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## **NOVEL BICONICAL ANTENNA CONFIGURATION WITH DIRECTIVE RADIATION**

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**Abstract**—In this paper a novel biconical antenna geometry has been proposed that has directive radiation pattern, higher gain and enhanced front to back ratio. Wide band performance is another characteristic of this new antenna.

### **1. INTRODUCTION**

Wide band and ultra wide band systems are growing dramatically and upon this demand on antennas to have ultra wide band performance has been very serious requirement. Scientific journals have too many articles in this subjects recently [1–15]. Biconical antennas were introduced many years ago as wide band antenna and scientists and engineers have published many papers on this subject and some books have sections on this type of antenna. Wideband operation of this antenna type is of interest and, suitable especially for wideband and ultra wideband applications.

Collin [16] and Schelkunoff [17] considered conical antenna structures in different cases and addressed various areas such as, general formulations, thin wire antenna, wide angle conical dipoles, antenna admittance, biconical antenna in inhomogeneous dissipative media, dielectric loaded biconical antenna, asymmetric biconical antenna, and so on. Input impedance and radiation characteristics

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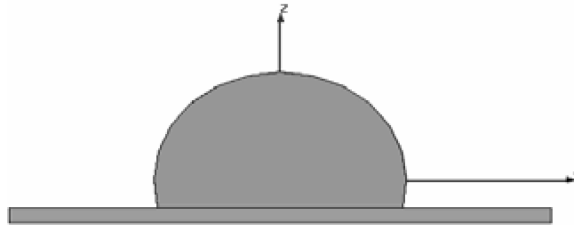
of bicones are solved problems as well but, research on this famous antenna type has been extended up to now [18, 19].

Biconical antenna in free space has omni directional pattern in  $H$ -plane. Nagasawa and Matsuaka have reported directional biconicals using oblique edges [20]. They achieved directive antenna with low front to back ratio up to 6 dB.

In this paper, novel configuration for biconical antenna is proposed. The proposed antenna is manufactured and tested. In addition to wideband operation it has directive pattern, higher gain and improved front to back ratio.

## 2. NOVEL ANTENNA STRUCTURE

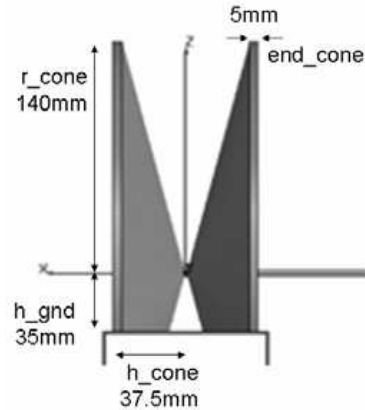
Proposed antenna consists of two components, each component is a part of a cone that is illustrated in Figs. 1 and 2. Due to large conical flare angle authors have added a 5 mm end cylinder to save sharp edge. Narrow ground improves antenna front to back ratio and fixes cut cones in front of each other. Because of space limitations in the project such a narrow ground has been used with 80 mm and 280 mm dimensions with coaxial cable feed structure. Also dimensions of antenna have been selected with trial and error and are plotted in Fig. 2.



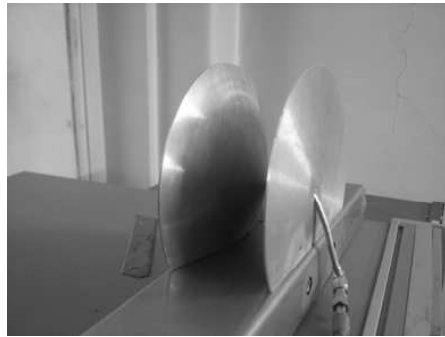
**Figure 1.** Antenna in  $y$ - $z$  plane ( $E$ -plane).

## 3. SIMULATION AND TEST RESULTS

The model had been simulated using commercial *Ansoft HFSS* package. Simulation has been done by a setup frequency at 3 GHz (highest frequency in the range). Fast frequency sweep from 1 GHz up to 3 GHz has been employed to calculate accurate  $S$ -parameters and Return Loss. Also radiation characteristics of antenna have been simulated using a discrete sweep from 1 GHz up to 3 GHz with 100 MHz frequency steps.



**Figure 2.** Antenna structure and its dimensions in  $x$ - $z$  ( $E$ -plane).



**Figure 3.** Three dimensional view of fabricated antenna.

Figures 4, 5, 6 show simulated  $E$ -Plane and  $H$ -plane at 1.2 GHz, 2 GHz and 3 GHz. All patterns have been scaled to dB. Green, black and red patterns are test, simulated co-polarized and cross-polarized patterns. The most noticeable property is improvement in front to back ratio from 6 dB in [5] to 20 dB and more. Although some difference between simulation and measurement has been observed in the above figures (measurement shows more directive and improved front to back level), authors describe this difference as the limits of simulation and manufacturing errors that are inherent.

Antenna gain could not be measured because there was no access to reference antenna in this band to calculate gain; but realized gain in simulation software is depicted in Fig. 7. Fig. 8 illustrates simulation and measured antenna return loss.

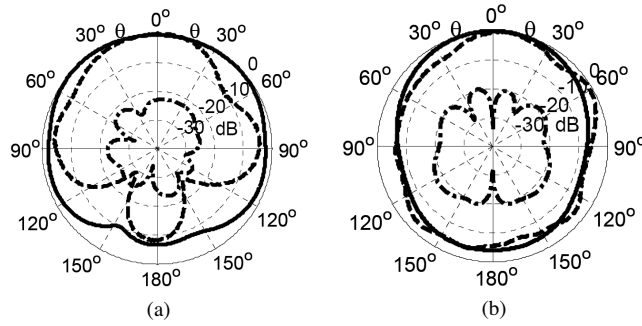


Figure 4. Radiation pattern at 1.2 GHz. (a) *E*-plane, (b) *H*-plane.

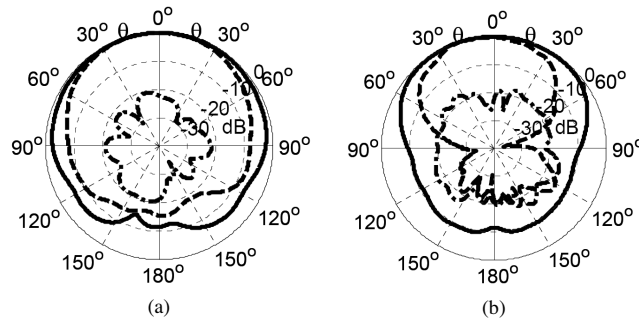


Figure 5. Radiation pattern at 2 GHz. (a) *E*-plane, (b) *H*-plane.

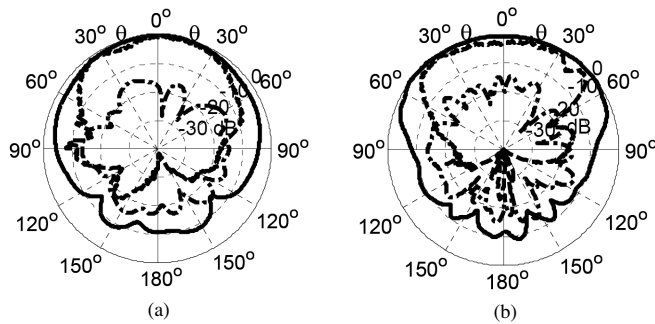


Figure 6. Radiation pattern at 3 GHz. (a) *E*-plane, (b) *H*-plane.

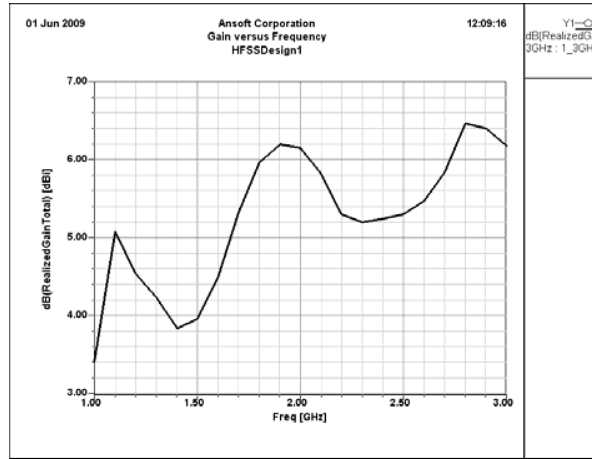


Figure 7. Simulated antenna gain in dBi versus frequency.

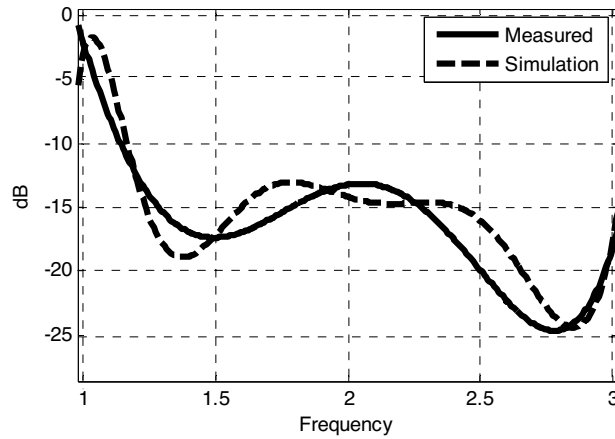


Figure 8. Antenna return loss (dB).

#### 4. CONCLUSION

In this paper novel biconical antenna geometry has been proposed and tested that has directive radiation pattern. Antenna gain is about 4 dBi to 6 dBi in simulation and front to back ratio is greater than 20 dB in practice and simulation. Wide band performance is the other characteristic of this new antenna with return loss less than 13 dB.

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