BACKSCATTERING REDUCTION OF CORNER REFLECTORS USING SCS TECHNIQUE

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ABSTRACT

Reduction of radar cross-section of dihedral corner reflectors using simulated corrugated surface (SCS) is reported. This technique is found to be more effective in the reduction of RCS or corner reflectors for normal incidence. A typical reduction of 40–50 dB is achieved using this method.

1. INTRODUCTION

Studies of the backscattering cross section of corner reflectors are important for many radar applications and are often used as an RCS standard. Several papers dealing with the backscattering from perfectly conducting dihedral corner reflectors have been published [1, 2]. The high range resolution and maximum backscattering return from a corner reflector is studied by Sorensen [3]. The enhanced backscattering from corner reflectors is due to the mutual orthogonality of the two or three flat surfaces comprising the corners. One way to reduce the echo from such targets is to tilt the orthogonal planes away from vertical, thereby sending the reflected wave in some direction other than that of the radar [4, 5].

It has been established that simulated corrugated surfaces (SCS) reduce the RCS of planar and cylindrical targets [6, 7]. In this article we present a simple and effective method to reduce the RCS of dihedral corner reflectors using the SCS technique. Backscattering from stationary corner reflecting surfaces can be reduced more effectively using this technique. In this study, the main interest is on 90° corner reflectors, since they are involved in many targets and normally show an enhancement in RCS.

2. EXPERIMENTAL SETUP AND METHODOLOGY

The SCS is made of thin conducting strips of width a, separation b and period d, etched over a dielectric medium (ϵr = 2.56) of thickness h. This structure is fixed inside the corner reflector [target under test (TUT)] parallel to its vertical axis. The dihedral corner reflector is specially designed for the precise adjustment of the including angle 2α. The instrumentation radar consists of an HP 8510B network analyzer along with a synthesized sweep source and S-parameter test set. The measurement principle is based on the time-gated signal, which is differentiated according to the time of arrival at the network analyzer and is analyzed. The measurement setup is based on an automated form of bistatic RCS technique. For error correction and proper isolation, the system is adjusted to measure the characteristics of the test equipment at a number of preset frequencies from 8.0–12.4 GHz, and these are stored and subsequently subtracted from the received test signals. A metallic dihedral corner reflector of same dimensions as TUT is used as the reference target for this purpose.

3. EXPERIMENTAL RESULTS

The monostatic RCS of the SCS loaded corner reflector is measured by arranging the TUT for TE polarization on a turntable. The variation of monostatic RCS of an orthogonal corner reflector with and without SCS is shown in Figure 1. From experimental iterations, it is found that the RCS reduction is more effective when two SCS of different periods are used in the two orthogonal planes.

Figure 2 presents the variation of backscattered power for strip loaded and the reference corner reflector for 8.0–12.4 GHz measured using the network analyzer, and it shows a typical reduction of 51.5 dB at 9.71 GHz. The variation of RCS against the variation of the included angle 2α of the

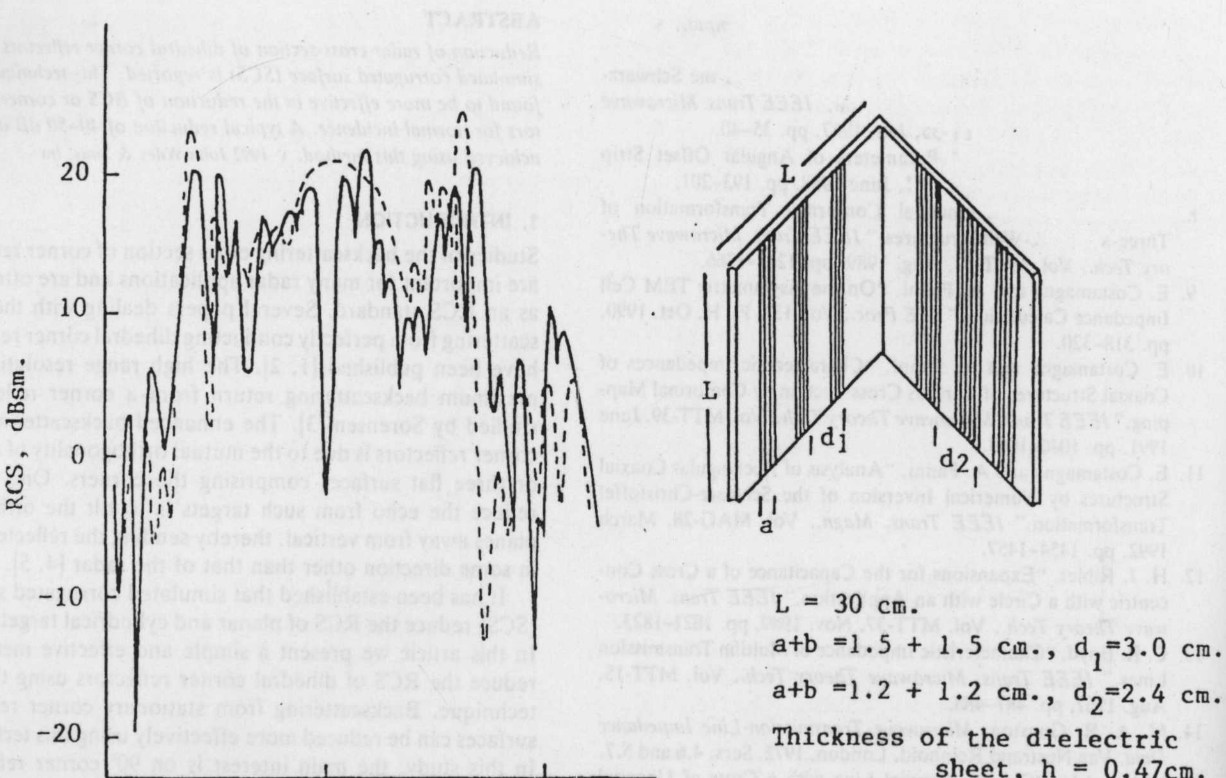

Figure 1 Variation of monostatic RCS of corner reflector with and without SCS. f = 9.71 GHz. d_1 = 1.5 + 1.5 cm, h = 0.12λ. d_2 = 1.2 + 1.2 cm, h = 0.16λ. Solid line, with SCS; dotted line, without SCS

loaded and unloaded corner reflector is shown in Figure 3. It is observed that, for SCS of h/d_1 = 0.12λ and h/d_2 = 0.16λ, the reduction of RCS is maximum for 90°. For other angles, the reduction can be achieved by suitably selecting the value of h/d. The variation of RCS against the variation of the thickness h of the dielectric medium is shown in Figure 4.

The multiple reflections inside the dihedral corner reflector are the main cause of the enhancement of its RCS. When it is loaded with SCS of different periods d on each plane, it is found that the multiple reflections inside the corner angle are destructively interfering in the normal direction and thus RCS is reduced.

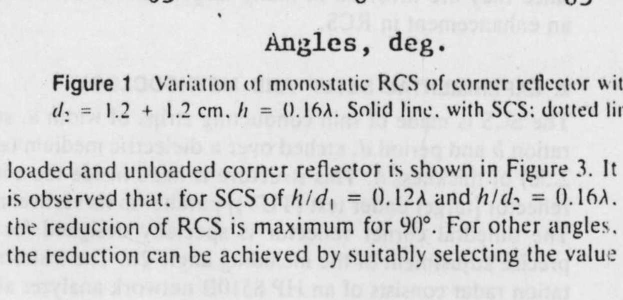

Figure 2 Variation of backscattered power against the frequency for the corner reflector with and without SCS. d_1 = 1.5 + 1.5 cm, h = 0.12λ. d_2 = 1.2 + 1.2 cm, h = 0.16λ. Solid line, with SCS; dashed line, without SCS

4. CONCLUSIONS

The backscattering cross-section of the dihedral corner reflector, which is large due to the mutual perpendicularity of

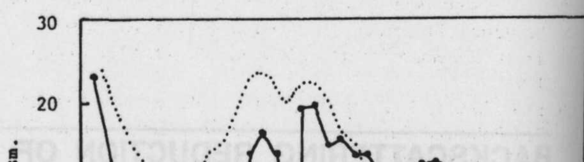

Figure 3 Variation of RCS against the variation of corner angle 2α. f = 9.71 GHz. Solid line, with SCS; dotted line, without SCS

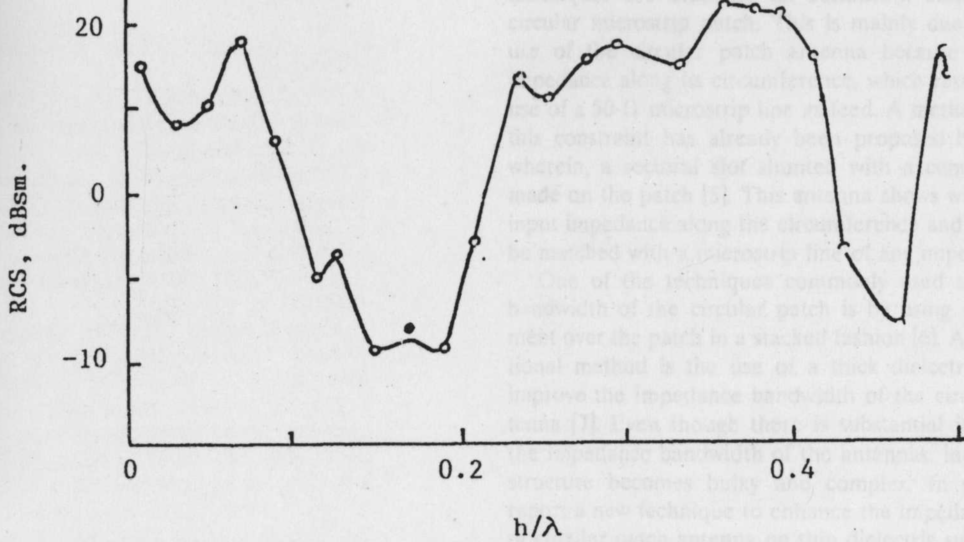

Figure 4 Dependence of the thickness of the dielectric sheet on RCS for corner reflector. f = 9.71 GHz

the two flat surfaces, is greatly reduced for TE polarization using the SCS technique. This simple method is found to be very effective in reducing the RCS of corner reflectors for any corner angle by suitably selecting the parameters of SCS. This may find potential use in strategic RCS reduction of targets in defense and space applications.

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