APCOM & ISCM
11-14th December, 2013, Singapore

Dual-reciprocity boundary element method for axisymmetric thermoelastodynamic deformations in functionally graded solids

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Abstract

A dual-reciprocity boundary element method is outlined for solving a class of initial-boundary value problems concerning axisymmetric thermoelastodynamic deformations in functionally graded materials. The time derivatives of the temperature and the displacement, which appear in the governing partial differential equations, are suppressed by using the Laplace transformation technique. In the Laplace transform domain, the problem under consideration is formulated in terms of integral equations which contain both boundary integrals and domain integrals. The dual-reciprocity method is used together with suitably constructed interpolating functions to reduce the domain integrals approximately into boundary integrals. The problem under consideration is eventually reduced to linear algebraic equations which may be solved for the numerical values of the Laplace transforms of the temperature and the displacements at selected points in space. The temperature and the displacement in the physical time domain are approximately recovered by using a numerical method for inverting Laplace transforms. To check that the numerical procedure presented is valid, it is applied to solve a specific test problem which has a closed-form analytic solution.

Keywords: Boundary element method, Dual-reciprocity method, Laplace transformation, Axisymmetric thermoelasticity, functionally graded materials.