BISTATIC SCATTERING FROM A RESISTIVE SHEET USING A MODIFIED PO CURRENT

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The physical optics (PO) current $\vec{J}_{PO} = 2\hat{n} \times \vec{H}^i$ (where $\hat{n}$ is the surface normal and $\vec{H}^i$ represents the incident magnetic field intensity) is frequently used to obtain a high-frequency approximation to the scattering from perfect electric conducting (PEC) objects. However, in certain applications, structures may be fabricated using imperfect conductors or resistive layers for the purpose of reducing certain scattering mechanisms. Under these conditions, the use of the above PEC physical optics current will lead to gross errors in the scattered-field calculation. In order to mitigate these errors, a non-PEC physical optics current expression must be developed. The purpose of this paper is to derive a physical optics current to accommodate a resistive layer and experimentally verify the analysis via bistatic radar cross section (RCS) measurements of a rectangular resistive strip under both horizontal and vertical polarizations.

The PO current of a resistive layer will be developed based upon a plane-wave analysis. The derivation will assume that the layer is an infinite non-magnetic planar slab having thickness d, permittivity ϵ and conductivity σ. A closed-form solution is found for the fields inside the layer for both horizontal and vertical polarizations. A Taylor-series analysis is then performed to obtain an approximate expression for the PO current $\vec{J}_{RPO}$ in terms of the resistance $R_s = 1/\sigma d$ ($\Omega/\square$) of the finitely-conducting sheet for both polarizations, namely

$$\vec{J}_{RPO} = \vec{J}_{PO}\left(1 + \frac{2R_s}{Z_0}\right)^{-1}$$

where $Z_0 = \eta_0 \cos\theta_i$ for horizontal polarization, $Z_0 = \eta_0/\cos\theta_i$ for vertical polarization and θ_i is measured relative to the surface normal. It should be noted that, in the high-frequency limit, this condition will also be approximately valid in a non-planar environment so long as any curvature is large compared to wavelength.

The RCS of several resistive strips of various thicknesses will be experimentally measured and compared to bistatic RCS calculations based on the above analysis for theoretical verification. In addition, a Method-of-Moments integral equation solution based upon a resistive boundary condition will be formulated and compared to the above results to validate $\vec{J}_{RPO}$.

[1]The views of the co-authors expressed in this article do not reflect the official policy of the U.S. Air Force, Department of Defense, or the U.S. Government.

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2. B - Fields and Waves

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4. C - Contributed Paper

5. Presenting on 8 January would be best for our schedules. If this can possibly be worked into the conference schedule, that would be fantastic. Sincerest thanks.