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STUDY OF PYRAMIDAL HORN ANTENNA FOR SATELLITE COMMUNICATION

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A B S T R A C T

This paper intends to give light about study of pyramidal horn antenna for S band application by studying the simulation. The Horn antennas are widely used for Television broadcasting, in microwave devices based applications and also in the satellite communication. As per the studies it has been found that the Horn antennas are not having any resonant elements and it just operate at a broad range of frequencies and due to this also poses a wide bandwidth. The Horns are also used for different applications associated with high gain devices and another remarkable application is in form of a feeder for satellite communication reflector and lens antennas. We propose a novel Horn antenna for application in satellite communication.

Keywords*: Horn Antenna, CST MW Studio Suite, VSWR, Far-field*

1. INTRODUCTION

The definition of antenna is given as a metallic device which can transmit and receive the electromagnetic waves in free space as per the IEEE standard. One can serve the purpose of the RF and Microwave signal transmission and reception with a horn antenna. The Horn antenna[1] by convention is used in an assembly with the waveguide feeds. A flared waveguide is forms the Horn antenna and also have the look just like a “Horn”. This antenna has the feature to transmit the radio waves into free space which has been carried by the waveguide.

The application of Horn Antenna is due to high gain[2]. Based on the requirements the aperture size of the horn antenna and the tapper of the horn antenna adjusted to have high gain and directivity. In 1897, the Indian Radio Researcher, Sir Jagadish Chandra Bose has constructed the first Horn Antenna by his novel work in his pioneering experiments with microwave frequency. In the World War II the Radar designs stimulates the developments of Horn Antenna is the composition of a rectangular waveguide at one end and flared at the opposite end forming a Horn shape. The waveguide needed a coaxial feeding to get the excitation and the forward waves radiates from the open aperture of the Horn antenna. The radiated wave forms a very narrow beam and the antenna is having a sharp directivity[3] and gain.

In the following Fig.1 the typical Horn Antenna has been shown.

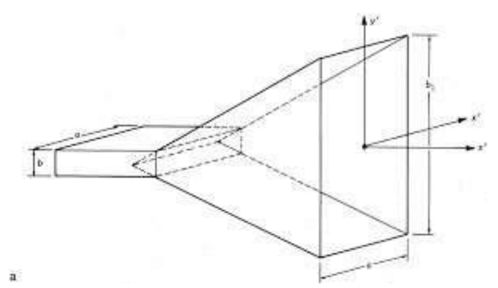

Fig. 1 Horn Antenna

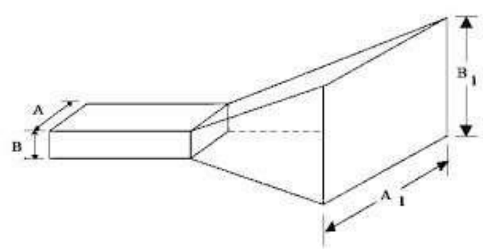

Fig.2: Pyramidal Horn Antenna

As per the Fig.2, the following parameters are being calculated and the proposed design has been made.

$a1 = 5.5\ \lambda$ (i)

$b1 = 75.2\ \lambda$ (ii)

$a = 5.0\ \lambda$ (iii)

$b = 25.0\ \lambda$ (iv)

$\rho 1 = \rho 2 = 6\lambda$ (v)

Where,

Wavelength, $\lambda = c / f$

Horn antenna offers several benefits when employed in that besides matching the impedance of the companion to that of free space or vice versa, it helps suppress signals travelling via unwanted modes in the waveguide from being radiated and it provides significant values of directivity and gain. While it serves as communicating medium for signal interception for processing in systems, it serves in the case of transmission to illuminate dish antenna from its focal area estimated from the f/ d parameters of the parabolic dish. Main text

2. METHODOLOGY

CST MW Studio Suite software is used for this work. The different parameters of the horn antenna are being calculated from the design parameters and design ratios.

3. RESULTS AND DISCUSSION

The proposed Horn Antenna has been simulated in CST MW Studio Suite and also the simulated antenna showing satisfactory results. For the modeling of the Horn antenna the standard theoretical equations are considered and the design has been validated in simulation platform.

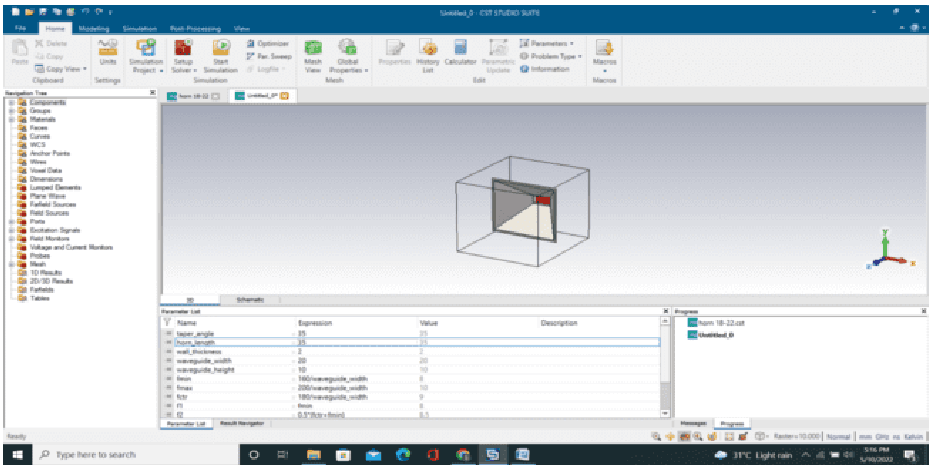

Fig. 3 Proposed antenna in the CST software

n Figure 4 the plot of VSWR vs Frequency is showing good results at 10 GHz.

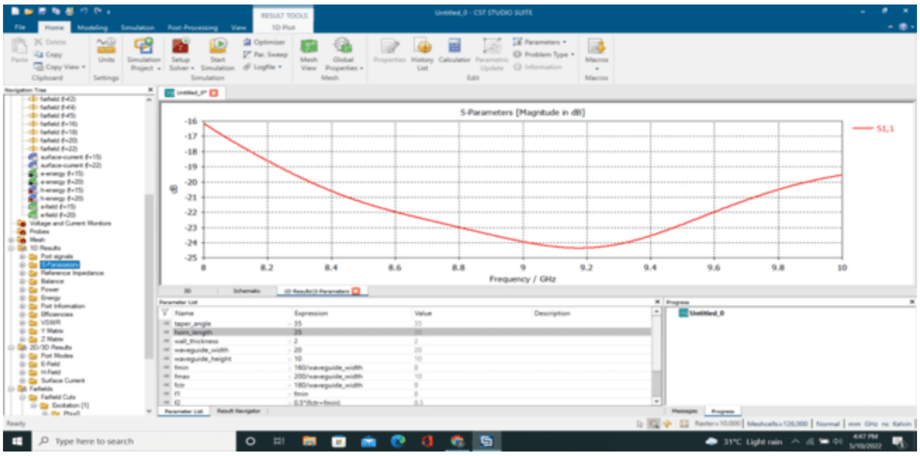

Fig. 4 VSWR vs Frequency plot

In Figure 5 the Far Field Directivity plot is shown where the result is satisfactory at X band frequency.

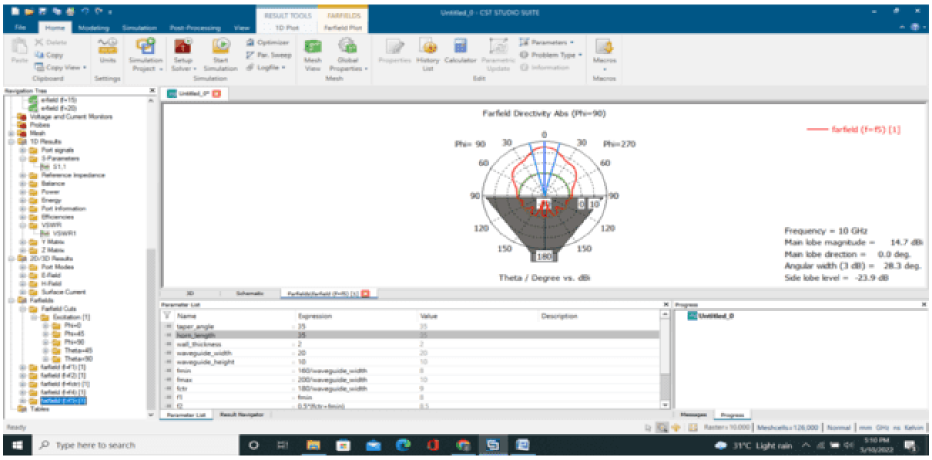

Fig. 5 far field directivity plot

In Figure 6 the S11 vs Frequency plot is shown which demonstrates that the proposed antenna will be suitable at 10 GHz.

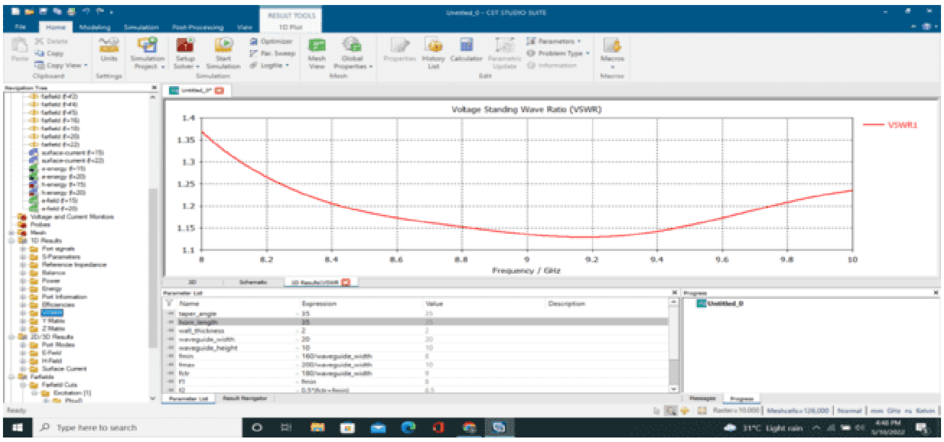

Fig. 6 S11 vs Frequency plot

In Figure 7 the Radiation Characteristics of the Proposed antenna is also showing significant characteristics.

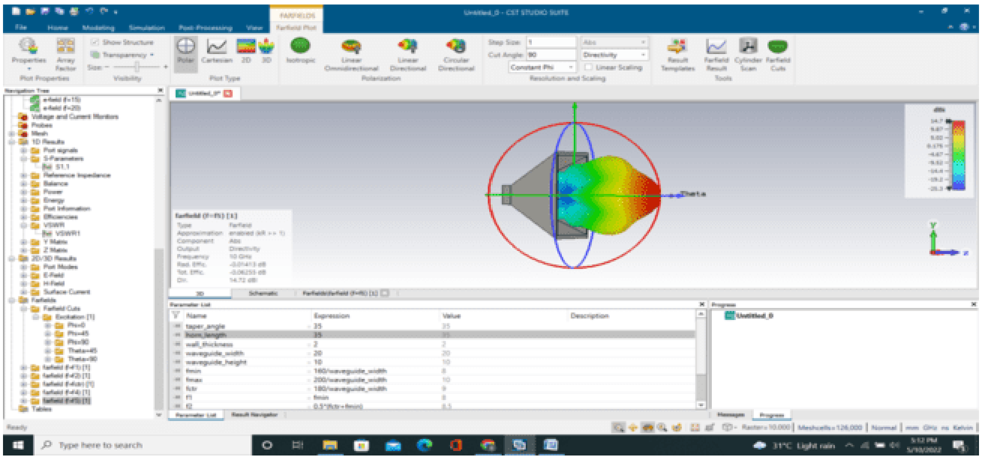

Fig. 7 Radiation characteristics of the proposed antenna

4. CONCLUSION

The successful implementation of the proposed Horn antenna is done in CST platform. As a part of our experimental studies it is clear that the signal can be transmitted as well as received by the proposed antenna. By checking the simulation results it is evident that our designed antenna gives a resonant frequency at 9.18 GHZ with a normalized impedance of 50 ohm. As per our simulation study we found the proposed antenna suitable for satellite communication.

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