Dirichlet to Neumann Boundary Conditions in Generalized Curvilinear Coordinates for Multiple Scattering

Vianey Villamizar

Department of Mathematics Brigham Young University

Provo, UT 84602, USA

A multiple scattering problem modelled by the Helmholtz equation is solved. Each arbitrarily shaped scatterer is enclosed by a relatively close artificial boundary. Following [J. Comp. Phys. 201 (2004) 630-650], a DtN boundary condition is derived for several disjoint components of the artificial exterior boundary. Then, a second order finite difference method, combined with the novel Dirichlet-to-Neumann (DtN) absorbing boundary condition in generalized curvilinear coordinates, is applied to the inner regions. These inner regions are bounded by the physical scatterer boundaries and the surrounding artificial scatterer boundaries. As a result, the computational cost to obtain a numerical solution is greatly reduced. An approximate solution for multiple scattering from two circular cylinders is obtained using this method. Excellent convergence is obtained for this case when compared to its exact solution. Approximate solutions for more general scatterer configurations of two and three obstacles are also presented. Finally, the radar cross section for various arbitrarily shaped scatterer configurations are obtained.