Generalized Formulations for Electromagnetic Scattering from Perfectly Conducting and Homogeneous Material Bodies—Theory and Numerical Solution

YEHUDA LEVIATAN, SENIOR MEMBER, IEEE, AMIR BOAG, AND ALONA BOAG

Abstract—**Generalized *E*-field formulation for three-dimensional scattering from perfectly conducting bodies and generalized coupled operator equations for three-dimensional scattering from material bodies are introduced. The suggested approach is to use a fictitious electric current flowing on a mathematical surface enclosed inside the body to simulate the scattered field and, in the material case, to use in addition a fictitious electric current flowing on a mathematical surface enclosing the body to simulate the field inside the body. Application of the respective boundary conditions leads to operator equations to be solved for the unknown fictitious currents which facilitate the fields in the various regions through the magnetic vector potential integral. The existence and uniqueness of the solution are discussed. These alternative operator equations are solvable via the method of moments. In particular, impulsive expansion functions for the currents in conjunction with a point-matching testing procedure can be used without degrading the capability of the numerical solution to yield accurately near-zone and surface fields. The numerical solution is simple to execute, in most cases rapidly converging, and is general in that bodies of smooth but otherwise arbitrary surface, both lossless and lossy, can be handled effectively. Boundary condition checks to see the degree to which the required boundary conditions are satisfied at any set of points on the body surface are easily made for validating the solution. Finally, results are given and compared with available analytic solutions, which demonstrate the very good accuracy of the moment procedure.**

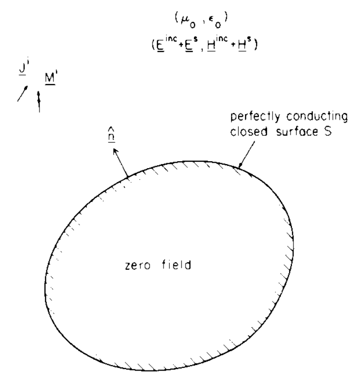

Fig. 1. General problem of scattering by perfectly conducting body.

terms of the yet to be determined surface current $\mathbf{J}_s$ induced on the conducting body surface S. This can be done in two alternative ways discussed both by Poggio and Miller in [1]. One formulation, known as the E-field integral equation, is derived by setting the component tangential to S of the sum of the incident electric field and the electric field due to $\mathbf{J}_s$, both