Computing Convergent Stress Intensity Factors Along the Front of a Three-Dimensional Crack on Unstructured Meshes

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ABSTRACT

Robust calculation of the stress intensity factors along the front of a crack is an essential ingredient of computational fracture mechanics. The most popular approach to their calculation is through the use of an extraction integral, namely the J-integral[1] or the interaction integral[2].

In this work, we present a formulation of the interaction integral and a method to compute the mixed-mode stress intensity distribution along the front of a non-planar crack. By our choice of the auxiliary fields, we simplify boundary integrals to require problem data only; the displacement gradient appears solely in volumetric integrals.

When our interaction integral is applied to the true solution of the elasticity problem, we recover exactly a weighted integral of the stress intensity factors over the crack front. By introducing a mesh of the crack front and applying the interaction integral to a finite-element approximation of the true solution, we formulate a linear system which we may solve for the stress intensity distributions.

Through analysis we are able to define conditions under which our method is guaranteed to converge. We demonstrate the efficacy of our method on several examples.

REFERENCES

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