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GENERAL BOUNDARY ELEMENT METHOD FOR DUAL-PHASE LAG EQUATION

Ewa Majchrzak

Silesian University of Technology, 44-100 Gliwice, Konarskiego 18a, Poland
E-mail: Ewa.Majchrzak@polsl.pl

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Dual-phase lag equation (DPLE) is used, among others, for the description of heat transfer processes in the micro scale e.g. for determining the temperature distribution in thin metal film subjected to an ultra-short laser pulse. The DPLE is also used in numerical modeling of thermal phenomnea occurring in living organisms subjected to the strong external heat sources.
Dual-phase lag equation contains a second order time derivative and higher order mixed derivative in both time and space. Two positive constants, it means the thermalization time and relaxation time appear in this equation.
So far, the dual-phase lag equation supplemented by appropriate boundary and initial conditions is most often solved using the finite difference method in its various variants (explicit and implicit schemes, generalized finite difference method etc).
In this work, the approach based on the concept of the boundary element techniques [1] is proposed. It should be noted that for the DPLE the corresponding fundamental solution is either unknown or very difficult to obtain. But, using the homotopy analysis method, introduced first by Liao [2], it is possible to elaborate the general boundary element method for the dual-phase lag equation. At the first stage, for the purpose of numerical stability, the DPLE equation is discretized in the time domain in terms of a fully implicit form with the backward finite-difference method for both the first-order and second-order time derivatives. In this way one obtains the equations that present a non-linear boundary-value problem at each time step. Next, the non-linear and linear differential operators are defined [3]. The equation associated with the first-order deformation derivative resulting from the homotopy analysis method can be solved using the traditional boundary element method for steady state problem.
In the full version of the paper the details concerning the general boundary element method and the results of computations will be presented.

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