A HIGH-ORDER DOUBLY ASYMPTOTIC TRANSMITTING BOUNDARY FOR VECTOR WAVE PROPAGATION

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Abstract

Dynamic soil-structure interaction plays an important role in the design and safety assessment of structures, especially for large-scale structures, such as concrete dams, nuclear power plants, bridges etc. A high-order doubly asymptotic transmitting boundary for vector wave propagation is presented in this contribution. The scaled boundary finite element equation in dynamic stiffness of unbounded domains is efficiently solved by a doubly asymptotic continued-fraction solution. The coefficient matrices of the solution are determined recursively by satisfying the dynamic stiffness at both high and low frequency limits. By introducing auxiliary variables and the doubly asymptotic continued-fraction solution to the force-displacement relationship in the frequency domain, a high-order doubly asymptotic transmitting boundary condition is constructed. The transmitting boundary is expressed as a system of first-order ordinary differential equations in the time domain, which can be solved by a direct time-domain integration method. The stability of the transmitting boundary depends on the general eigenproblem of the coefficient matrices $[K_u]$, $[C_u]$ and is guaranteed by eliminating the spurious modes by means of the spectral shifting technique. The validity of the high-order doubly asymptotic algorithm is shown by means of two numerical examples.

Keywords: Dynamic soil-structure interaction, the scaled boundary finite element method, unbounded domain, doubly asymptotic continued-fraction solution, vector wave, frequency domain, time domain.

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