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Comparative study of CPW-fed Bowtie antenna with ACS-fed Bowtie antenna for wireless applications

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***Abstract*-The bowtie antenna with two types of feed structure is analyzed in this paper. The co-planar waveguide (CPW) fed bowtie antenna is compared with the asymmetric co-planar stripline (ACS) fed bowtie antenna on the parameters like return loss characteristics and frequency bandwidth percentage. The antenna is designed using the software CADFEKO 5.5 suit and the results are analyzed. The results show that Bowtie antenna with CPW feed gives good bandwidth enhancement and Bowtie antenna with ACS feed gives good impedance matching for the wireless applications.**

Keywords: CPW; ACS

I. INTRODUCTION

With rapid progress in wireless communication systems, the demand to enhance the information accessibility and wideband utility has become major importance in wireless technology. Microstrip patch antenna are widely used due to their inherent advantages of low profile, light weight, low cost. The major limitation of microstrip antenna is narrow bandwidth. The main advantages of the bow-tie antenna aresimple design and broadband impedance. To have wider bandwidth and simple planar antenna configuration, bow-tie dipole. Several papers have been published [2, 4] to improve isolation in similar antenna applications. To meet the specification of wide bandwidth, simplicity, and high isolation CPW-fed bowtie antenna is proposed in this paper. It is followed by the design of ACS- fed Bowtie antenna for good impedance matching.

Feed line is one significance of a broadband antenna structure, one type of feed line that popular is CPW-fed antennas, is now increasingly interesting for modern wireless communications. They have many features such as low radiation loss, less dispersion, easy integrated circuits and simple configuration with single metallic layer, and no via holes required. These antennas have recently become more and more attractive.

The ACS feeding technique is used due to compactness of the antenna (Fang and Wang, 1999). This feeding mechanism is analogous to the coplanar wave guide feed expecting that the ACS feed has single lateral ground strip compared with twin lateral strip in the CPW feeding.These antennae are simulated using CADFEKO 5.5 suitand observed the return loss characteristics and bandwidth characteristics of both ACS and CPW feeding technique.

II. ANTENNA DESIGN

An empirical formula of resonant frequency of bow-tie antennas is presented, which is based on the cavity model of microstrip patch antennas as in [2] [3]. A procedure to design a bow-tic antenna using generic algorithm (GA) in whichthe formula is taken as a fitness function is also given. An optimized bow-tic antenna by genetic algorithm is measured. Numerical and experimental results are used to validate the formula and GA.

The design formulae of a bow-tie patch, for the dominant TM_{10} mode, can be obtained using the equations that follow

$$f_r = \frac{c}{2\sqrt{\epsilon_e}L}\left[\frac{1.152}{R_t}\right] \quad (1)$$

$$R_t = \frac{L}{2}\frac{(W+2\Delta l)+(W_c+2\Delta l)}{(W+2\Delta l)(S+2\Delta l)} \quad (2)$$

$$\Delta l = h\,\frac{0.412(\epsilon_e+0.3)\left(\frac{w_i}{h}+0.262\right)}{(\epsilon_e-0.258)\left(\frac{w_i}{h}+0.813\right)} \quad (3)$$

$$\epsilon_e = \left(\frac{\epsilon_r+1}{2}\right)+\left(\frac{\epsilon_r-1}{2}\right)\left[1+\frac{12h}{w_i}\right]^{-1/2} \quad (4)$$

$$W_i = \frac{(W+W_c)}{2} \quad (5)$$

Where, W_c is the central gap between the bows, which is made 0 because the antenna is designed from the origin (0,0,0) for the basic bowtie antenna, R_t, is the terminating resistance of the bowtie antenna and Δl is the extension length due to the fringing effect of the radiating antenna also the parameters, ε_r, h and $\varepsilon_e$are the permittivity of dielectric constant of the substrate, thickness of the substrate and effective permittivity of the substrate respectively and c is the velocity of electromagnetic wave in free space.The basic bowtie design is designed in FEKO and shown in figure 1.

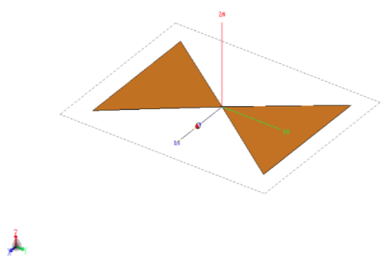

Figure 1. Basic bowtie antenna in FEKO

The return loss characteristics of the basic bowtie antenna at 50 ohms impedance matching is shown in figure 2.

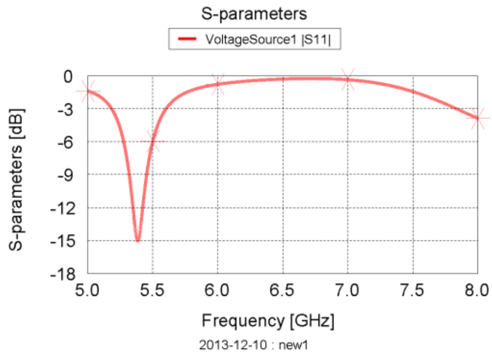

Figure 2. Return loss characteristics of Basic bowtie antenna

The radiation pattern of the conventional basic bowtie antenna is shown in figure. 3

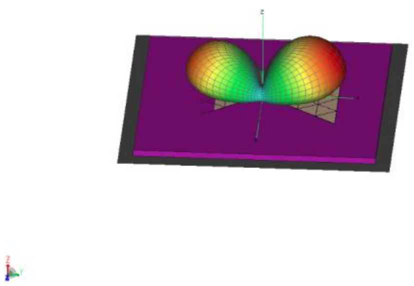

Figure 3. Radiation pattern of the basic bowtie antenna

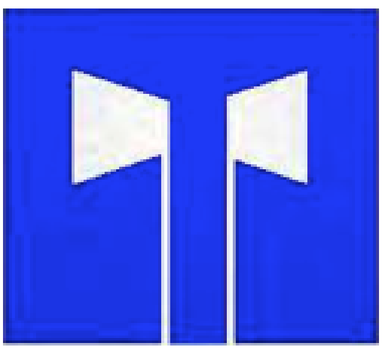

Figure 4. Geometry of CPW-fed bowtie antenna

III.CPW FEED

Antennas using CPW-fed line as shown in figure 1, have many attractive features including low radiation loss, less dispersion, easy integration for monolithic microwave circuits (MMICs) and a simple configuration with single metallic layer, since no backside processing is required for integration of devices as in [5], [9], [12]. Therefore, the designs of CPW-fed antennas have recently become more and more attractive. CPW-fed slot antennas with modified shape reflectors have been proposed. By shaping the reflector, noticeable enhancements in both bandwidth and radiation pattern, which provides unidirectional radiation, can be achieved while maintaining the simple structure. Here, the possibility of covering some the standardized WiFi and WiMAX frequency bands while cling to the class of simply structured and compact antennas.

The return loss characteristic of the CPW-fed bowtie antenna at 50 ohms impedance matching is shown in figure. 5

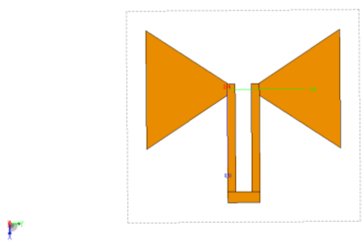

Figure 5. Cad model of CPW-fed bowtie antenna in FEKO

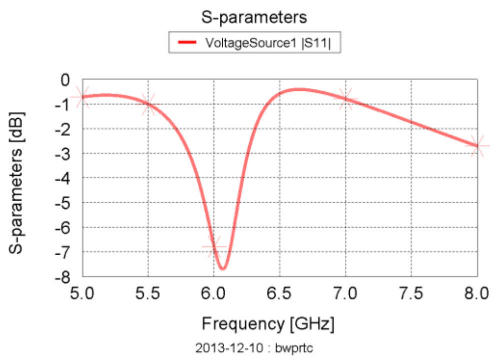

Figure 6. Return loss characteristics of CPW-fed bowtie antenna

The radiation pattern of the bowtie antenna with CPW feed is having high directivity compared to conventional antenna shown in figure. 7

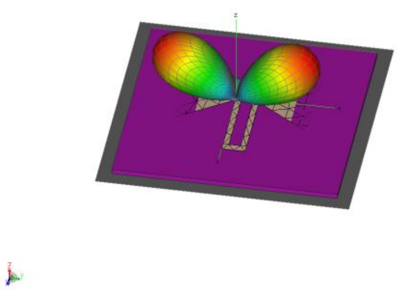

Figure 7. Radiation pattern of the CPW-fed bowtie antenna

IV. ACS FEED

In this antenna design a compact and effective feeding technique is employed. The ACS fed used for all the advantages of a uni-planar fed along with compactness [17]. This feeding mechanism is analogous to the coplanar wave guide fed expecting that the ACS fed has single lateral ground strip compared with twin lateral strip in the CPW feed. These antennas are simulated using CADFEKO 5.5 suit and observed the return loss characteristics of both ACS and CPW feeding technique. Figure 6 shows the geometry of the ACS feed.

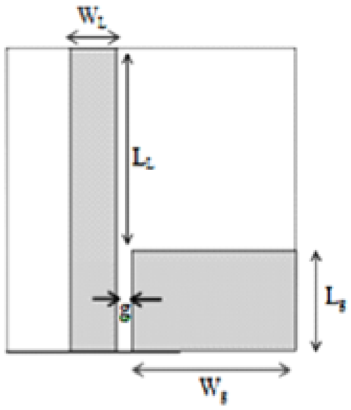

Figure 6. Geometry of ACS-fed

ACS feeding geometry designed is shown in Figure 7 having the length (L_L= 41 mm) and width (W_L = 1.5 mm). The dimensions of ground plane of both the antennae are L_g = 15 mm, W_g = 1 mm and the gap (g = 1 mm) taken for good impedance matching

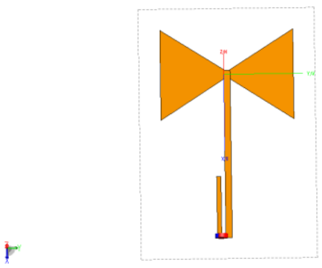

Figure 7. Cad model of ACS-fed bowtie antenna in FEKO

The return loss characteristic of the CPW-fed bowtie antenna at 50 ohms impedance matching is shown in figure. 8

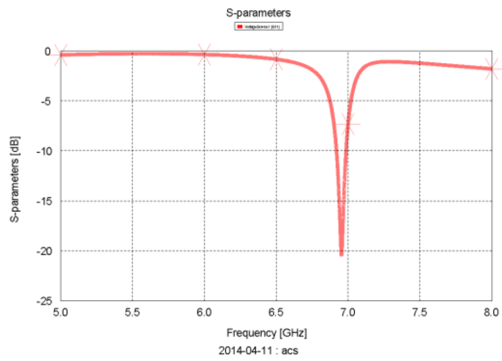

Figure 8. Return loss characteristics of ACS-fed bowtie antenna

The radiation pattern of the bowtie antenna with ACS-fed bowtie antennais having high directivity compared to CPW-fed bowtie antenna shown in figure. 9

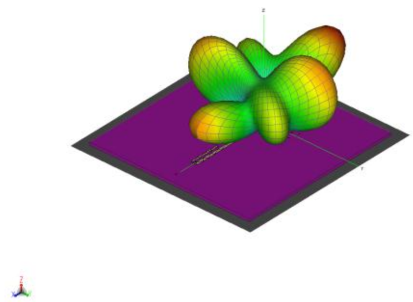

Figure 9. Radiation pattern of the ACS-fed bowtie antenna

Table 1 shows the types of feed analysis in bowtie antenna. Line feed, ACS feed and CPW feed are compared on the parameters like return loss and fractional bandwidth respectively.

Table 1.Types of feed analysis in bowtie antenna

Feed type	**Return loss (dB)**	**Fractional Bandwidth (%)**
Line	-15	7.08
ACS	-22	5.65
CPW	-7.8	13.57

From table 1 it is observed that the ACS feed gives good impedance matching compared with CPW feed and also the CPW-fed bowtie antenna gives better bandwidth compared to ACS-fed bowtie antenna, which is suitable for wireless applications.

VI. CONCLUSION

It is analyzed from the results that the CPW feed for the antenna achieves bandwidth enhancement double the original value which is a good candidate for wireless applications.Also the ACS feed provides good return loss characteristics.

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