DESIGN OF A NOVEL STEPPED BICONICAL ANTENNA

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Abstract
The biconical antenna has a broad bandwidth because it is an example of a traveling wave structure; the analysis for a theoretical infinite antenna resembles that of a transmission line.The proposed antenna is able to give a newer radiation pattern with a little more range then basic shape and S-parameter vale of -20 dB. Results indicate that the addition of posts and lumped resistive loading has important role in coming up with broadband antennas that are in small size.
Keywords: Biconical, antenna

I. INTRODUCTION

In radio systems, a **biconical antenna** is a broad-bandwidth antenna made of two roughly conical conductive objects, nearly touching at their points. Biconical antennas are broadband dipole antennas, typically exhibiting a bandwidth of three octaves or more. A common subtype is the **bowtie antenna**, essentially a two-dimensional version of the biconial design which is often used for short-range UHF television reception. These are also sometimes referred to as **butterfly antennas**.

.**Typical applications for biconical antennas are:**

- Broadband RX-antenna for emission testing (20-300 MHz)
- TX-antenna for immunity testing, especially at low frequencies
- Measurements of shielding effectiveness
- Evaluation of test sites e.g. anechoic rooms (FAC) and open area test sites (OATS)
- Passive field probe for immunity testing

II. MODEL DEFINITION

The antenna pure mathematics consists of a 0.2 m tall bronze cone with a prime angle of ninety degrees on a finite ground plane of a 0.282 m radius. The central conductor of the cable is connected to the cone, and also the screen is connected to the bottom plane.

The model takes advantage of the motion symmetry of the matter, which permits modeling in 2nd victimization cylindrical coordinates. You'll be able to then use a really fine mesh to attain a superb accuracy. The central conductor of the cable is connected to the bronze cone, and also the cable screen is connected to the finite ground plane.

III GEOMETRY DESIGN

Designing a biconical antenna using comsol tool, to generate the above biconical antenna geometry we needed the following steps.

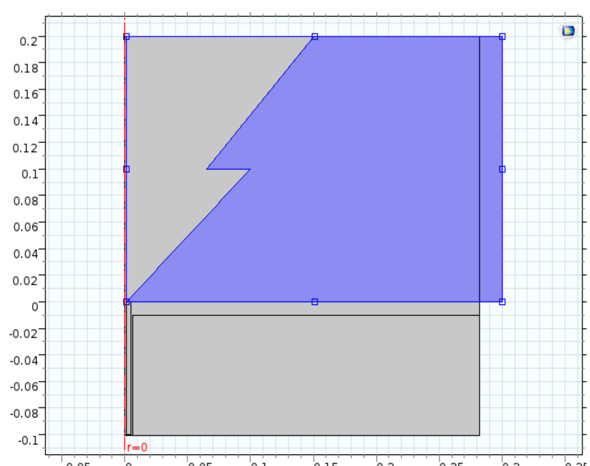

Figure 1: Polygon Design

By using r = 0.3, 0.3, 0.15, 0.065, 0.1, 0.0015 and z = 0, 0.2, 0.2, 0.1, 0.1, 0 we design a polygon as shown in blue.

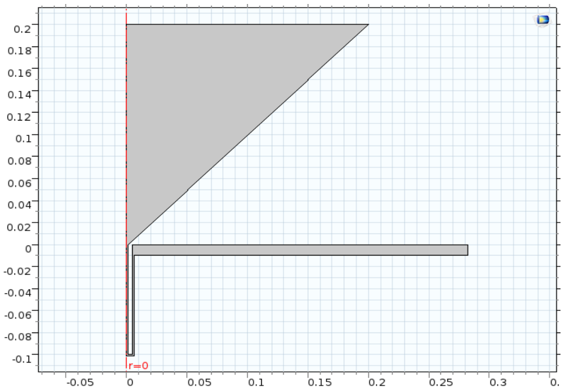

Figure 2: Symmetrical Half of Biconical Antenna.

Symmetrical half of typical biconical antenna is shown in figure 6. The central conductor of the cable is connected to the bronze cone, and also the cable screen is connected to the finite ground plane.

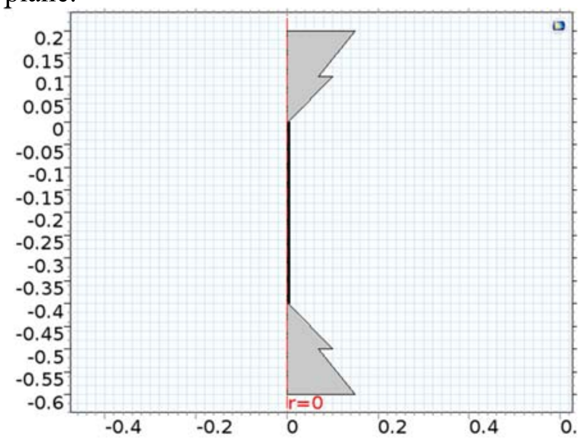

Figure .3: symmetrical half of Novel Biconical antenna.

Symmetrical half of novel biconical antenna is shown in figure 7. The central conductor of the cable is connected to the bronze stepped cone, and also the cable screen is connected to the finite ground plane.

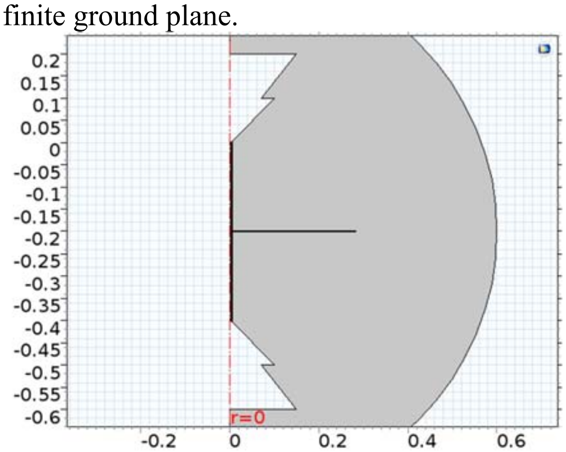

Figure 4: symmetrical half of Novel Biconical antenna.

Then a semi-circle of radius of 60 cm is drawn as an air domain for radiation pattern which is shown in figure 4.8.

Appling Material

The central conductor of the cable is connected to the stepped cone is made up of bronze, and also the cable screen is connected to the finite ground plane.

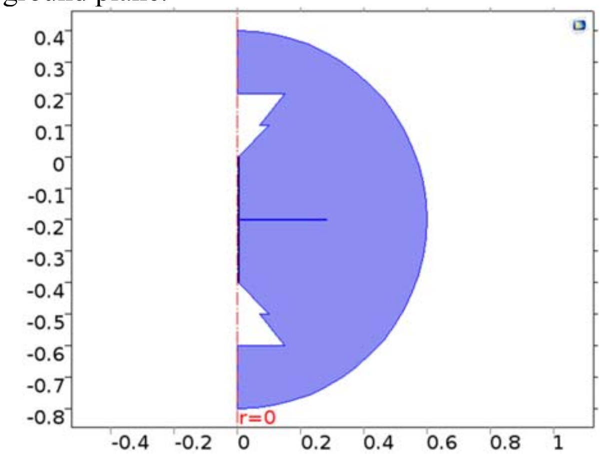

Figure 5: Appling Material

The concentrical feed incorporates a central conductor of 1.5 millimetre radius Associate in Nursingd an outer conductor (screen) of 4.916 millimetre radius separated by a teflon nonconductor of relative permittivity of 2.07. The central conductor of the cable is connected to the cone, and also the screen is connected to the bottom plane.

Table 4.1: Teflon Properties

	Property	Name	Value	Unit
✓	Relative permittivity	epsilonr	2.07	1
✓	Relative permeability	mur	1	1
✓	Electrical conductivity	sigma	0	S/m

Boundary Conditions

By using Electromagnetic Waves, Frequency Domain physics we can analyze the novel stepped biconical antenna.

The boundary conditions for the bronze surfaces are:

$$\mathbf{n} \times \mathbf{E} = 0$$

At the feed purpose, a matched concentrical port stipulation is employed to form the boundary clear to the wave.

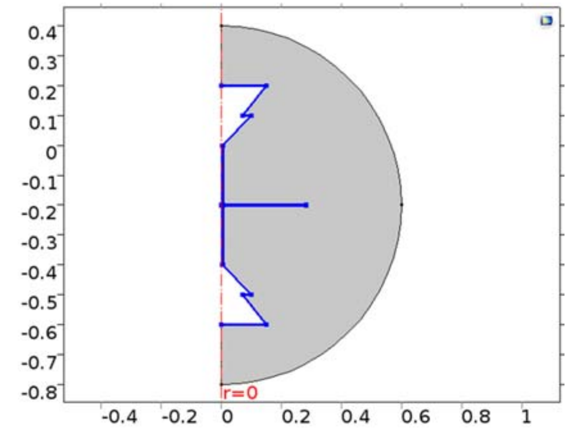

Figure 6: boundary conditions for the bronze surfaces

The antenna is divergent into free area, however you'll be able to solely discretize a finite region. Therefore, truncate the pure mathematics a long way from the antenna employing a scattering stipulation providing outgoing spherical waves to pass with little reflections. A symmetry stipulation is mechanically applied on boundaries at r = 0.

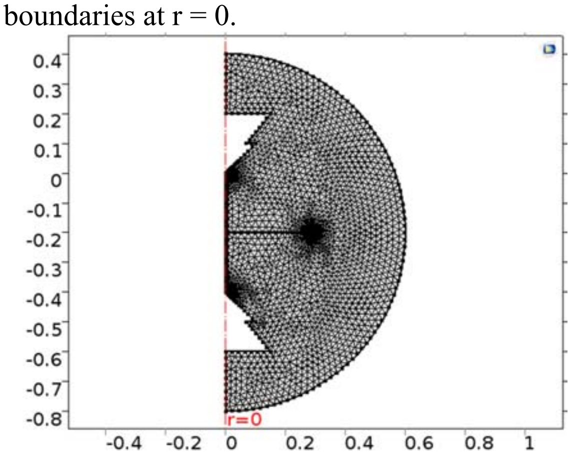

Figure 7: Meshing

Meshing

By meshing we can interruption of the geometry into small parts to make the solution more accurate, as shown in figure

Study

In study we provide the study parameters for a geometry, in this model we apply the frequency at terminal ranging from 200 MHz to 3 GHz with a step size of 25 MHz as shown in figure below

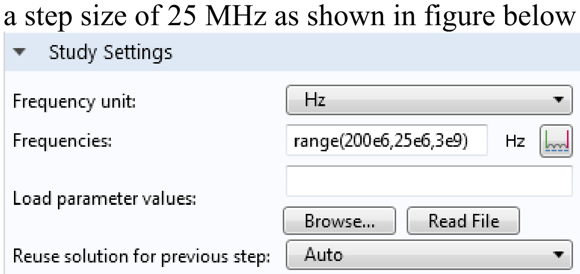

Figure 8: Appling Frequency Range

Post Processing

In post processing we analyze the various results of the basic design and new proposed stepped biconical antenna design with various parameters of them.

Electric field

The electric field of basic biconical antenna are shown in figure 13, the blue and red circles around the cone in air domain are shown, with maximum value of 118 A/m.

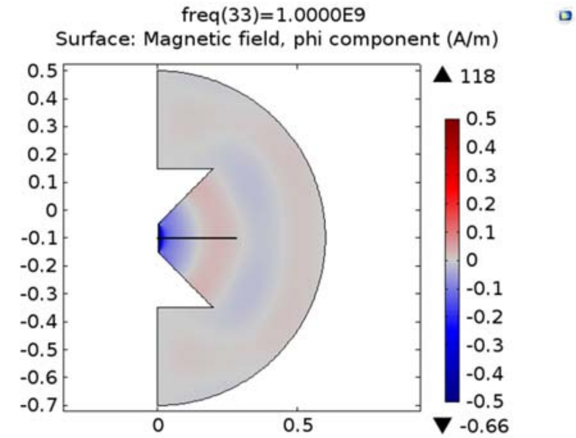

Figure 9: Electric Field basic

The electric field of proposed stepped biconical antenna are shown in figure 4.14, the blue and red circles around the cone in air domain are shown, with maximum value of 89.6 A/m.

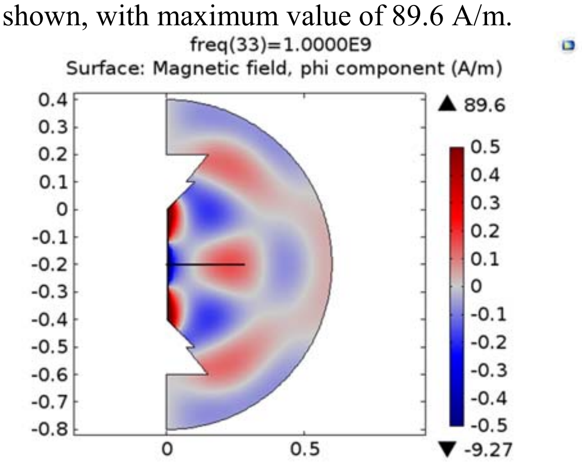

Figure 10: Electric Field of stepped

IV RESULTS

S - Parameter

The S - parameter of basic biconical antenna are shown in figure 15, the losses in dB are shown for range of frequency is shown below with maximum loss of -12 dB.

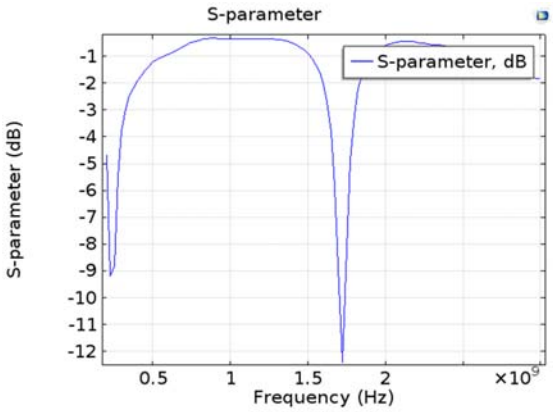

Figure 11: S – parameter basic

The S - parameter of proposed stepped biconical antenna are shown in figure 16, the losses in dB are shown for range of frequency is shown below with maximum loss of -21 dB. Which is nearly double of the basic biconical antenna.

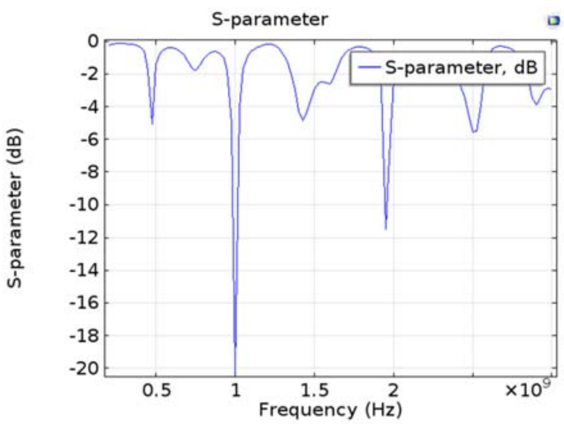

Figure 12: S-parameter of stepped

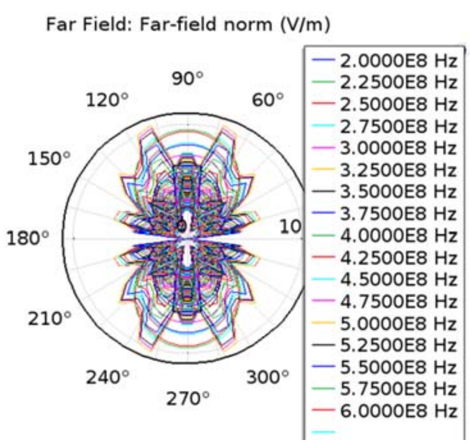

Figure 13: far field basic

Far-Field norm (V/m)

The polar far field pattern of basic biconical antenna are shown in figure 17, with band of frequency starting from 200 MHz to 3 GHz with step size of 25 MHz.

The polar far field pattern of stepped biconical antenna are shown in figure 18, with band of frequency starting from 200 MHz to 3 GHz with step size of 25 MHz. coveres nearly double distance.

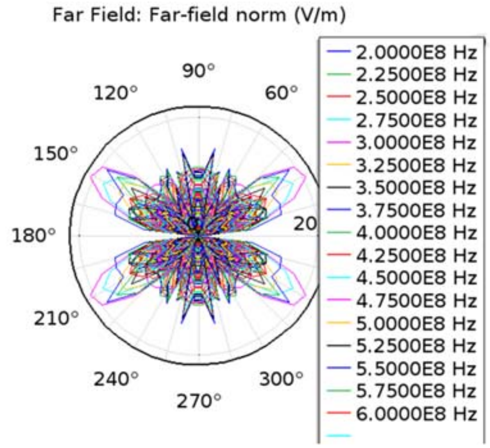

Figure 14: Far field of stepped

Far-Field norm (V/m) 3D

The polar far field pattern of basic biconical antenna are shown in figure 18, with band of frequency starting from 200 MHz to 1.5 GHz with step size of 25 MHz.

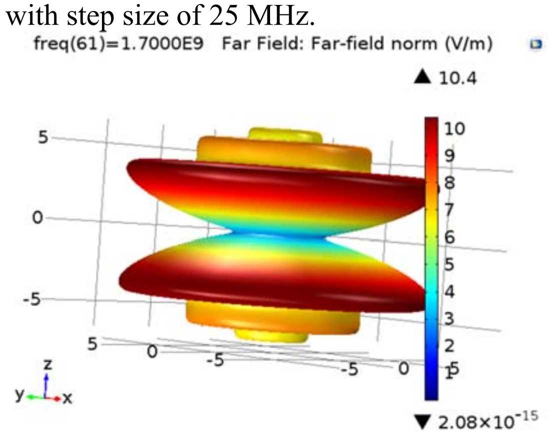

Figure 16: far field basic

The polar far field pattern of stepped biconical antenna are shown in figure 20, with band of frequency starting from 200 MHz to 1.5 GHz with step size of 25 MHz. a unique pattern of field is shown below.

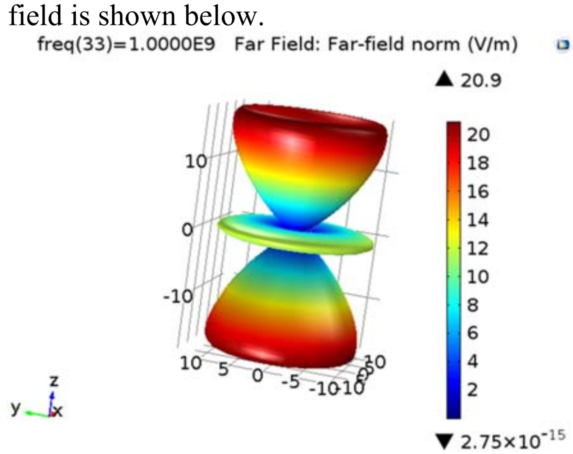

Figure 15: Far field of stepped

V CONCLUSION

In practice, the stepped biconical antenna is difficult to fabricate but the 10 dB return loss result in the low frequencies is small compared to the normal biconical design. Thus the stepped biconical antenna may be useful in some applications which demand specific radiation pattern. The input impedance of the biconical antenna varies according to the step, as expected. It is observed that an optimum step exists for 50Ω matched impedance. From the above results, the influence of geometric parameters on impedance matching is noted. It is observed that the improvement in bandwidth can be obtained with the height of the biconical antenna is approximately equal dimension to the base radius of the cone.

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