Multiwavelet Collocation for Boundary Integral Equations

S. Amini, R. Elmazuzi and S. P. Nixon

Mathematics
School of Computing, Science and Engineering
University of Salford
M5 4WT

Abstract

Generally, wavelet analysis has been carried out in the context of Galerkin solution of boundary integral equations. In this paper we consider the collocation method with multiwavelet bases for the discretisation of boundary integral equation with *analytically standard* kernels.

We employ orthogonal multiwavelets with compact support with k vanishing moments. The number of vanishing moments in this case is related to the number of mother wavelets rather than the size of the compact support. This makes the implementation of boundary integral methods much easier than when using wavelet basis functions, where the order of the vanishing moments is related to the size of the compact support.

A fast algorithm, using multiwavelet and collocation method for operators of order $2q$ is presented. The resulting matrix is numerically sparse and it can be compressed a priori to $\mathcal{O}(N \log^p(N))$ nonzero matrix entries, by setting small elements to be zero, without loss of accuracy of the collocation method. We present the theoretical analysis of the compression technique and provide some examples of the applications of the scheme to the boundary integral solution of the two dimensions Laplace's equation.