A new implementation of time domain boundary element method for 3D transient heat conduction problems

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Abstract

A direct time integration scheme is applied in the boundary element method (BEM) to solve transient heat conduction problems in 3D case. In this new implementation of BEM, the variation rate of the temperature along time is not approximated directly through the Lagrange interpolation method. The variation speed of temperature was treated as known variables in the corresponding boundary integral equation. The relation between the temperature and its variation speed was constructed by the Laplace transformation and its inverse form. Thus this method can be considered as a semi-discrete method. The direct time integration scheme avoids the numerical damping which usually appears in time-domain BEM implementations [1]. However, the computational scale in this method is twice of that in other implementations of BEM for transient heat conduction problem. The stability of the scheme had been proved by John T. Katsikadelis in [2]. The convergence order of this scheme is $O(\Delta t2)$. In our application, the domain integral which appears in the boundary integral equation is transformed into boundary integrals through a dual reciprocity method (DRM). In order to improve the stability of the DRM, the shape variable radial basis function (RBF) [3] is adopted as the interpolation function of the domain source. In the numerical examples, Comparisons between the new scheme and traditional schemes have been made to illustrate the advantages of the new scheme.

Keywords: boundary integral equation, time domain method, time integration scheme, dual reciprocity method, radial basis functions

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