IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

A study of RCS reduction using the designing of Chaotic Structures

Er. Tejasvi Thanvi[1], Er. Piyush Vyas[2], Prof. K. K. Arora[3]

Student of B.Tech, Department of Electronics & Communication Engineering, JIET, Jodhpur, India[1]

Assistant Professor, Department of Electronics & Communication Engineering, JIET, Jodhpur, India [2]

Associate Professor, & HOD of M.Tech. (DC), Dept., of Electronics & Communication Engg., JIET, Jodhpur, India[3]

Abstract: The main aim of this paper is to Design such a target so that there is least detection of it by the Radar system. For this we need to implement the strategies so that the RCS (Radar Cross Section) of the target is reduced to its minimum amount, the two types of reduction process we will be using are Stealth Technology and Materials & Absorption (Use of Radar Absorbent Materials). RCS reduction is chiefly important in stealth technology for aircraft, missiles, ships, and other military vehicles. With smaller RCS, vehicles can better evade radar detection, whether it be from land-based installations, guided weapons or other vehicles. The distance at which a target can be detected for a given radar configuration varies with the fourth root of its RCS. Therefore, in order to cut the detection distance to one tenth, the RCS should be reduced by a factor of 10,000. Whilst this degree of improvement is challenging, it is often possible when influencing platforms during the concept/design stage and using experts and advanced computer code simulations to implement the control options.

Keywords: RCS, advanced computer code, roots, land based installations, weapon vehicles.

I. INTRODUCTION

RCS Measurement of the standard targets is a complex task due to the many factors that may affect these measurements. Instrumental errors, spurious interferences and reflections are some of contributors that degrade the quality of the measurement data.

In RCS measurement, it is important that the radar is illuminated by an electromagnetic wave which is uniform in phase and amplitude. For practical purposes the maximum tolerance for amplitude variation is 0.5dB whereas the phase deviation should not be more than by 22.50. These characterize the far field condition and also limit the Quiet Zone size of the anechoic chamber.

II. TECHNIQUES & ALGORITHMS BRIEFING

Anechoic Chamber Measurement setup:

The Anechoic Chamber is of size 3m x 3m x 10m. The target-to-source distance is about 7m. The instrumentation comprises of the HP 8530 Microwave receiver, HP 83620 synthesized sweeper, and an 8511A Front-End. Broadband illumination horns covering the frequency range 3-8GHz and 8-18GHz with low side lobes for reduced coupling are used to transmit and receive. A target stand made of low-density foam is used for placement of the target. The instrumentation interfaces to a PC based controller over GPIB bus.

The basic instrumentation required for RCS measurements consists of four subsystems that can be controlled by a central station; these subsystems are:

- Positioners and drivers (Target Positioning Systems)
- Receiver
- Transmitter
- Data acquisition system.

Using a simple setup and placing the transmitter (TX) and receiver (RX) antennas in the scheme showed in Figure, it is possible to measure the RCS of targets in different frequency ranges. The distance between both antennas needs to be tested to eliminate the radiation coupling between them.

fig. 2.1 VNA Machine for RCS experiment

fig. 2.2 VNA Instrumentation and Anechoic Chamber for RCS Measurements

DOI 10.17148/IJARCCE.2015.412111

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

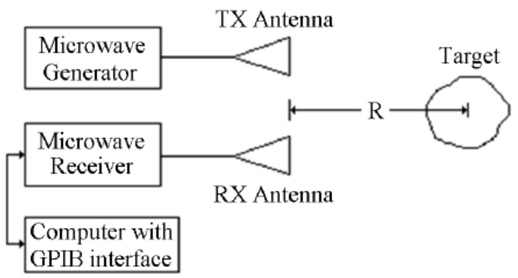

fig. 2.3 General RCS Measurement technique with the help of Tx/Rx antenna and computer GPIB interface

Figure shows the system composed by:
a. Target under test (square flat plate with 0.2 m side);
b. Pyramidal microwave absorbers;
c. Horn antennas to the 8.2 – 12.4 GHz frequency range;
d. Low loss coaxial cables;

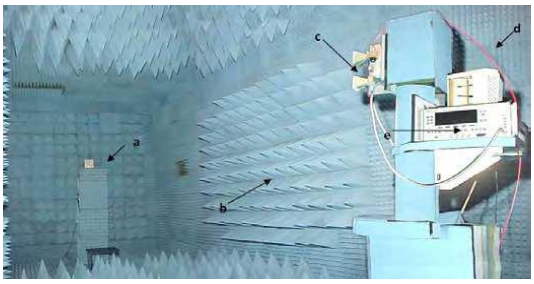

Fig. 2.4 Anechoic Chamber inside view

1.3 Parameters and steps of measurement:
Setting the appropriate parameters is essential to step-frequency RCS measurement system. According to the different requirements of measurement, the parameters need to be intercalated as follows:

1) The span of frequency: The signal provided by network analyzer is equivalent to a serial pulse in time-domain. The width of pulse τ is $1/BW$, where BW is the span of frequency, so the resolution of range Δd is $c/2BW$. We can see that is a wide frequency span and narrow pulse signal which introduces a very good resolution of range. Therefore, the span of frequency must be chosen according to the desired resolution.

2) Number of points: According to the measurement distance R, the maximal interval of frequency $\Delta f_{\max}$ is $c/2R$, and the least points is $BW/\Delta f_{\max}$.

3) IF bandwidth: It's helpful to improve the signal to noise ratio (SNR) by setting appropriate IF bandwidth. In theory, the narrower IF bandwidth we set, the better results we get. However, if the IF bandwidth is too little, the sweep time will be increased greatly, and the time of measurement must be unbearable.

4) Power: Due to the effect of cable loss and attenuation on space, the received energy of signal will be reduced. So it's necessary to increase the transmitted power to improve the SNR. However, the stability of power cannot be assured beyond a limited scope. Therefore, we add a power amplifier to keep the source unchanged.

III. ALGORITHM APPROACHES

The steps of measurement are as follows:

Step 1: The whole chamber is measured, and then the time cancellation is done to reduce the impact of clutters.

Step 2: The target is measured. The region where energy from target tested is higher than that from background will be chosen by a range gate, and returned to frequency-domain.

Step 3: The scaling is measured. The frequency-domain data are recorded in the same range gate.

The RCS of target is calculated by the following formula:

$$\sigma_{\text{target}} = \sigma_{\text{s.target}} \cdot \frac{S_{\text{target}}}{S_{\text{s.target}}}$$

$\sigma_{dBsm} = S_{21} - S`_{21} + \sigma`_{dBsm}$

Where, σ_{dBsm} *is the RCS of target,*
$\sigma`_{dBsm}$ *is the RCS of standard target,*
$S_{21}, S`_{21}$ *are the scattered power density measured value of target and standard target.*

Proposed system:

The earliest forms of RAM were the materials called *Sumpf* and *Schornsteinfeger*, a coating used by the German navy during World War II for the snorkels (or periscopes) of submarines, to lower their reflectivity in the 20-centimeter radar band the Allies used. The material had a layered structure and was based on graphite particles and other semi conductive materials embedded in a rubber matrix. The material's efficiency was partially reduced by the action of sea water.

Germany also pioneered the first aircraft to use RAM during World War II, in the form of the Horten Ho 229. It used a carbon-impregnated plywood that would have made it very stealthy to Britain's primitive radar of the time. It is unknown if the carbon was incorporated for stealth reasons or because of Germany's metal shortage.

IV. CONCLUSION

In this paper, we surveyed about the technology used in our project is a highly advanced and under process technology on which many scientists are still working, the technology may be implemented for the defence purposes which are highly effective when it comes to the national security of the nation. The designing and results are are under processing of chaotic structure in CST software. We will submit the next part of this paper as early as possible with results and algorithms.

VI. REFERENCES

[1] Bo Fidé, Draft version released 29th October 2012 at 16:48 CET—Downloaded from http://www.plasma.uu.se/CED/Book, 2014
[2] PROFESSOR ALLEN E. FUHS, *radar cross section lectures*, Department of Aeronautics. April 2013.
[3] Glen Dash, *How RF Anechoic Chambers Work*, Ampyx LLC, Glen Dash at alum.mit, Copyright 1999, 2005 Ampyx LLC
[4] Understanding the Fundamental Principles of Vector Network Analysis, Agilent technologies, June 2014
[5] A. Hebeish, Factors affecting the performance of the radar absorbent textile materials of different types and structures, National Research Center Dokki, Giza, Egypt, August 2015
[6] Radar Signatures and Relations to Radar Cross Section, Mr P E R Galloway, Roke Manor Research Ltd, Romsey, Hampshire, United Kingdom, research institute of UK, April 2015

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

[7] Role of Radar Cross Section facilities, in a Radar and Electronic Warfare Defence Research and Evaluation capability. Authors: EW_Erlank Pienaar, Thomas Küsel, Pieter Goosen, Christo Cloete, Louis Botha. October 30, 2014.

[8] Guilherme G. Peixoto, Mauro Angelo Alves, Alberto José de Faro Orlando, “Measurements in an Outdoor Facility and Numerical Simulation of the Radar Cross Section of Targets at 10 GHz”, J. Aerosp.Technol. Manag., São José dos Campos, Vol.3, No.1, pp. 73-78, Jan. - Apr., 2011.

BIOGRAPHIES

Mr. Tejasvi Thanvi receives his B.Tech. Degree in Electronics & Communication Engineering Branch from Rajasthan Technical University, Kota, Rajasthan, India in 2015.

Er. PIYUSH VYAS Completed his B.Sc. Degree in Electroics Engineering Branch from Jai Narayan Vyas University, Jodhpur, Rajasthan, India in 2004, M.Sc. in Electronics Engineering Branch from Devi Ahilya Vishwa Vidhyalaya University, Indore, MP., India in 2006, and M.Tech. in Communication Engineering Branch from VIT University, Vellore, Tamilnadu, India in 2009. He is Pursuing his Ph.D. degree from Faculty of Engg., ECE Department , MBM Engg. Colege, JNVU, Jodhpur.

Prof. K. K. Arora Completed his B.E.& M.E. Degree in Electronics Engineering Branch from MBM Engineering College, JNVU, Jodhpur, Rajasthan, India in Batch 1985, He is pursuing PhD. He has also completed MBa from KOU, Kota, Rajasthan, India

 DOI 10.17148/IJARCCE.2015.412111