

ABSTRACT

THE BOUNDARY ELEMENT METHOD SOLUTIONS OF DIFFUSION AND SCALAR WAVE EQUATIONS USING TIME-DEPENDENT FUNDAMENTAL SOLUTIONS

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In this thesis, the two-dimensional diffusion and scalar wave equations are solved using the boundary element method (BEM) with the time-dependent fundamental solutions. This procedure does not have to deal with the time derivatives of the governing equations whereas the other domain discretization methods need to. The entries of the BEM matrices containing the boundary and time integrals are computed numerically by using constant elements both on the boundary and in the time intervals. This way, necessity of using another numerical time integration scheme is eliminated since the resulting equations are not a system of ordinary differential equations with respect to time. When a time iteration is used for the transient dynamic problems, it is known that the solution possesses instabilities since the errors are build up as the time-stepping is progressed. In this study, the obtained linear system of algebraic equations, is solved for the unknown and its normal derivative directly at the required time levels without the need of a time iteration which usually requires very small time steps due to stability problems. Locating the source and the field points at the center of each time level, the solution is advanced in time to get the results until the steady-state solution is reached. Numerical computations are carried out for two-dimensional diffusion and scalar wave problems in rectangular regions. The solutions are in good agreement with the exact solutions whenever available.

Keywords: Boundary element method, diffusion and wave equations.