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# Design And Analysis Of Modified Bowtie Antenna

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**ABSTRACT:** In this paper, a modified bowtie microstrip patch antenna is designed and simulated by using software HFSS (High Frequency Structure Simulator) software. This modified antenna is first designed and simulated and then further analysed for various parameters like return loss, VSWR, Radiation pattern, gain etc. In this work, for simulation purpose we have used ArlonCuClad 217 (tm) as dielectric material. We have modified the basic bowtie antenna by doing some modification in its structure i. e. on its arms. In simulation result we have achieved return loss below -10 dB. This simulated antenna has broad application in the field of satellite communication. Proposed model has been validated for various results like VSWR, antenna gain and radiation pattern.

**Keywords:** Patch antenna, Bowtie Antenna, Microstrip, Transmission Line Model.

## 1 INTRODUCTION

MICROSOFT patch antennas are widely in demand these days due to their excellent characteristics like low profile, light weight, easy to fabricate, easy installation and low cost [1]. For wireless communication, an antenna operating at more than one frequency is more efficient than a single band antenna. Requisite for any antenna to be used for wireless communication is that it must be small in size and light in weight. In order to minimum antenna, cutting a slot in proper position on microstrip patch plays a major role in minimizing the size of the antenna. Bowtie antenna is one of the special classes of patch antennas introduced in order to meet the bandwidth requirement [2]. These antennas can be easily integrated into modules transmit or receive due to their flexible shape and size [3], [5]. Therefore much of the advancement is done on these antennas these days. In this paper, a bowtie shaped microstrip antennas with modified arms is proposed. The edge of the arms is cut into various saw-tooth shapes. For better results Transmission line model is used. The main aim is to increase the return loss and gain-bandwidth performance of the antenna. The antenna is designed and simulated with the help of HFSS software. The organization of paper is done as follows: Section 2 describes the structure of antenna and various calculations using equations are done. We have highlighted the results of the antenna and discussion of various parameters in Section 3 and Section 4 consists of the Conclusion part.

## 2 ANTENNA STRUCTURE & CALCULATIONS

The configuration of the designed antenna is shown in fig. 1. The arms of the bowtie are cut to provide better results. The dielectric material used is ArlonCuClad 217 (tm) with dielectric constant ($\epsilon_r$) = 2.17 with a dielectric loss tangent of 0.0009.

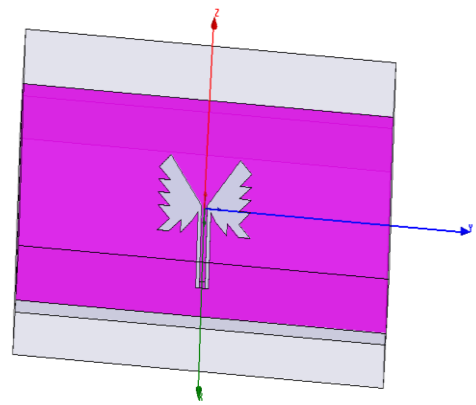

***Fig.1** Design of Bowtie Antenna*

Fig.2. shows the meshing design of proposed bowtie antennas. For the huge domain computation, tetrahedral meshing is chosen. Greater element size is designated to decrease the computational load and to achieve the convergence plot

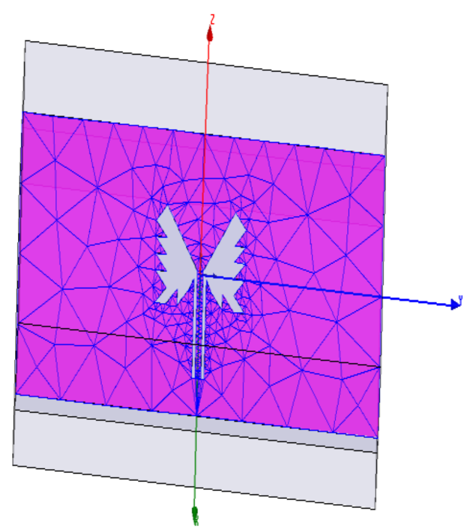

***Fig. 2** Meshing of Bowtie Antenna*

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The antenna is designed after certain calculations given by following equations: The width of rectangular patch, W is given by:

$$W=\frac{c}{2f_o\sqrt{\frac{\epsilon_r+1}{2}}}$$

The effective dielectric constant is given by:

$$E_{reff}=\frac{\epsilon_r+1}{2}+\frac{\epsilon_r-1}{2}[1+12\left(\frac{h}{W}\right)]^{1/2}$$

The actual length of rectangular patch is given by:

$$L=L_{eff}-2\Delta L$$

$L_{eff}$ i.e effective length is given by:

$$L_{eff}=\frac{c}{2f_0\sqrt{\epsilon_{reff}}}$$

and $\Delta L$ is the length extension of patch calculated as:

$$\Delta L=0.412h[\frac{(\epsilon_{reff}+0.3)(W/h+0.264)}{(\epsilon_{reff}-0.258)(W/h+0.8)}$$

The length and width of ground plane is given by:

$$L_g=6h+1$$
$$W_g=6h+w.$$

## 3 RESUTS & DISCUSSION

Analysis of proposed antennas are carried out and presented. Parameters analysed and studied are return loss, radiation pattern, VSWR, gain and directivity. Fig. 2 shows that the return loss of -10.1 dB is achieved at the first resonant frequency of 12 GHz, and -19.60 dB at the second resonant frequency of 15.5 GHz. Both these frequencies are used for satellite communication operating at X and Ku band. The bandwidth obtained is 0.1GHz and 2GHz respectively.

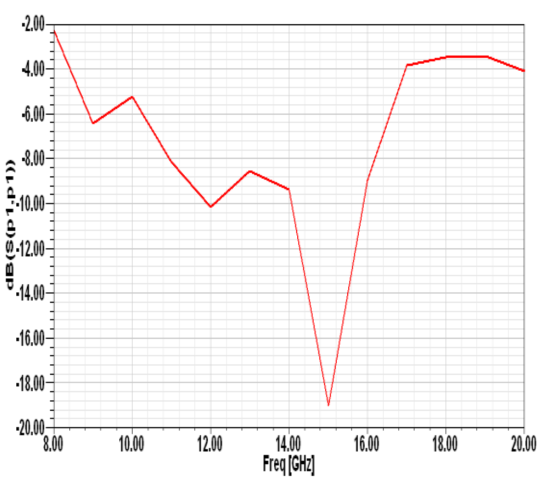


***Fig.3*** *Return loss versus Frequency*

VSWR versus frequency graph shown in fig. 4 tells how much power is reflected back or transferred into a cable. In the VSWR versus frequency plot, VSWR for the proposed bowtie antenna is 1.96 dB at 15.5 GHz resonant frequency.

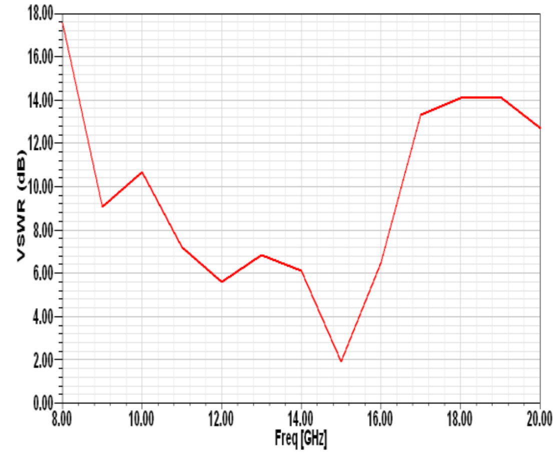


***Fig.4*** *VSWR versus Frequency*

Fig. 5 shows the total gain and radiation characteristics of proposed bowtie antenna. The red colour shows the maximum radiation in the covered area while the other colours show less radiation in different fields. However, the radiation pattern designates the power radiated by an antenna that allows us to visualize where the antenna transmits or receive power in the different fields. The total gain of the proposed antenna is 3.9653 dB at 15.5 resonant frequencies.

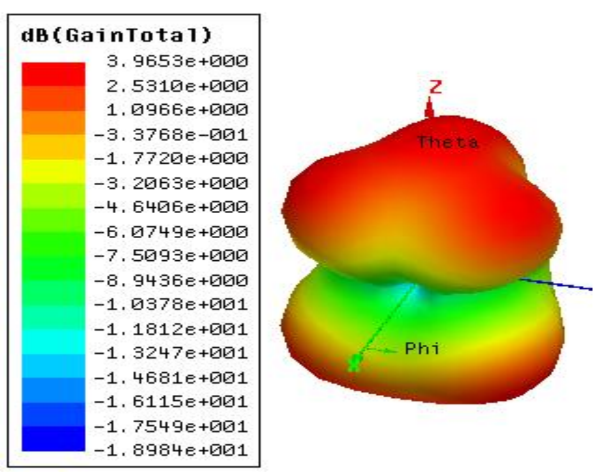


***Fig.5*** *Total gain*

The radiation pattern of the proposed bowtie antenna at resonant frequencies 12 GHz and 15.5 GHz are shown below in fig. 6. It is mostly bidirectional. It is clear from fig. 6 that the back lobe is minimized due to the reflector plane and radiates effectively and efficiently in desired directions.

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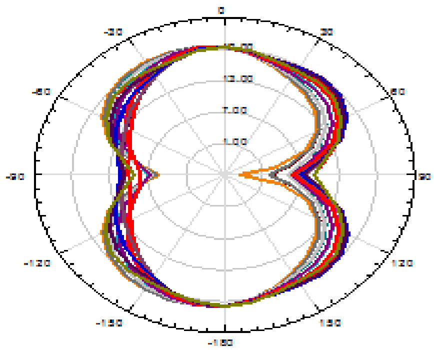

***Fig. 6*** *Radiation Pattern*

## 4 CONCLUSION

In this paper, a modified microstrip bowtie antenna has been proposed and investigated. Modified bowtie antenna can be designed by making some change in reference bowtie antenna. Simulations and measurements in HFSS software verified the design and the new concept of the antenna. This antenna has improved values of different parameter like return loss, VSWR, gain and directivity with respect to standard bowtie antenna. This modified bowtie antenna can be used for X and Ku band applications which further make this antenna most suited for satellite communication.

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