RCS Measurement Technique in Semi-Anechoic Chamber

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Abstract— This paper presents the implementation of a broadband Radar Cross Section (RCS) measurement system inside the Semi-Anechoic Chamber (SAC) of the Directed Energy Research Center. The setup is used to measure the RCS of a PEC canonical target, and the results are compared with numerical simulations using a rigorous method.

Keywords: Radar Cross-Section (RCS); RCS measurement;

I. INTRODUCTION

The RCS of a target can be estimated using numerical electromagnetic modeling if an accurate 3D geometry of the target is available [1]. An exact numerical calculation of the RCS in the X or Ku band frequencies and for a large bandwidth is often very long and requires a prohibitive memory effort [2]. Therefore, to estimate and validate the numerical prediction, it becomes necessary to have a suitable RCS measurement facility. In general, the measurement of RCS takes place in anechoic chambers [4], that simulate free-space and far-field conditions and where the unwanted reflections are reduced.
This paper focuses on the implementation of an RCS broadband measurement system in a SAC where fully anechoic conditions are not available, and consequently, spurious reflections and interferences become important. Background subtraction and a time gating are performed to extract the target RCS. Finally, the measurement result is compared to numerical calculations.

II. MEASUREMENT SYSTEM

The measurement system is presented in Figure 1.The target is positioned on a Styrofoam column support of 1.5-meter height, and the support is placed on a turntable to rotate the target in azimuth. A laptop is located inside the control room to simultaneously control the VNA and the turntable. The measurement is performed in the azimuth range from -90 to 90 degrees around the target, with a 0.5-degree resolution.

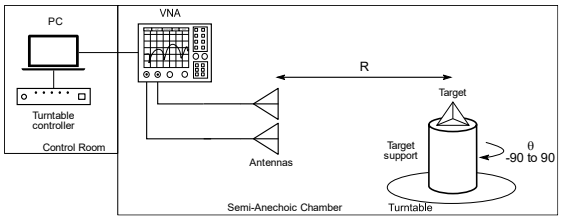


Figure 1: Schematic diagram of the measurement system.

III. RESULT AND DISCUSSION

The RCS of a metallic square trihedral corner reflector of 30 cm sides is measured at 10 GHz for vertical transmit and receive polarization. The measurement is performed using the following steps: First, a full 2-port SOLT (short-open-load-thru) calibration is performed to establish the reference plane at the output of the coaxial cables. Secondly, a metallic sphere of 30 cm diameter (see Figure 2) is used as a reference. The third step consists of measuring the response of the target.

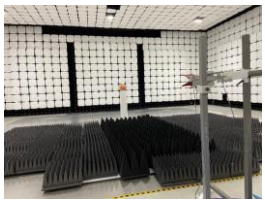
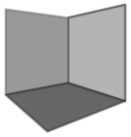


Figure 2:Calibration sphere in the SAC

The geometry of the trihedral and a comparison between measurement and numerical simulation are shown in Figure 3.



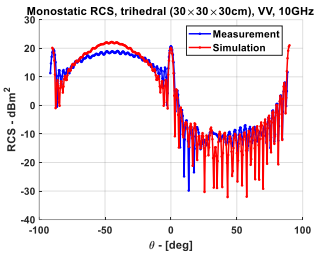


Figure 3: Monostatic RCS of a trihedral corner reflector of 30cm.

According to the plots in Figure 3, between 0 and 90 degrees, the agreement between the simulation and measurement results are very good. Below 0 degrees, the differences are most likely caused by the impact of the imprecise reference target used for calibration. Further discussion will be presented during the final presentation.

REFERENCES

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