Computation of the Bistatic RCS of Stealth Airborne Targets via the Fast Multipole Method

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In this paper, bistatic radar cross section (BRCS) values of a stealth airborne target is predicted by performing numerical simulations. Solutions of real-life problems at microwave frequencies result in very large matrix equations. In order to achieve the solution of large-scale electromagnetic problems in the numerical simulation environment, the fast multipole method (FMM) is implemented and used to solve the electric-field integral equation (EFIE) and the combined-field integral equation (CFIE) of the scattering problem. The FMM has produced remarkably accurate results, in addition to its efficiency. The efficiency of the FMM is due to its reduced computational complexity and memory requirement, which are both $O(N^{1.5})$ for a single-level implementation of the FMM and goes down to $O(N\log N)$ for a multi-level implementation of the FMM. We will address several other points that lead to an efficient implementation of the FMM, such as the choices of the preconditioner and the initial guesses required for the iterative solver.

The BRCS values of a stealth target are computed for several different illumination angles. In addition to comparing results obtained for various illumination angles, we will also compare the BRCS results of a stealth target and a nonstealth target for the same illumination conditions. RCS prediction can be achieved through numerical calculations or scaled-model measurements. In this paper, the use of both of these techniques to predict the RCS of a stealth airborne target is reported, and the validation of the numerical results has been achieved by comparing to measured RCS values of the same stealth target obtained by scaled-model measurements. Comparison of the measured and computed BRCS values has resulted in a surprising agreement, which serves to validate both of the prediction techniques.