International Journal of Computational Engineering Research||Vol, 03||Issue, 7||

A Triband Slotted Bow-Tie Antenna for Wireless Applications

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ABSTRACT

This paper presents a new approach for the design of a tri-band bowtie antenna. By incorporating slots with triangular shapes on the arms of the bowtie, resonance is obtained in the 2.5 GHz, 4.4 GHz, and 6.2 GHz bands. A study of the effect of triangular slots, their size and their location on the return loss of the antenna is presented. The designed antenna enjoys advantages such as low profile, low cost of fabrication, and high radiation efficiency. Details of the design along with experimental and simulation results in FEKO are presented and discussed. .The simulation results of proposed antenna are analyzed by using Method of Moment (MoM) from FEKO software.

INDEX TERMS: *Triband,Triangular slots,Resonance.*

I. INTRODUCTION

A simple bowtie antenna is made from a bi-triangular sheet of metal with the feed at its vertex. This type of antenna is used extensively in many applications such as ground penetrating radar and mobile station.Bowtie antennas have many advantages such as low profile, high radiation efficiency, ease of manufacturing and low fabrication cost. With many IEEE certified wireless networking standards are booming it is expected several bandwidth will be made available for open use. The techniques used to obtain multi-resonance were borrowed from patch antennas . In [8], two parallel rectangular slots are incorporated into the antenna patch, leading to 30% increase in bandwidth. The [2]resulting E-shaped patch antenna had another desirable property: it had two resonant frequencies. In this work, triangular slots are introduced on each arm of the bowtie antenna, leading to triple-resonance which, by modifying the location and size of the slots.Due to the rapid progress in wireless communication systems, high gain broadband antennas are of great demand. Bow-tie slot antennas have the advantage of wide bandwidth.

Antennas performance and size have a large impact on the development of wireless system. Compared to traditional antenna it is more complicated to provide the typical parameters like bandwidth, efficiency and gain within the limited antenna volume. This becomes even more critical with respect to the UWB system with high data rate and low power density. Microstrip antennas are extensively used in different applications due to their many advantages, such as low profile, light weight, easy to fabricate and low cost and also higher bandwidth. Because of the limited bandwidth of the patch antennas,several designs of broadband patch antenna have been studied, some of them are [1]-[6]. The radiation characteristics of the printed dipole antenna expected to be similar with rectangular patch except for those features that depend on the width to length ratio. The input impedance, bandwidth and the cross polarization radiation can be different extensively. In this paper a new broad-band planar impedance matching scheme is achieved by using a simple triangular slots without any structural complexities. The shape and position of the triangular slot is changed . So more electromagnetic energy is coupled in to the patch .The antenna has three working frequencies and can be used in wireless applications.

II. DIFFERENT BOWTIE DESIGNS

In this section, bowtie antennas designed with different slot sizes are presented. By studying the effect eachconfiguration has on the reflection coefficient of the antenna allows us to decide on the final design that produces resonance in the 2.5GHz, 4.4GHz and 6.2GHz bands

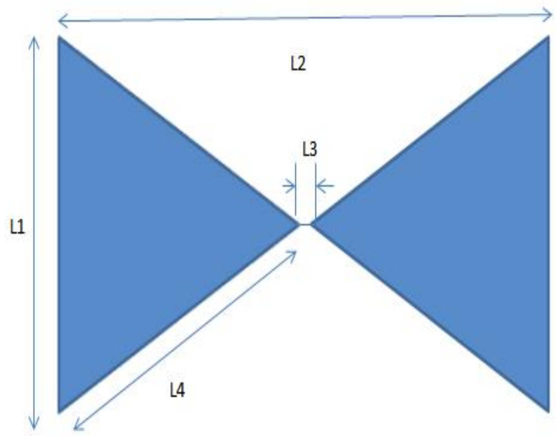


Fig 1:A simple Bow-Tie antenna

A bowtie antenna is shown in Fig. 1. In this case, the antenna L1 is 17.2 mm ,L2 is 32.2,L3 is .5mm and L4 15.2. The corresponding antenna is working in 2.4Ghz frequency . In order to obtain multiband antenna the geometry of this antenna is modified trying various slots and patches of various shapes.For a triangular slot triband antenna a triangle of similar dimension is placed inside the border of existing antenna The inner and outer triangles making each slot are isosceles and share the same vertex. The dimension of the antenna is L1 23.88 mm,L2 34.42mm,L3 .5mm,L4 33.02mm,L5 34.44 and L6 .11mm. The dimensions of the arms are the same used in the first design. The S11 plot of this antenna is shown in Fig. 3. Therefore, the incorporation of triangular slots will give resonance in the bands of interest.The dimensions of the arms of the bowtie were changed in order to keep the impedance matched. On each, triangular slots of equal dimensions were taken. Both triangles share the same vertex, with an opening width of 0.5 mm.A line fed is given at the meeting point which drives the antenna.

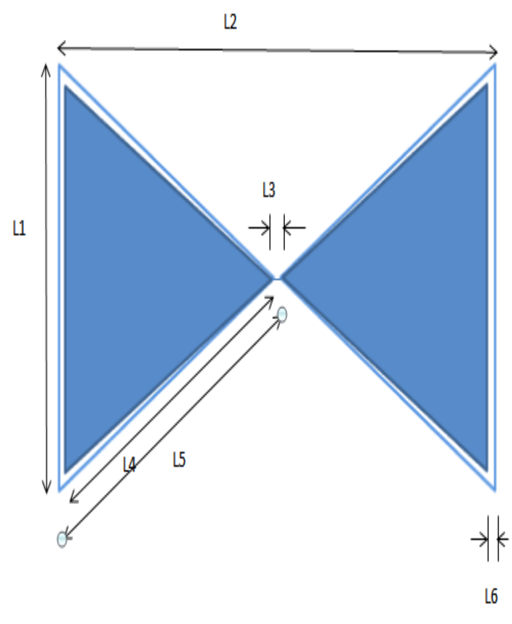


Figure 2: Geometry of the proposed antenna

III. RESULTS AND DISCUSSIONS

The simulation and the experimental studies of the antenna are done using FEKO suit 6 which is basically a recent tool used for electromagnetic analysis involving bodies of arbitrary shape. Fig. 3 shows the simulated and experimental return loss characteristics of the antenna. Return loss is achieved minimum at three major resonances centered at 2.5 GHz, 4.4 GHz and 6.2 GHz respectively .

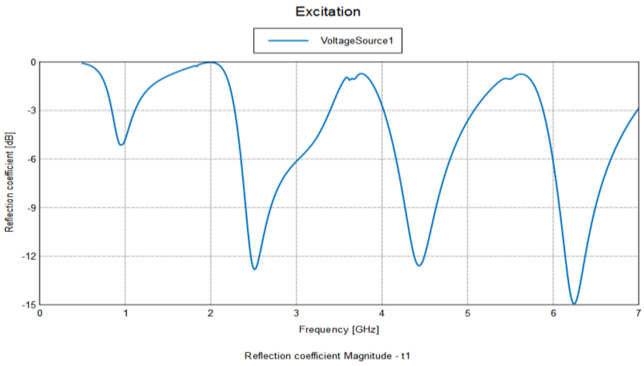


Figure 3: Return loss characteristics of proposed antenna

The patches and slots are placed on several places on bowtie antenna and resultant graphs are analyzed and superior performance is observed in the proposed model.The spacing between the triangular patch is varied in order to find a better impedance matched circuit.

Fig. 4 shows the return loss characteristics of the antenna with different patch dimensions . It is evident from the graph that with triangular patch of higher dimension there exists only two poorly matched resonances. As length of the spacing increases impedance matching also increases and the maximum bandwidth is obtained when L6=.11mm. Also the resonant frequencies shift towards the lower side with increase in L6.

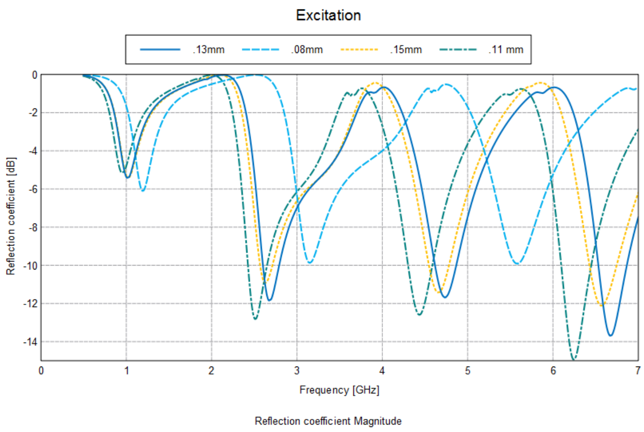


Fig 4: plot of reflection coefficient characteristics of proposed antenna with varying L6

It is clear from the below figure the simulated voltage standing wave ratio (VSWR) of the modified bow-tie antenna is less than 2 for the fixed frequencies 2.5 GHz,4.4 GHand6.2GHz for other frequencies(VSWR) is greater than two. The resulting return loss plot for this antenna is shown in Fig.3. Triple resonance is achieved: at 2.5GHz (– 12.8dB), at 4.4 GHz (- 12.6dB) and at 6.2 GHz (-14.7 dB). The antenna radiation pattern at Φ= 00 is shown in Fig. 5.

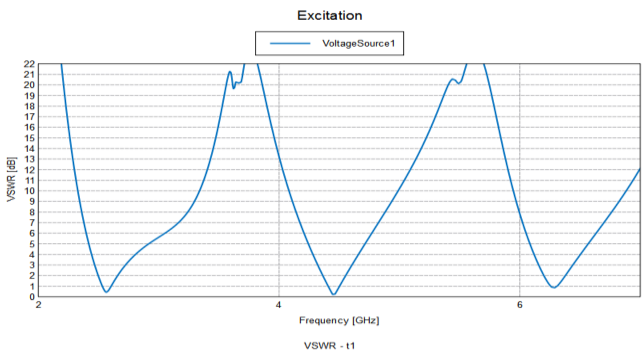
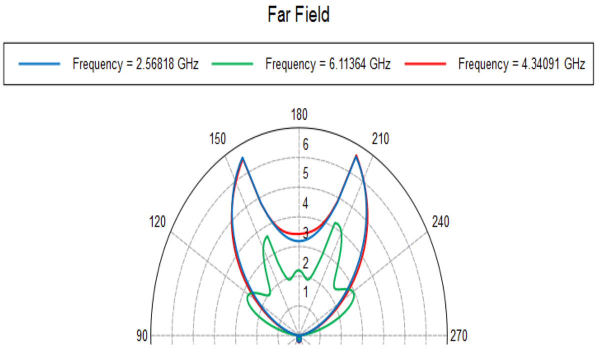
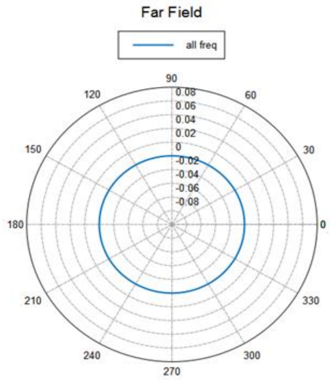


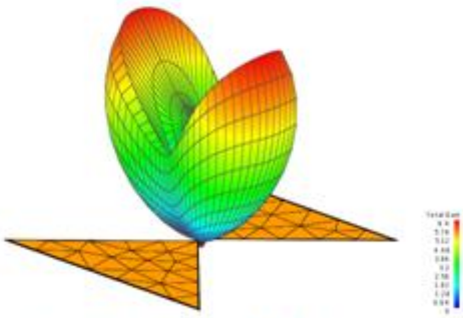
Figure 5:VSWR characteristics of proposed antenna



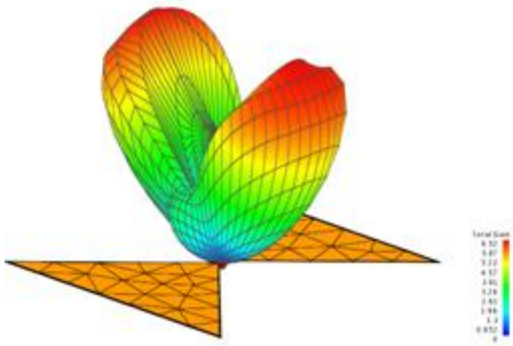
(a)radiation pattern with elevation(theta=0,phi=90)



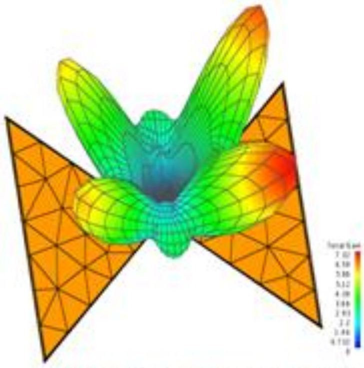
(b)radiation pattern with azimuthal



(c) 3D far field at 2.4 GHz



(d)Far field pattern at 4.4GHz



(e)Far field pattern at 6.2GHz

Figure 6: simulated far field patterns in2D and 3D

IV. CONCLUSION

The above figures shows the simulated radiation patterns with Elevation and azimuthal at different frequencies by using CAD FEKO software. The simulated radiation patterns of antenna in the E-plane (XZ-plane) and H-plane (YZ-plane) for three different frequencies 2.5 GHz, 4.4GHz and 6.2 GHz are shown in figure.6 . The patterns and other curves are obtained at the time of simulation. We observed good radiation patterns by taking 20 cells per wavelength.

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