Time-domain BEM analysis for elastodynamic problems using expanding element interpolation method

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Abstract

Time-domain boundary element analysis of 2D transient elastodynamic problems with initial conditions by a new expanding element interpolation method is proposed in this paper. The expanding element is made up based on a traditional discontinuous element by adding virtual nodes along the perimeter of the element. The internal nodes of the original discontinuous element are referred as source nodes and its shape function as raw shape function. The shape functions of the expanding element constructed on both source nodes and virtual nodes are referred as fine shape functions. The polynomial order of fine shape functions of the expanding elements increases by two compared with their corresponding raw shape functions. This feature makes the expanding elements able to naturally and accurately interpolate both continuous and discontinuous fields. Moreover, in order to take into account the non-null initial conditions, a sphere subdivision method is used to deal with the spherical integral in the boundary integral equation. With the sphere subdivision, the element is subdivided into a number of patches through a sequence of spheres with decreasing radius. As the radius is obtained by elastic parameters and time step, the wave front can be excellent simulated. Coupled with the expanding element interpolation method, the numerical stability is improved significantly. Numerical results have demonstrated that the accuracy, efficiency, stability and convergence rate of the expanding element method.

Keywords: boundary element method (BEM); transient elastodynamic; interpolation method; expanding element; sphere subdivision method;