FMM Computation of the Bistatic RCS

of Stealth and Nonstealth Targets

L. Gürel* and H. Bagci

Department of Electrical and Electronics Engineering

Bilkent University

Ankara, Turkey

e-mail: lgurel@ieee.org

In many civilian and almost all military applications, an accurate knowledge of the radar cross section (RCS) of the involved targets is highly desirable. The RCS information is used for numerous purposes, ranging from the design of novel stealth vehicles with reduced radar signatures to the decision of what kind of electronic counter measures (ECM) to engage against a certain threat.

In this paper, bistatic radar cross section (BRCS) values of stealth and nonstealth airborne targets are predicted by performing both numerical simulations and scaled-model measurements. 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 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. 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 stealth and nonstealth airborne targets 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.