EXPERIMENTAL MEASUREMENT OF THE
SCATTERING PATTERNS OF RESISTIVE SHEETS

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Introduction

Reducing the scattering sidelobes of a perfectly conducting strip with resistive loading may be done in several ways. First, a constant resistive strip reduces the scattering sidelobes, but not relative to the main beam. Second, edge-loading, if done correctly, can significantly reduce the scattering sidelobes relative to the mainbeam. Finally, a taper across the entire strip will also significantly reduce the scattering sidelobes relative to the mainbeam.

This paper presents theoretical and experimental bistatic scattering and backscattering results from a tapered resistive sheet.

Tapered Resistive Sheet

Assume the sheet lies in the x-z plane with the resistive taper varying in the x-direction and remaining constant in the z-direction. The tapered resistive sheet consists of a thin dielectric substrate (kapton) with a very thin coating of indium tin oxide on its surface. The indium tin oxide is highly conductive and the deposited film varies from a minimum resistivity of approximately 0 at the center to a maximum resistivity of 2000Ω/sq at the edges. Southwell Technologies, Inc. manufactured the sheet with the taper running from 0 Ω/sq at one edge to highly resistive at the other edge. We cut this sheet and joined the highly conducting edges together to form a symmetrically tapered sheet. The sheet is 16x16 inches and has a normalized resistive taper given by

$$\eta = \frac{3}{2}x^4 + 2x^2 + 5$$

where x is given in inches and x=0 is in the center of the sheet. A graph of the normalized resistive taper for a 4λ x 4λ sheet appears in Figure 1.

Experimental Measurements

Bistatic and backscattering measurements were performed on the sheet. The bistatic scattering measurements were made at the RADC bistatic scattering measurement facility in Ipswich, MA. These measurements were made at a frequency of 3.029GHz, making the sheet 4λ x 4λ. The backscattering measurements were made at the University of Michigan anechoic chamber in Ann Arbor, MI. These measurements were made at a frequency of 2.8GHz, making the sheet 3.8λ x 3.8λ. In both cases, a 16 x 16 inch aluminum plate served as the calibration target.

The measurements are compared with computed results for a resistive sheet in which the current density is calculated via an integral equation approach in the x-direction and...
PO in the z-direction. Angles of incidence are limited to the x-y plane and the scattered field is calculated only from $\theta = 0^\circ$ to $\theta = 180^\circ$.

Figure 2 shows the H-polarization bistatic scattering pattern ($\phi = 0^\circ$) for a sheet with the taper given by (1). The experimental results are shown by the solid line and the computed results are shown by the line with circles.

Figure 3 shows the H-polarization backscattering pattern for a sheet with the taper given by (1). The experimental results are shown by the solid line and the computed results are shown by the line with circles.

Conclusions

We have experimentally shown that it is possible to lower the bistatic scattering and backscattering side-lobe levels of a resistive sheet by tapering the resistivity. The experimental and theoretical results show some disagreement in the low side-lobe region because of errors in the resistive taper, experimental errors, the return from the styrofoam mount, and the joining of the two tapered sheets to form a symmetrically tapered sheet.

![Figure 1. Graph of resistive taper on strip.](image-url)
Figure 2. H-polarization bistatic scattering ($\phi_s = 60^\circ$) results for a tapered resistive sheet. The solid line is the experimental measurement and the circles indicate computed results.

Figure 3. H-polarization backscattering results for a tapered resistive sheet. The solid line is the experimental measurement and the circles indicate computed results.