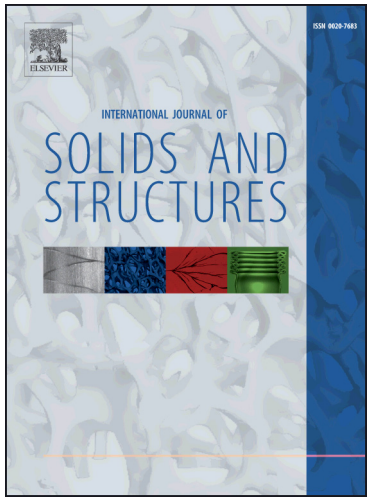

A disk-shaped domain integral method for the computation of stress intensity factors using tetrahedral meshes

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Abstract

A novel domain integral approach is introduced for the accurate computation of pointwise J-integral and stress intensity factors (SIFs) of 3D planar cracks using tetrahedral elements. This method is efficient and easy to implement, and does not require a structured mesh around the crack front. The method relies on the construction of virtual disk-shaped integral domains at points along the crack front, and the computation of domain integrals using a series of virtual triangular elements. The accuracy of the numerical results computed for through-the-thickness, penny-shaped, and elliptical crack configurations has been validated by using the available analytical formulations. The average error of computed SIFs remains below 1% for fine meshes, and $2-3$% for coarse ones. The results of an extensive parametric study suggest that there exists an optimum mesh-dependent domain radius at which the computed SIFs are the most accurate. Furthermore, the results provide evidence that tetrahedral elements are efficient, reliable and robust instruments for accurate linear elastic fracture mechanics calculations.

Keywords: stress intensity factor, finite element, tetrahedral, interaction integral, J-integral, unstructured mesh, 3D crack

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