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Dynamic crack analysis under thermal shock considering Lord–Shulman theory

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Abstract

A boundary element method using Laplace transform in time domain is developed for the analysis of fracture mechanics considering transient coupled thermoelasticity problems with relaxation time in two-dimensional finite domain. The dynamic thermoelastic model of Lord and Shulman are selected for showing finite thermal propagation speed. The Laplace transform method is applied to the time domain and the resulting equations in the transformed field are discretized using boundary element method. Actual physical quantities in time domain is obtained, using the numerical inversion of the Laplace transform method.

The singular behavior of the temperature and displacement fields in the vicinity of the crack tip is modeled by quarter-point elements. Thermal dynamic stress intensity factor for mode *I* is evaluated from computed

nodal values, using the well-known displacement and traction formulas. The accuracy of the method is investigated through comparison of the results with the available data in literature. Conditions where the inertia term plays an important role are discussed and variations of dynamic stress intensity factor are investigated. Different relaxation times are chosen for briefly showing the effects on stress intensity factor considering Lord and Shulman (LS) theory.

Keywords: Fracture mechanics; Lord–Shulman theory; boundary element; Laplace transform

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