ACOUSTICS2008/586
Fast multipole accelerated boundary element method (FMBEM) for solution of 3D scattering problems

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Wideband FMBEM codes are challenging to implement since there are problems at both very low and high frequencies. Substantially different schemes for function representation and translation are efficient for low and high frequency ranges. We present a method which is suitable for solution both high and low frequency problems since it implements a switch between different representations and uses fast translation methods appropriate to each representation. For a high frequency problem the switch between representations may occur at some intermediate levels of hierarchical space subdivision of the FMM. We also present an FMM-based preconditioner used in the flexible GMRES iterative solver for scattering problems and discuss example problems computed in range $0.001<kD<200$, where k is the wave number and D is the size of the computational domain. The theoretical and experimental computational complexity of our algorithm is approximately $O((kD)^3)$ at large kD with relatively small asymptotic constant and the algorithm allows to solve problems with up to million nodes used for surface discretization in the range tested on a conventional personal computer.