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This is the sixth monthly progress letter on Contract F33615-73-C-1174 and covers the period 15 August - 15 September 1973.

The extension of program TWOD to include magnetic as well as dielectric materials is nearly complete, with debugging and preliminary testing well under way. In its present form, the program assumes that incidence is E-polarized and that the geometry consists of an inner core satisfying an impedance boundary condition, plus outer magneto-dielectric layers. After the program has satisfied reasonable test requirements, it will be expanded to include the H-polarized case, which can be done quite simply because of the duality between the E and H integral equations. This is, in fact, the reason for imposing an impedance boundary condition over the surface of the inner cylindrical core.

Preliminary tests show that the program duplicates the results of program REST for a perfectly conducting ogival cylinder and the results of RAMD for a constant impedance boundary condition. The magneto-dielectric layer feature of the program will soon be tested by choosing layer thickness and electrical properties so as to simulate a resistive sheet, for then the results can be compared with those of program REST. We also hope to test the program for a geometry that can be solved exactly, such as the case of a metallic circular cylinder surrounded by a concentric magneto-dielectric layer.

Considerable attention has been given in this reporting period to the data generated thus far by program REST. As has been reported previously, of all the treatments examined, a single resistive sheet placed in front of an ogival cylinder along the plane of symmetry produces optimum cross section reduction in the edge-on aspect region. For sheets more than (about) 0.5λ in width, a square law distribution of resistivity yields increasingly better performance as the terminal value of resistance (at the leading edge of the sheet) becomes progressively higher. Curiously enough, the behavior does not carry over to the case of a linear resistance distribution: optimum performance depends rather strongly on both the sheet width and the terminal resistance value. This lack of any definite trend has been referred to as a "resonance" phenomenon for the want of a better description.

The resonance appears to be due to scattering from the leading edge of the resistive sheet combined with that of the cylinder to which it is attached. The echo from the leading edge of the sheet decreases with increasing resistance, but a linear resistance distribution seems to be less effective in shielding the conducting body from the incident wave than does a square law distribution. Moreover large rates of change, such as are demanded by narrow sheets or very large terminal resistance values for linear distributions, may introduce a third source of scattering at the junction between the strip and the body and thereby degrade the performance of the treatment. No such discontinuity is presented by the square law distribution, however, and the cross section reduction behaves far more uniformly than it does for the linear case.

An examination of the surface fields on the strip-loaded ogival cylinder shows that the currents are discontinuous at the point where the strip is attached to the cylinder. Increasing the sheet resistance increases this discontinuity, but decreases the currents at the leading edge of the strip. The leading edge strip currents are nearly independent of the resistance distribution over the remainder of the strip, but the nature of the current jump at the junction of strip and cylinder is markedly different for the linear and square law distributions. The resonance phenomenon noted earlier is closely related to this current jump, since the leading edge strip currents are virtually the same for linear and square law loadings.

In order to arrive at a more thorough understanding of the scattering mechanisms involved, we are collecting more data in order to extend the conditions examined thus far. In addition, we have modified program REST so that the individual cross sections of various portions of the scatterer can be printed out, as well as the total scattering. (The modified program is called RISK and was delivered to AFAL on September 14, 1973.) This will permit us to extend our analyses and to establish empirical relations in those cases for which there are no firm theoretical guidelines.

We hope to be able to model the scattering from the leading edge of the resistive strip by means of the solution of the half plane with an impedance boundary condition. The integral equations for a resistive half plane and for the impedance sheet can be derived and compared in order to do this. Since the diffraction coefficient is available for the impedance sheet, a comparison of the integral equations leads to the identification of a diffraction coefficient for the resistive half plane. Although the identification is obscure for arbitrary angles of incidence, a diffraction coefficient can be defined for the special case of edge-on indidence.

While this theoretical approach shows promise for the leading edge of the resistive sheet, there is no comparable formulation for the trailing edge. In order to study the rear edge scattering we have collected a comprehensive set of data for an isolated resistive strip having both linear and square law resistance distributions. Analysis of these data are currently under way.