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Design of Horn Antenna for Surface Ship Radar Application using Computer Simulation Technology

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ABSTRACT

This technical paper describes about design of horn antenna. The simulation and its analysis is done using Computer Simulation Technology. They are widely used for applications such as radio astronomy, satellite, terrestrial communication, plasma diagnostics etc.… It has no resonant elements, they can operate over a wider range of frequencies and bandwidth.The material used in the designing is Perfect Electric Conductor . The designed horn antenna is practical for Surface Ship Radar Application and the gain is 15.5 dB and the operating frequency is 2 GHz . The parameters of these antennas like Directivity, Gain, S-Parameters, VSWR, Efficiency are calculated by using CST software.

Keywords : Horn Antenna, PEC, CST, Bandwidth, Frequency, Gain, resonant element

1.INTRODUCTION

A horn antenna is additionally called microwave horn. A Horn antenna could be a sort of aperture antenna which is specially designed for microwave frequencies. the primary horn antenna was designed with pioneering experiments through microwaves by a radio researcher namely Jagadish Chandra Bose in 1897. The present horn antenna was invented separately in 1938 by G. C. Southworth& Wilmer Barrow. additionally, an oversized range of radiation characteristics will be obtained in line with the kind of horn and therefore the excitation conditions like polarization and propogation. A Horn consists of a flared length of waveguide ending during a radiation aperture. The several horn configurations bust most populary used are Sectoral horn, Pyramidal horn, Conical horn. By doing flaring impedance of 50 ohms with the free space impedance of 377 ohms for better graphical record. It eradigates VSWR ratio for providing great directivity and narrower beam width. The Electromagnetic Horn Radiator is understood as flare wave guide. Φ is thought as flare angle of the horn antenna which is a crucial parameter to be considered. The flaring not only helps in impedance matching but also gives higher directivity and narrow beam width thus we get the specified graph. The antenna is meant for various purposes like long distance communication, microwave applications, medical applications. the most reason for horn antenna to be most popularly because it is employed as feeds for other antenna like parabolic, lens antenna. The horn antenna is widely classified into Pyramidal horn, Sectoral horn - E-plane and H-plane, Conical horn, Corrugated Horn Antenna and

Exponential horn. Sectorial horn is generated when flaring is done solely in one direction. The sectorial E-plane horn and sectorial H-plane horn are obtained by flaring in the direction of the Electric and Magnetic vectors, respectively. Pyramidal horn is generated by flaring along both the walls (E and H) of the rectangular wave guide. A conical horn is created by flaring the walls of a circular waveguide. Horn Antennas are basically just opened waveguides. All the horn antennas are derived from rectangular waveguides are called Rectangular horn anteenas.

2. ANTENNA PARAMETERS

There are various charactetistics of an antenna which might be understood by using antenna parameters like radiation pattern, beam width, directivity, radiation intensity.

2.1 ANTENNA RADIATION PATTERN

Even though a perfect antenna has only one radiation lobe, we know that the antenna's radiation diagram has radiation lobes. However, because no antenna is ideal, the design includes major and minor lobes. The major lobe of the antenna pattern represents the direction with the highest radiation. The antenna pattern's primary lobe represents the direction with the most radiation. Because they relate to all or any extra pattern directions, minor lobes are sometimes known as side lobes. Essentially, the antenna pattern depicts the sector strength or power density as seen at a hard and fast distance from the antenna, taking into account the orientation. The ratio of the facility required at a loss-free reference antenna's input to the antenna's amount of gain that is delivered to the input of a given antenna to offer the same intensity at the same distance in an excessively given direction is referred to as gain.

$$D = \frac{P(\theta,\Phi)_{\max}}{P(\theta,\Phi)_{average}} \text{..........(1)}$$

The ratio of the antenna's highest radiation intensity (power per unit surface) radiated within the maximum direction divided by the intensity radiated by a hypothetical isotropic antenna radiating the same total power as that antenna is known as antenna directivity.

$$D = \frac{4\pi}{\iint_{4\pi} P_n(\theta,\Phi)d\Omega} = \frac{4\pi}{\Omega_A} \text{..................(2)}$$

TRP (Total Radiated Power) is a measurement of how much power is radiated by an antenna when it is connected to a real radio (or transmitter).

$$P_{rad} = \iint_{\Omega} U d\Omega = \int_0^{\pi}\int_0^{2\pi} U \sin\theta d\theta d\Phi \text{............(3)}$$

3. DESIGN EQUATIONS OF HORN ANTENNA

Assume we have a sectoral horn in the E-plane with a cylindrical radiation source, as shown below.

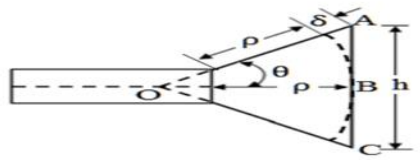


Fig 1: Section view of Horn Antenna

Where,

difference in the path of travel is δ

flare angle is θ

height of aperture is h

length of aperture is ϱ

In comparison to the waveguide, the electromagnetic horn produces a homogeneous phase front with a larger aperture.

The cylindrical wavefronts that propagate outward are uniform wavefronts.

$$COS\theta = \frac{\rho}{\rho+\delta} \text{..................................(4)}$$

Also

$$\tan\theta = \frac{h/2}{\rho} = \frac{h}{2\rho} \text{...............................(5)}$$

Hence we get,

$$\theta = COS^{-1}\frac{\rho}{\rho+\delta} = \tan^{-1}\frac{h}{2\rho} \text{................(6)}$$

The angle θ represented in equation is termed the optimum aperture angle.

The maximum directivity are often achieved by the biggest flare angle but the trail difference must not exceed the standard values they're as follows

For conical horn – 0.32 λ, plane horn - 0.25 λ, H – plane sectoral horn antenna - 0.40 λ and optimum flare horn, the half power beam width can be.

$$\theta_H = \frac{67^\circ}{a_H} \text{.....................(7)}$$

$$\theta_E = \frac{56^\circ}{a_E} \text{.......................(8)}$$

Directivity in terms of effective aperture-

$$D = \frac{4\pi A_e}{\lambda^2} = \frac{4\pi \varepsilon_{ap} A_p}{\lambda^2} \text{...................(9)}$$

Where,

Ae is effective aperture, in m^2

Ap is physical aperture, in m^2

εap = Ae /Ap is Aperture efficiency

4. HORN ANTENNA USING CST

The excitation of antenna is completed by employing a wave guide that is fed with a co-axial cable. The antenna here is desgined employing a simulation Technology (CST) and it's likely that antenna is created of PEC (Perfect Electrically Conducting). The pure mathematics of a horn antenna with spacial coordinates is as xmin = -100; xmax = 300 andymin = -150; ymax = 150 and zmin = -100; zmax= 200. The necessary a part of the antenna style is , wherever the resistivity of wave guide from 50Ω at the feeding purpose to 377Ω at the aperture of the antenna. The %Bandwidth is 50 and gain obtained is 15.5 dB just about, close to field is discovered and analysis ofassorted frequencies area unit discovered.

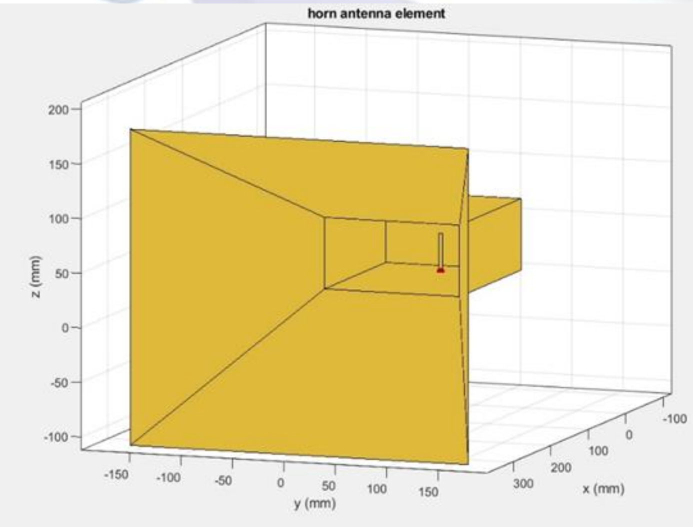


Fig 2: Horn Antenna using CST

5. SIMULATION AND EXPERIMENTAL RESULTS

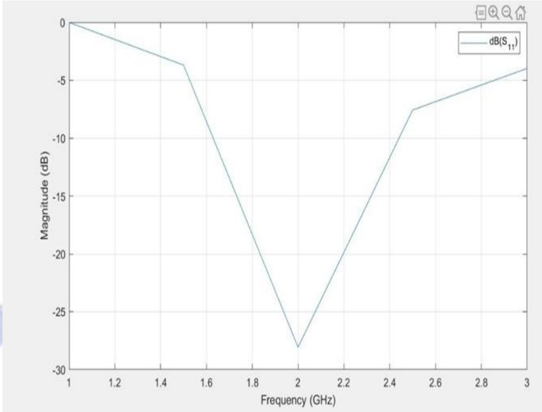


Figure 3: S- Parameter

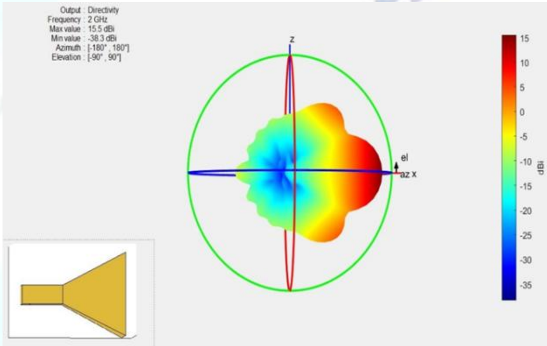
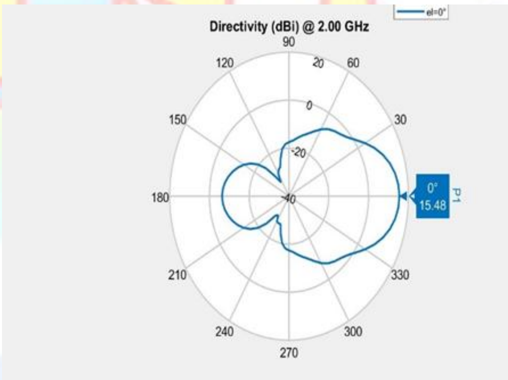


Figure 4: Polar Plot of gain for 2GHz



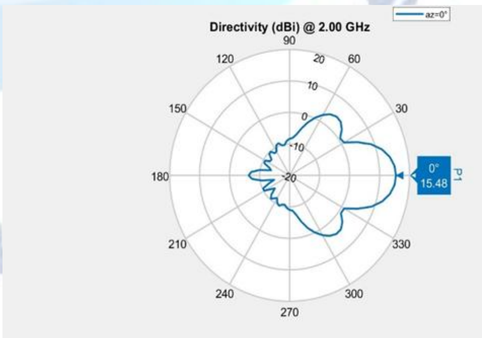


Figure 5: Directivity

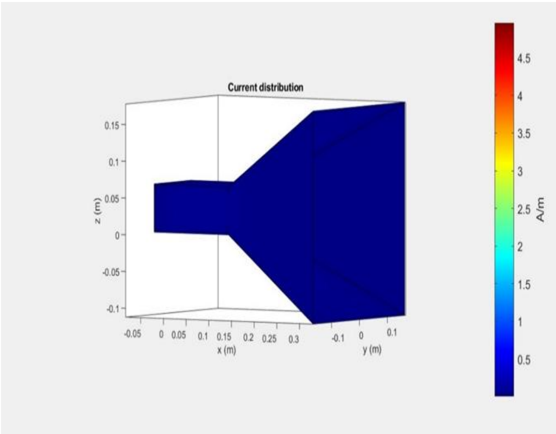


Figure 6: Current Distribution

Figure 3: The design analysis with S(1,1) parameters is shown. Because the network changes both the magnitude and phase of the input signal, sparameters are called complex scattering parameters. Some energy is reflected back into the system due to an impedance mismatch.referred to as "return loss" (dB). It's a numerical measure of how dissimilar two things are.loads' impedances and metallic transmission lines' impedances It is crucial in apps that use bidirectional transmission in both directions at the same time larger numbers It indicates that there is less reflection.

6. CONCLUSION:

The implementation and simulation of horn antenna is completed Succesfully by using Computer Simulation Technology. By the experimental studies, it's proved that the number of signal transmitted depend upon the look issues of the pyramidical horn antenna. they're in the main used wherever radial asymmetry of signal is of main firm . Central Time could be a tool for higher 2D and 3D analysis and structure of antenna will be designed at less time. By simulated results, the antenna is intended at a gain 15.5 dB with a resonant frequency of 2 GHz, VSWR is 0 (perfectly matched), %Bandwidth is 50 and normalized electric resistance of 50Ώ.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] BiswaranjanBarik, A.Kalirasu, "Design of UHF Pyramidal Horn Antenna using CST", International Journal of Pure and Applied Mathematics, vol.114, 2017.

[2] BiswaranjanBarik, A.Kalirasu, "Design Of A Hemi-Spherical Dielectric Resonator Antenna In S-Band", November 2017 , ICPCIT 2017.

[3] BiswaranjanBarik, A.Kalirasu, "DESIGNING OF TRAPEZIUM CUT SHAPE MICROSTRIP ANTENNA IN X BAND", November 2016 icriet-2016, Volume: Nov-2016,145-152.

[4] BiswaranjanBarik, "DESIGNING OF AN ULTRA HIGH FREQUENCY-BAND PASS FILTER USING HFSS", December 2016, ICMSEA, Volume: 2.

[5] AyodeleS.Oluwole,viranjanM.Srivastava, "Design of smart antenna using waveguide-fed pyramidal horn antenna for wireless communication systems", IEEE(INDCON),2015.

[6] Katsushige Harima, MakatoSakasai, Katsumi Fujii, "Determination of gain for pyramidal horn antenna on basis of phase center location", IEEE (ISEC), 2008.

[7] Deqinsyang, Sihaolio, Bao Sun, Jin Pan, "Research on Pyramidal Horn Antenna using integrating optical E – field probe", IEEE (APMC), Vol.3, 2015.

[8] Chintin A. Patel, Shobhit K. Patel, "Pyramidal Horn antenna design loaded by meta – material for performance enhancement", IEEE (MEMO), 2015.

[9] AniketBhumkar, "Design and Implementation of Pyramidal Horn Antenna," IJRASET, Vol. 3 Issue V, May 2015.

[10] Arvind Roy, "Design and Analysis of X band Pyramidal Horn Antenna Using HFSS," IJARECE, Vol. 4 Issue 3, March 2015.

[11] Daniyan O.L., "Horn Antenna Design: The Concepts and Considerations," IJETAE, Vol. 4 Issue 5, May 2014.

[12] Priyanka Bhagwat, "High gain Conical Horn Antenna for short range communications", IJERA, Vol 3 Issue 6, Nov-Dec 2013.

[13] G.Abhignya, B.Yogita, C.Abhinay, B.Balaji, MBR Murthy, "Design, fabrication and testing of pyramidal horn antenna", IJEAS ISSN: 2394-3661, Volume-2, Issue-4, April 2015.

[14] N.Smitha,VipulaSingh,S.N.Sridhara,"Pyramidal horn antenna for ground penetrating radar application", IEEE(INDICON), 2016