THE UNIVERSITY OF MICHIGAN RADIATION LABORATORY

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Air Force Avionics Laboratory
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4950 Test Wing (Technical)
ATTENTION: AFAL-WRP
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| CONTRACTING OFFICER | George E. Himes |
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This is the tenth monthly progress letter on Contract F33615-73-C-1174 and covers the period 15 December 1973 - 15 January 1974.

Three separate efforts during this reporting period are noteworthy, each involving a different computer program.

RAMVS

When we were planning the development of a generalized computer program earlier in the contract, it had been assumed that a metallic two-dimensional body would be treated by the application of thin layers of materials whose electromagnetic properties could be specified on input. If it appeared that a thick layer would be required in order to obtain the desired performance, it could be synthesized by building up two or more thin layers with the properties of each layer being different from those of adjacent layers, if necessary. Thus the program was designed to accomodate layers of different properties, but once specified, the layer parameters were fixed at the same value everywhere in the layer.

However, recent studies of resistive sheets have shown that optimum performance is obtained by varying the resistance along the sheet, suggesting that a constant layer characteristic would unnecessarily restrict our search for desirable layer properties. Thus the generalized program, completed during the last reporting period, has been revised in order to accomodate variable electromagnetic characteristics. Because we found it convenient to interpret and analyze previous data on the basis of variable impedances, the revised program requests impedance information on input instead of complex permeability and permittivity. After favorable impedance characteristics have been found, it will be a straightforward matter to convert or interpret them in terms of electromagnetic properties. The revised program is named RAMVS and a FORTRAN source deck has been forwarded to AFAL.

RASP

As reported previously, we had virtually exhausted the capability of purely resistive sheets (using program RISK) and a modification thereof (program RASP) permitted electric sheets to have reactive components. As expected, the reactive component can be used to "tune out" residual echoes, and thereby improve performance by a few dB. However, like all reactive schemes, the improvement is obtained at the expense of deteriorated performance at other aspect angles. For example, the near edge-on return of a treated ogival cylinder can be reduced below

the optimum level obtained with a purely resistive sheet by 5dB, but the aspect angle coverage decreases from 30 degrees to only 20. Thus the use of reactive sheets entails a trade-off.

RAMF

The near field study initiated earlier has been completed with the aid of program RAMF, which was used to investigate the errors incurred by measuring two-dimensional metallic obstacles at less than (or greater than) the standard far field distance. Of the variety of geometries studied, we found that an ogival cylinder presented the greatest challenge for accurate measurements, and errors as large as 2dB could be made. Using the proven theories of physical optics and the geometrical theory of diffraction, we succeeded in isolating the cause of the measurement errors, and extended the analysis to a three-dimensional shape. The errors are related to the distribution of scattering sources and are most pronounced for simple edged bodies. In the three-dimensional case of a flying saucer, for example, the error can exceed 10dB at the standard far field distance, and can still be as large as 2dB even if the body is measured at 5 times this distance. A short paper on this subject has been prepared for submission to an engineering journal and a copy will be forwarded to the sponsor for approval.