MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

Author: Prof. Harijono Djojodihardjo
Universitas Al Azhar Indonesia, Indonesia, harijono@djojodihardjo.com

FURTHER DEVELOPMENT IN THE APPLICATION OF FAST MULTIPOLE BOUNDARY ELEMENT METHOD FOR UNIFIED BEM-FEM ACOUSTIC-STRUCTURAL COUPLING

Abstract

The present work further develops the modeling and analysis of structural-acoustic interaction using Boundary and Finite Element Coupling. By using boundary elements, the Helmholtz integral equation has been discretized with the prevailing boundary conditions of the equation, and matrix equation in the basic form is obtained with the entries of the influence coefficient matrices formulated as appropriate following another work of the author and techniques established in the literature. Numerical treatment to overcome the appearance of irregular or fictitious frequencies was carried out by using a method known as Combined Helmholtz Interior integral Equation Formulation. To allow the treatment of large matrices, increase accuracy and computational time, as well as to reduce computational complexity and memory requirements, Fast Multipole BEM (FMBEM) is applied, formulated and developed based on the fast multipole algorithm. The boundary element formulation is based on original Helmholtz integral equation for the acoustic sound pressure field in its basic form to maintain simplicity. Commensurate with reducing computational complexity, constant elements are employed. The fast multipole method (FMM), which has been regarded as one of the top 10 algorithms in scientific computing and has progressed very significantly, is then combined with the boundary element method (BEM) to solve large-scale problems with very high degrees of freedom on a desktop computer within reasonable time. The core of the method lies in the Multipole Translation Theory, the mathematical theory underlying a class of algorithms called fast multipole methods (FMM), which has been undergoing intensive development. Multipole translation theory, the mathematical theory underlying a class of algorithms called fast multipole methods (FMM), has also been undergoing intensive development. In applying the Fast Multipole Algorithm, an iterative method is used to solve the linear systems. For that purpose the algorithm include two branches, one for the left hand side and the other for the right hand side of the matrix equation, where the right hand side incorporates the boundary conditions. After giving certain values as the initial vector, the matrix-vector multiplication in the left side of the equations is recursively evaluated to calculate the residual vector at successive step, defined for the schemes. Convergence criterion is defined accordingly. The fast Multipole BEM is then incorporated in the Unified BEM-FEM Acoustic-Structural Coupling developed earlier, following a unified integrated scheme carried out in the author's earlier work. Preliminary results obtained has led to further development outlined. New results are discussed.