A Wavelet-Galerkin Boundary Element Method for the 2D Helmholtz Problem

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Abstract

The Galerkin method is one of the best known methods for finding numerical solutions to partial differential equations. The Galerkin approach consists of selecting a function basis for the solution space of the equation, projecting the solution onto this basis, and then minimizing the least-squares residual between the exact solution and the projection onto the subspace spanned by the basis functions. In recent years, the use of wavelets has become increasingly popular in the development of numerical schemes for the solution of partial differential equations. In wavelet applications to the PDE problem, one of the most frequently used wavelets are the Daubechies wavelets which have compact support and are an orthonormal basis for square integrable functions. In this paper, the Wavelet-Galerkin method is used with the Daubechies wavelets as basis functions to solve the two dimensional Helmholtz equation. The method converts the differential equation into a system of algebraic equations. Matlab programs have been developed to solve the equations of the Wavelet-Galerkin method with the Daubechies wavelet basis functions. The results show that the Wavelet-Galerkin method with a Daubechies wavelet basis gives efficient and accurate algorithms for the numerical solution of the two dimensional Helmholtz problem. In order to test the accuracy of our numerical solutions from the Wavelet-Galerkin method we have applied the method to a Helmholtz problem with a known exact analytical solution.

Key words: *Wavelet-Galerkin method; Daubechies wavelet and 2D Helmholtz equation*