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CONTRACT NR, PROJECT and TITLE	F 33615-73-C-1174, 7633 "Non-Specular Radar Cross Section Study"
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This is the third monthly progress letter on Contract F 33615-73-C-1174 and covers the period 15 May - 15 June 1973.

Until this reporting period we had been troubled by the failure of program RAM1B for E-polarization when applied to edged structures. This failure was mysterious because program REST, which was designed to include resistive sheets instead of a surface impedance boundary condition, worked admirably well for bare edges for E-polarized incidence. We discovered that the two programs are based on different integral equations: REST solves for the currents along the z-axis for z-directed incident electric field, while RAM1B solves the currents for incident transverse magnetic field. Although the physical conditions of the two cases are identical, the integral equations are different and the trouble is due to a singularity in an integral that is present in one case, but not the other. By exploiting the duality of the E- and H-polarized integral equations for the axial fields, we modified subroutines ALLLK and FIELD to accommodate both polarizations. Program RAM1B now behaves as well as does program REST, although perhaps less efficiently. Copies of the revised subroutines were sent to AFAL in May, 1973.

Both programs were used extensively during this reporting period to investigate the cross section reductions available by means of surface impedance variations and the application of resistive sheets. As was discovered for H-polarization, the application of a high impedance at the edge of an ogival cylinder has the effect of reducing the scattering, but only as long as the impedance is not carried to too high a level. We have studied both linear and square law loadings but one seems to have no decisive advantage over the other. As the length of the loaded portion of the body becomes shorter, the cross section reduction becomes less. Variations of the loading schemes, as well as detailed analyses of the results, are being continued.

Our investigations of the use of resistive sheets via program REST have uncovered a resonance phenomenon which has not yet been resolved. We found that a short flat sheet $\lambda/4$ long placed along the plane of symmetry at the front of the ogival cylinder was far more effective than a sheet $\lambda/2$ or λ long. Moreover, we obtained results similar to those for the $\lambda/4$ sheet by using a $3\lambda/4$ sheet. The resonance may be analogous to that of a Salisbury screen, which is a resistive sheet placed parallel to a surface and positioned $\lambda/4$ away from it.

Further studies of resistive sheets show that, if at all possible, a sheet placed forward of the leading edge should be aligned along the direction of incidence. The

use of several sheets (in order to accommodate several directions of incidence) is not necessarily the best treatment, for then some sheets are viewed at angles not far from their surface normals. Evidently a flat resistive sheet is useful in front of the body only so long as it is viewed near its own edge-on region. As with the results of program RAM1B, variants of these loading schemes and analyses of the results are continuing.

Other areas of progress are in the extension of program TWOD to include a) permeability not necessarily that of free space and b) incident H-polarization. Because the program essentially compresses the effect of a finite layer into an infinitesimally thin sheet, and thus operates much as program REST does, it may require sampling in depth as well as along the surface of a thick layer of material. We are also considering the possibility of using a homogeneous material of arbitrary thickness to avoid the necessity of volume sampling.