numerical examples.

Keywords: scaled boundary finite element method, scaled boundary polygons, finite fracture mechanics, energy release rate, stress singularity