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THE ANALYSIS OF THE DIFFERENT MODELING IN CST FOR PREDICTING DESIGNS OF A MONOSTATIC AND BISTATIC RCS

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Abstract

In this, research paper, we analyzed different radar cross-sections and models in Computer Simulation Technology (CST) software and tell in advance the RCS of the layer. In this variation exploration and representation of antenna layout in CST, we make a decision on various polarized plane wave angles. The research results may influence aircraft and any vehicle building, connecting with the incorporation of magnetic and electrical part power going return, therefore the polarization of plane waves, the use of different materials, aircraft, and any vehicle size. For this article, a microstrip antenna design with a reduced monostatic (RCS) with changing angle is described. Radar recognizes a reflected signal from this target due to microwave sensors' capacity to adequately light it with energy. The research used several both basic and sophisticated targets at an unaccompanied median rate of occurrence. Two categories of target forms, basic and complicated, made of iron material, give an appearance for assessing RCS in two distinct systems, Monostatic and Bistatic, with a range of angles.

Keywords: antenna, monostatic RCS, bistatic RCS, reflection, decrease RCS, CST

1. INTRODUCTION

The important challenge of dependent more factors, for example, frequency-selective surfaces (FSSs) with different geometrical patterns have been discovered as a complete form of experience software, for the reasons of the filter quality. For the Monostatic and Bistatic RCS antenna anonymity diagram of FSS bandpass. For this reason, we can use FSSs unsystematically. Monostatic and Bistatic RCS antennas have been very different in used in kinds of aircraft, and any vehicle structure by the advantage of them characteristically lightweight, having a little side view, and good physical state to incorporate. Consequently, the role of monostatic and bistatic RCS decrease using different types of antenna systems are extremely necessary [17].

The most significant Radar technologies depend on the Radar Cross-section (RCS) aspect, which displays the dimensional shape of the electrical signal that the observed item provided as its fingerprint. Physical objects such as tanks, aircraft, and vessels can be analyzed. Although microwave devices are used, measuring this characteristic is a costly and challenging process. Radar recognizes a reflected signal from this target because of the electromagnetic sensors' capacity to adequately light it with power. In our research, RCS was made using (CST) programs for several easy and more complicated marks with a particular maximum frequency. Simple and sophisticated object shapes are made from a metallic material. We make desertion for analysis of the different types of RSC and a number of gradients in two independent structures, Monostatic and Bistatic, with the understanding that all of them will use one wavelength, such as (X-band frequency). It has been demonstrated suggesting reduced-size object is easier to hit identified since a big magnitude of the primary lobe signifies a greater awareness of objective idea. The RCS estimates for different uncomplicated and complicated objects are more accurate and diverse than earlier simple objective computations based on objective form, dimensions, and kind, as well as wavelengths and substances utilized.

RCSs are a real channel characteristic that discovered the ability of a to fine object in different directions of having magnetic and electrical radiation. That is characterized by the objective's dimensions, substance, look, and various other characteristics. A radar's transmitting and receiving terminals are grouped in an RCS monostatic, whereas its transmitting and receiving terminals are split in an RCS bistatic.

Monostatic and Bistatic RCS are aircraft and any vehicle's particular importance that is dependent on more aspects. Resolution of the calculation of monostatic and bistatic RCS for microstrip antennas system is possible at most for as easy objects. Electron paramagnetic resonance (EPR) depends on simple

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geometric shapes on the proportion of the arrangement of structural measurement of the figure to the wavelength. While passenger aircraft and any vehicle's design are more focused on efficiency and safety, military aircraft are focused on keeping this reflective surface as small as possible. The size to succeed in this is named stealth technologies [1-2].

The difference in the comparison of the energy thickness goes back to the radar receiver to the energy thickness event on the aircraft and any vehicles.

$$\sigma = 4\pi R^2 \frac{P_r}{P_i} \qquad (1)$$

σ- Cross-section of a radar [m^2 or dBsm];

R- the interval in the middle of the aircraft and any vehicle's radar receiver [m];

P_r-Backscattered or send back energy thickness [$Watt/m^2$];

P_i-incident energy thickness aircraft and any vehicle's [$Watt/m^2$].

The RCS is contingent on four factors primarily dependent on the material's shape and substance, the monitoring system's orientation, the orientation of the reflected signal, and the electromagnetic signal's wavelength [3-6].

Monostatic and Bistatic RCS are contingent on three main factors antenna RCS, structural style RCS, and microstrip antenna style RCS. A plane wave is dependent polarization of the plane wave. It is an θ-horizontal surface waveform, and ϕ- polarization in the negative direction.

The worth of RCS depends on a measure of how easily an object can be detected, so the lower the RCS value, the better for a military vehicle or all anti-missile missiles or aircraft. As a result, they do not want to be get detected and RCS has two classifications one is monostatic RCS. This is monostatic RCS, where the terminals for the signaling device and receiving device are situated, and then we have static RCS, where multiple receiver antennas are located at different positions. We also have the transmitting antenna at different positions, so this is a static RCS case, at the moment monostatic RCS of the antenna is different from the simple RCS concept, for example, if we have a planetary patch antenna. [7-12].

To say what the meaning of the monostatic acids' antenna is in terms of two components the first one is the structural mode RCS. Which is normally expressed the send by σ_s and the second one is the antenna mode RCS, which is defined by σ_a.

The total antenna RCS $\left|\sqrt{\sigma_s} + \sqrt{\sigma_a}\, e^{j\emptyset}\right|^2$ and ∅-phase difference between the two modes. They have got a matched load termination. Condition so in that case we can ignore the antenna mode the RCS and what practically matters is the structural mode RCS.

The plane wave originates from the solution of this wave equation.

$$\nabla^2 \vec{E} - \mu\epsilon \frac{\delta^2 \vec{E}}{\delta t^2} = 0 \qquad (2)$$

This wave equation is derived from Maxwell's equation that can be derived from maximum situations so the plane wave is one of the solutions of this wave occasion there are many solutions to this wave equation and one of them is the plane wave solution and why they are called a plane wave.

$$\vec{E}(z,t) = \vec{E_0}\, e^{j(\omega t - kz)} \qquad (3)$$

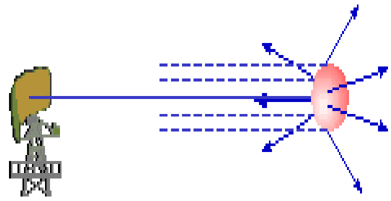
In this (3) following formula for calculation of the RCS is the official lower position of the condition of optical, frequency-independent reflection at bodies that are much additional elsewhere from the radar than the wavelength and which are much larger than the used wavelength of the radar.

$$\tau = 4\pi r^2 * \frac{S_r}{S_t} \qquad (4)$$

In this equation, σ is an apparent area in [m²], the calculation of the deflection of radiation capability, S_t: power density of the transmitter at the radar aircraft and any vehicle in [W/m²].

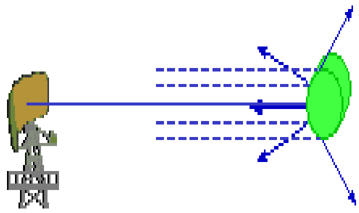
S_r: compensation of the power density at the receiving point [W/m²] [12-14].

1. The reflection from a sphere



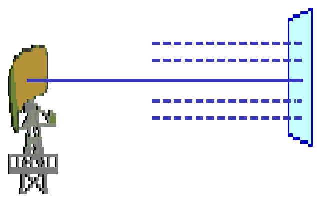
$$\tau = \pi r^2 \ (5)$$

2. The reflection at a cylinder



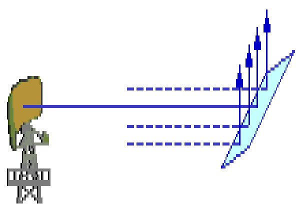
$$\sigma_{max} = \frac{2\pi r h^2}{\lambda} \ (6)$$

3. The reflection at a flat plat



$$\sigma_{max} = \frac{4\pi b^2 h^2}{\lambda^2} \ (7)$$

4. The reflection at an inclined plate



In fact, like this in the previous example, if the calculation of the layer to the radar is used as the surface. The returned power is sent back in a variation line. So, the scanning radar cannot to get this power. That is for that reason there are bistatic radars, where the emitter and the receivers are spatially separated [5-7].

2. METHODOLOGY

There are several RCS calculations that are regarded as legitimate conventional kinds. One of these ways is the CST MWS computer program. The CST's simulator evaluates RCS using a similar frequency, considering a Monostatic and a Bistatic RCS. These ratings are given in decibels per square meter (dBm). Our research focuses on both basic and complicated targets. Simple targets might be rectangular, cylindrical, truncated cones, or ellipsoids, whereas complicated targets are made up of many examples that achieved simple aims. The metallic composition was attached to the revolving support and revolved compared to both left and right.

More factors may be influences of RCS for example the value of electromagnetic waves. For this reason, a vehicle and other machines are more important parts is utilizing bistatic radar.

Using the same transmitting and receiving antenna, the gain and R will be the same $G_r = G_t = G$ and $R_r = R_t = R$ and the monostatic radar range can be written like this equation.

$$P_r = \frac{P_t G^2 \tau\lambda^2}{(4\pi)^2 R^2} \tag{8}$$

Thus, in the equation where G_t and G_r are equal putting $S_{min} = P_r$ will give the max range as

$$R_{max} = \left[\frac{P_t G^2 \tau\lambda^2}{(4\pi)^2 S_{min}}\right]^{1/4} \ldots\ldots\ldots\ldots\ldots(9)$$

It is clear in Bistatic Radar Tx and Rx, antennas are placed apart. Thus, if alpha (bistatic angle, sum of incidence, and reflection angle) is small then bistatic RCS is similar to that of monostatic RCS.

RCS reduction design and simulation results. The design of the AP element was performed using computer simulation in the CST Studio Suite The research paper microstrip patch antennas is a appear by a band microstrip patch antennas have effect at 6 GHz. In this microstrip patch we can see how is makes [16-20].

The band FSS is putted on a material wich is depended dielectric constant is equal 2,2 and loss tangent equals 0,0009. The antenna configuration is taken from which substrate Rogert RT5880 [8-9].

The antenna patch dimension was PL=15,3 and PW=21, whereas the size of the ground antenna patch was SL=SW=64,62. The antenna model made in the CST Studio suite program is presented in Figure 1.

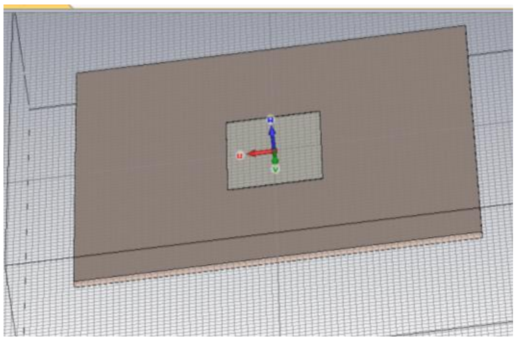
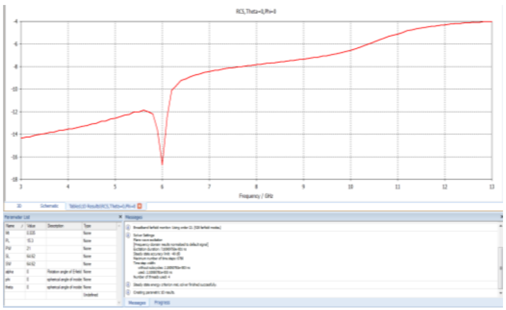


Fig. 1. View of the reference antenna in CST

Result 1: The obtained results show in the first case, we are taken plane wave θ=0 and φ=0 polarized plane wave and the first case result.

The radar plate is used as a surface in our work. Only: the reflected energy is reflected in the other direction.

In our work we are most important concentrate on reduce the recording antenna RCS in the presence of polarization impact, required for u-polarized RCS plane wave impact. A comparison this work of the monostatic RCS antenna below u-polarized amount is presented. Fig. 2. From the occurrence viewpoint, there is a substantial decrease RCS. [14-20].



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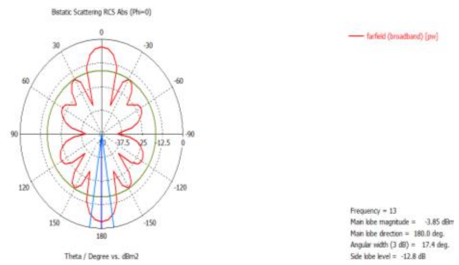

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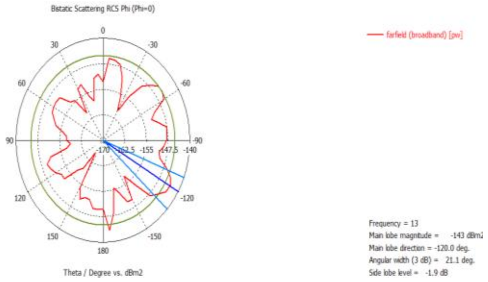
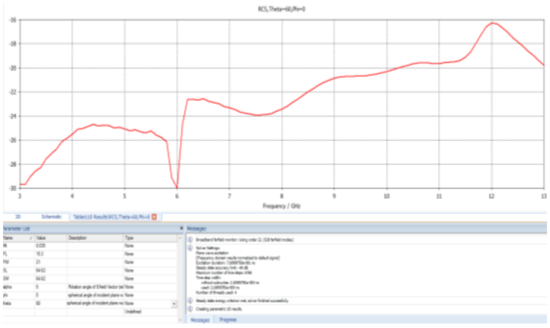


c) polar

Fig. 2. In this figure we take plan wave θ=0 and φ=0 Monostatic RCS resultant antenna

Result 2: The obtained results show in our second case, we change plane wave θ=60, and φ=0 polarized plane wave and the second case result.



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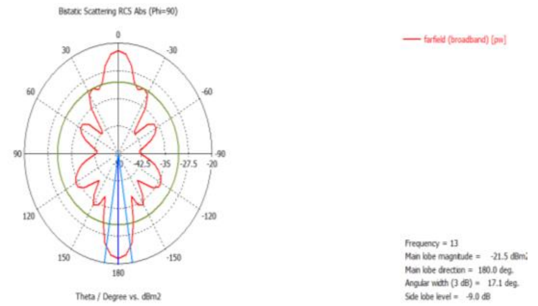
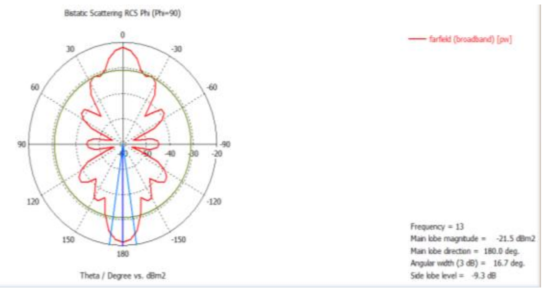


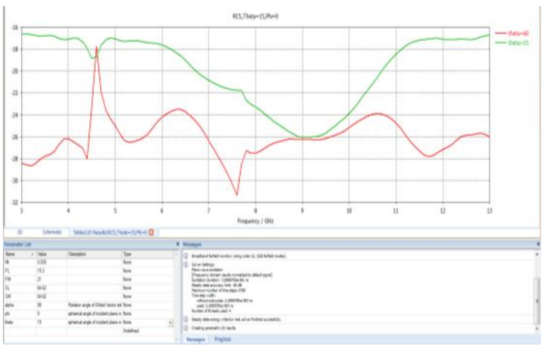
b) polar



c) polar

Fig. 3. Monostatic RCS of the reference antenna plane wave θ=60 and φ=0

Result 3. The obtained results show in the third case, we change for phi-polarized plane wave, the value of alpha is 90 degrees, and simultaneously we change wave, θ=15, θ=60, and φ=0 polarized plane wave and third case result.



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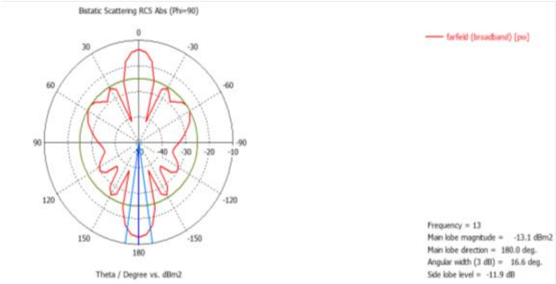
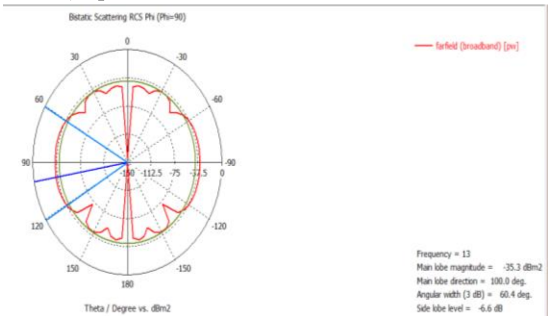


b) polar



c) polar

Fig. 4 Monostatic RCS of the reference antenna plane wave θ=15 and φ=0 and value of alpha is 90 degrees

As a result, the truncated cone target is easier to detect. In addition, more complicated targets can be developed using CST software and then determined by the RCS. Because of the size, form, and variations in targets, as well as the frequencies and substances used, the RCS makes a computation of straightforward and complicated objects more accurate and diverse than prior straightforward object predictions. In addition, the simulation findings show these observations and analyses in greater depth.

In our previous IEEE conference article, we only analyzed and predicted the different models in the CST program and took few results. Our renewal research paper not only makes a model antenna design in CST consequently, but we also make a decision on various polarized plane waves angle. In our previous IEEE conference article. In our article, we analyze the impact of the different components in any object and vehicle. The polarization of the waves may depend on the amount and characteristics of the electromagnetic wave returning to the receiving radar source when using different surface planes and using different materials, and using different cross-sections. Therefore, these parameters should be paid special attention to.

Vivaldi antennas will be built in our next post because they are commonly used in practice. The Vivaldi antenna is built to withstand any weather. It is carried out on a thin flexible substrate, making it easy to install on diverse surfaces. The Vivaldi antenna is used in microwave technology. Wide stripe and printed technology can help to decrease design and production expenses. The Vivaldi antenna is available in numerous variations, including one manufactured from a flat metal sheet. These antennas offer good SWR characteristics in the 1.5 - 15 GHz region and impedance up to 200 ohms.

3. CONCLUSIONS

Today, IoT technologies continue to develop, so it is appropriate to develop antenna technologies. Because it is necessary to develop antenna technologies in self-driving cars in smart cities. Taking into account the changing size and shape of cars, it is appropriate to study the propagation of electromagnetic waves. In this research, we organized a number of scientific articles and developed conclusions and recommendations. Using CST software, which is used in many articles, we decided to do our scientific work in this program. The advantage of the CST program is that it can work together with the MATLAB program. In this work, we have analyzed our antenna at different frequencies and for different antenna angles. Antennas for two types of radar systems, including monostatic and bistatic radar systems, were developed using the CST program and analyzed at different levels of complexity. We have shown above the results obtained in the CST program in different ways. Because of the huge magnitude of the primary lobe, the imagination of the truncated cone target is more obvious.

The trend of increasing demand for mobile networks requires efficient use of the frequency spectrum. Because as a result of the development of the network, the coverage of network users is also increasing sharply. Not only are devices such as smartphones, tablets, and laptops on the rising, but IoT devices are also on the rising. As a result of car-to-car communication, it is necessary to reconsider the efficiency of using the available spectrum.

The trend of increasing demand for frequency spectrum may not be able to meet the demand for it in the future. As a solution to this, we consider it appropriate to use high-frequency resources. As we said above, we used CST software in this article. In this scientific work, we have presented in our research the results obtained from different angles using different materials and different frequencies. The antennas are shown in the analysis of the results obtained in the CST program of 3 different monostatic radars.

In these obtained results, we presented the results obtained at different angles of incidence, including the following angles: θ- horizontal surface waveform, and φ- polarization in the negative direction. The incident angles of ($\theta = 0^{\circ}$, $\varphi=0^{\circ}$),($\theta = 60^{\circ}$, $\varphi=0^{\circ}$), ($\theta = 15^{\circ}, \theta = 60^{\circ}$, $\varphi=0^{\circ}$), are investigated. In my next scientific work, we intend to research different types of antennas and carry out practical work related to this scientific work.[6]

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