Improved RCS from the Induced Surface Currents in Illuminated and Shadow PO Regions of the Complex Cylindrical Resistive Shell

M. Havrilla *[(2)], J. Lee[(1)], and E.Rothwell[(1)]
(1) Michigan State University, 2120 Engineering Building, East Lansing, MI, 48824, http://www.egr.msu.edu/~rothwell
(2) Air Force Institute of Technology, AFIT/ENG, 2950 Hobson Way, WPAFB, OH, 45433-7765

The physical-optics (PO) approximation has been widely used for electrically large structures. A modified PO planar current has been derived for a thin resistive sheet (D. Dwyer, et. al., 2005 National Radio Science Meeting, Boulder, CO) and applied recently to the curved case of a circular cylindrical shell. Unfortunately, due to penetration of the incident wave through the shell, the current in the shadow zone is more significant than in the case of a perfect conductor, and, consequently, the computed scattered field is less accurate. In this paper we introduce a correction to the current in the shadow zone, which improves the computed scattered field.

For simplicity, consider the two-dimensional (2D) problem of a resistive circular cylindrical shell illuminated by a TE or TM normally-incident plane wave. The 2D bistatic radar cross section (RCS) is determined analytically using a series solution, and compared to the RCS found by integrating the modified PO current over both the illuminated and shadow portions of the surface.

Typically, calculation of the PO bistatic RCS of conducting bodies only utilizes the current in the illuminated region, and assumes the current in the shadow region is zero. This is not a good assumption in the case of the resistive shell, since the incident field that penetrates the walls of the shell directly induces a current in the shadow region, which adds to the current induced by the secondary field produced by the current in the illuminated region. A first-order correction to the current in the shadow region can be obtained by using the PO identity with an incident field assumed to be the sum of the illuminating wave and the near-zone field produced by the PO current in the illuminated region. As a second-order correction, the near-zone field produced by the computed PO current in the shadow zone may then be used to modify the PO current in the illuminated region.

The corrected PO currents are compared to the exact current from a series solution over the full range of angles (illuminated and shadow regions) and show a significant improvement in both magnitude and phase. As expected, the bistatic RCS computed from the corrected currents also shows improved accuracy.