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A PLANAR BAND NOTCHED SELF-COMPLEMENTARY BOW-TIE ANTENNA FOR UWB APPLICATIONS

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Abstract: **Ultra band technology could represent a revolutionary approach to wireless communication. In this paper a planar band notched bow-tie antenna is projected for UWB applications. The self-complementary principle has been applied to a planar triangular monopole antenna at the side of bending the Microstrip feed line. The antenna includes a wider band compared to the standard bow-tie antenna, complies with the UWB needs and it's directly matched to the SMA connective via 50 ohm Microstrip. This antenna includes a straight forward form that overcomes the sophisticated matching techniques exploitation baluns or electric resistance matching sections that are normally utilized in bow-tie antennas for widening their restricted bandwidths. Desired patch antenna style was simulated by exploitation ANSYS HFSS software system. The Substrate material used for making patch antenna is FR-4 with a Thickness of 1.6mm.**

Keywords: **UWB, bow-tie, self-complementary, SMA, HFSS.**

1. INTRODUCTION

Recently, ultra wideband (UWB) wireless communication techniques (3.1–10.6 GHz) have earned a lot of attention due to their merits such as high data rate, small emission power, and low cost. To tackle the effect caused by the frequency interference from WLAN (5.15–5.825 GHz) and WiMAX (5.25–5.85 GHz) systems, some UWB antennas with band-notched feature have been designed in [1]– [8]. One simple way is to etch thin slots on the antenna surface, such as L-shaped slot [1], U-shaped slot [2]– [4], and T-shaped slot [5]. By adding either a split-ring resonator (SRR) [6], [7] or a multi-resonator load [8] in the antenna structure, the undesired frequencies can be rejected so that the system performance may be enhanced well. However, all of these designs need a complex structure to generate and control the stopband property, so that the cost in fabricating antenna will be increased for practical applications [1].

The Ultra-wide band (UWB) technology has become more popular due to various applications such as medical imaging applications, multimedia connectivity, personal communications, ground penetrating radar and sensor networks. Also, one of the very important leading wireless communication systems is an ultra-wideband (UWB) system due to low power consumption, high speed, and efficient frequency use [4].

Ultra-wideband (UWB) technology has attracted much attention since the frequency band within 3.1~10.6 GHz was released by Federal Communications Commission (FCC). The UWB technologies have low power, high data rate, and short range wireless communications advantages. In current literatures, most of the UWB antennas have large in sizes, which are about 26 mm × 30 mm ~ 80 mm × 80 mm [1, 2]. The self-complementary antenna [3] has the merit of promising broadband characteristics [2].

The self-complementary antenna (SCA) was first reported in [2-3] with a broad impedance bandwidth characteristic. According to the equation derived by Mushiake, the input impedance of the SCA is a constant 188.4 Ω on an infinitely large ground plane. If the antenna's configuration is complementary to itself, frequency-independent impedance property, which means independent of the source frequency and its dimensions, can be accomplished. In practice, the SCA has to be fabricated on a finite ground plane and transform the input impedance to 50Ω to integrate with the RF front end [3].

2. BACKGROUND

This section presents various studies on ultra wideband technique. Liu et al. presented a compact planar monopole Antenna with standard band-notched characteristic suitable for ultra wideband (UWB) applications. Fairly good omni-directional radiation patterns and transmission responses both indicate that the proposed antenna is well suited to be integrated within various portable devices for UWB operation [1].

Lin et al. presented a self-complementary antenna for ultra wideband (UWB). The proposed antenna has a compact size of 25 × 15 mm and covers the specification for UWB operation in the 3.1-10.6 GHz bands. It has been proven that the proposed compact antenna can generate UWB and reasonable radiating properties [2].

Huang et al. presented a printed quasi-self- complementary antenna fed by a 50-Ω microstrip line. By inserting an inverted L-shaped slit embedded on the quarter-circular disc, a destructive interference can take place and cause the antenna to be nonresponsive at certain frequency. This band-rejection will make it easily meet with the dual WLAN applications [3].

Shaker et al. introduced UWB antenna integrated with Bluetooth, which can be cover the band of Bluetooth application (2.3 - 2.7 GHz) and the band of UWB applications (3 - 12 GHz). The proposed antenna consists of semi ring connected with tapered section for more matching. The dielectric material for the proposed antenna is FR4-expoxy having thickness of 1.5 mm and has compact size 11.5 × 14.5 mm^2 [4].

Yuan et al. presented a strategy for W-LAN and WIMAX i.e. trapezoid conductor-backed plane which can be work with dual mode. This technique is utilized to cover the W-LAN and WIMAX of 2.4/5.2/5.8 GHz and 2.5/3.5/5.5 GHz separately [5].

Krishna et al. presented a CPW-fed planner monopole receiving wire. This receiving wire is utilized for triple band operations [6]. Wen et al. proposed and researched a UWB radio wire with dual score band. This UWB remains for ultra wide band receiving wire. This reception apparatus comprises of a square patch and redesigned grounded plane [7].

Hong et al. coplanar waveguide (CPW) tri band planar monopole receiving wire for WLAN/WIMAX application [8]. Chung et al. proposed and researched multi band operations with triple recurrence micro strip fed planner monopole radio wire [9]. Cai et al. exhibited compact printed monopole radio wire utilizing two U-sort slot working at Bluetooth/WI-MAX./W-LAN. The reception apparatus can be executed with measurement like the traditional strip-sort slot [10].

3. DESIGNING PROCEDURE

Most of the conferred style methodologies were trial and error strategies with the assistance of simulation packages to urge the required UWB operation by trade corners, tips, slots, or parasitic elements. Yet, there square measure another economical strategies that may be exploited to style UWB antennas, however, these strategies were seldom used. one in every of these strategies depends on the concept, introduced by Yasuto Mushiake within the 1940's, that accounts for the supposed self-complementary principle, to supply frequency freelance antennas. that job was then updated by inventing another kind of this antenna. One in every of the necessary forms of antennas, employed in several broadband applications, is that the Bow-Tie antenna that has undergone numerous makes an attempt to boost its performance. a number of these makes an attempt were to resistively load the antenna to get higher radiation potency with tiny late-time ringing and reduced antenna dimensions. Another improvement in ultra-wide band was introduced by applying the Sierpinski form on the bow-tie arms to supply multi-resonant slender bands of operation frequencies.

In the efforts of up the bow-tie antenna, some researchers hottest resorting to make this antenna at intervals a slot that in addition needs the on high of mentioned matching techniques, or a minimum of the first one. Variety of such trials have succeeded to realize matching over the total UWB system of measurement, but on the account of a long list of antenna parameters. Such solutions have superimposed quality on the planning procedure. Various researchers have formed the bow-tie slot antenna at intervals the bottom plane of an exact monopole antenna.

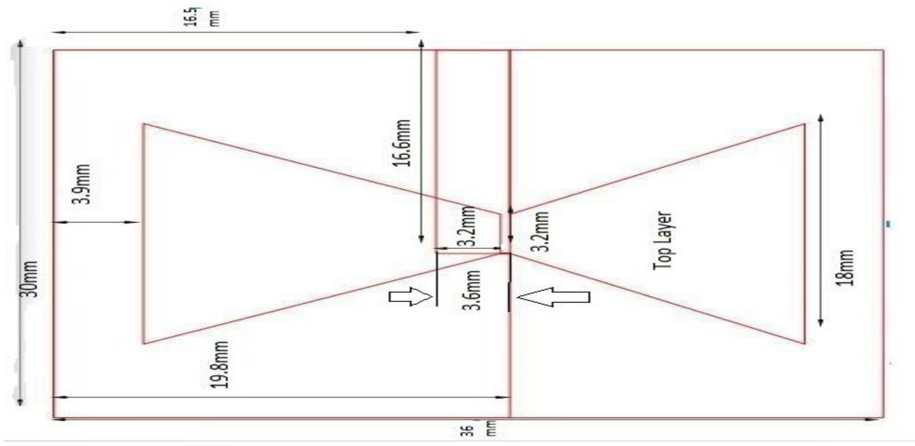

Fig.1.lay out for proposed self-complementary bow-tie antenna

Figure1 shows the lay out for proposed self-complimentary bow-tie antenna. The proposed antenna is designed using FR-4 substrate having dielectric constant 4.4 and thickness 1.6mm. the dimensions of the substrate are considered as 30mm*36mm*1.6mm.top layer of the substrate consists a triangular patch and Microstrip line and bottom layer of the substrate consist a ground plane with self-complimentary slot.

4. SIMULATION RESULTS

The proposed design is analyzed and assessed by computer simulation software packages; the Ansoft HFSS, which is based on the Finite Element Method. The performance of the proposed antenna is examined using return loss and its beam width in elevation and azimuth plane.

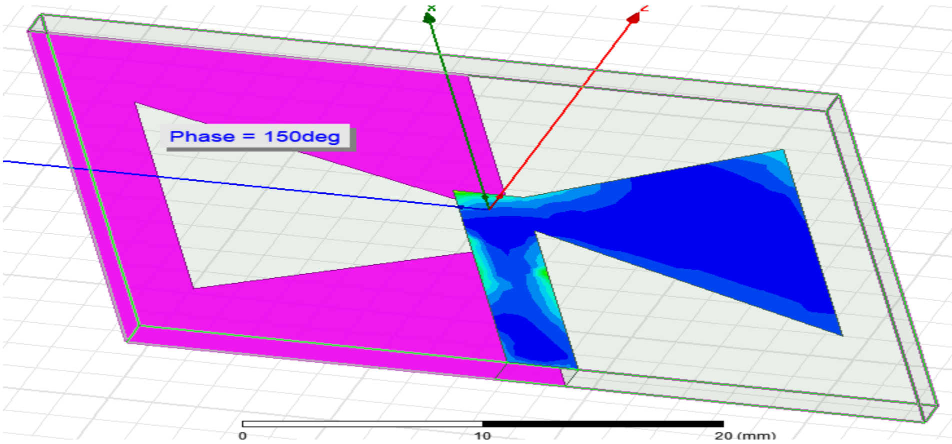

Fig.2.simulation model for proposed self-complementary bow-tie antenna

Figure 2 shows self-complementary bow-tie antenna designed using ANSYS HFSS and the current distribution on top surface of substrate.

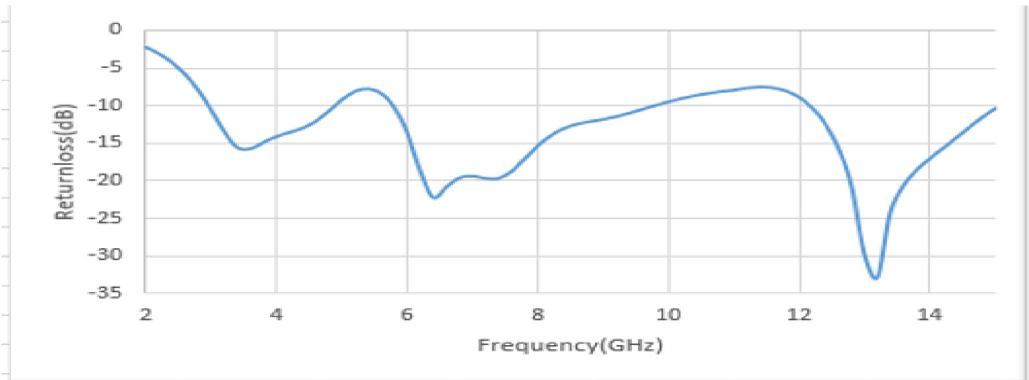

Fig.3.frequency versus return loss plot for proposed self-complementary bow-tie antenna

The figure3 shows the simulated return loss value in dB over the ultra-wide band frequency. The value obtained in the simulation is more than -10dB entire ultra-wide band except at some particular frequencies that's why this antenna is called as band notched self-complimentary ultra-wide band antenna.

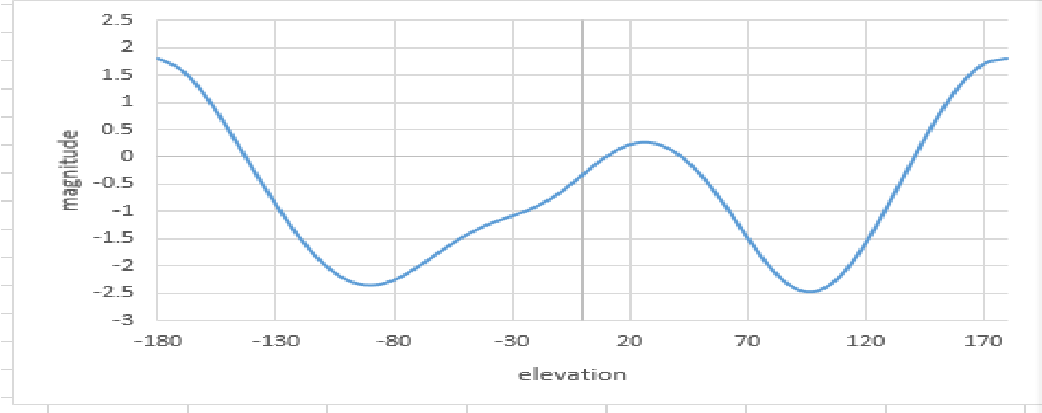

Fig.4.elevation pattern for proposed self-complementary bow-tie antenna

The figure4 shows the simulated elevation pattern for proposed self-complementary bow-tie antenna. The x-coordinate is elevation angel and the y-coordinate is the magnitude and this graph is plotted for particular azimuth angel.

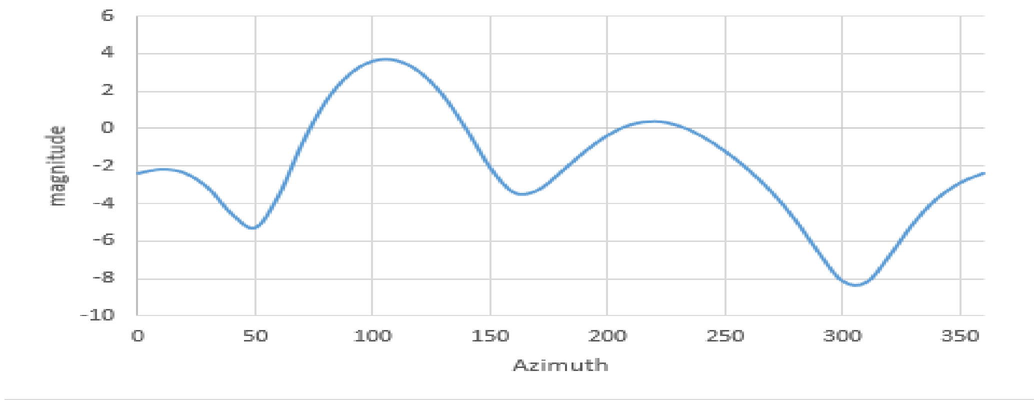

Fig.5.azimuth pattern for proposed self-complementary bow-tie antenna

The figure5 shows the simulated azimuth pattern for proposed self-complementary bow-tie antenna. The x-coordinate is azimuth angel and the y-coordinate is the magnitude and this graph is plotted for particular elevation angel.

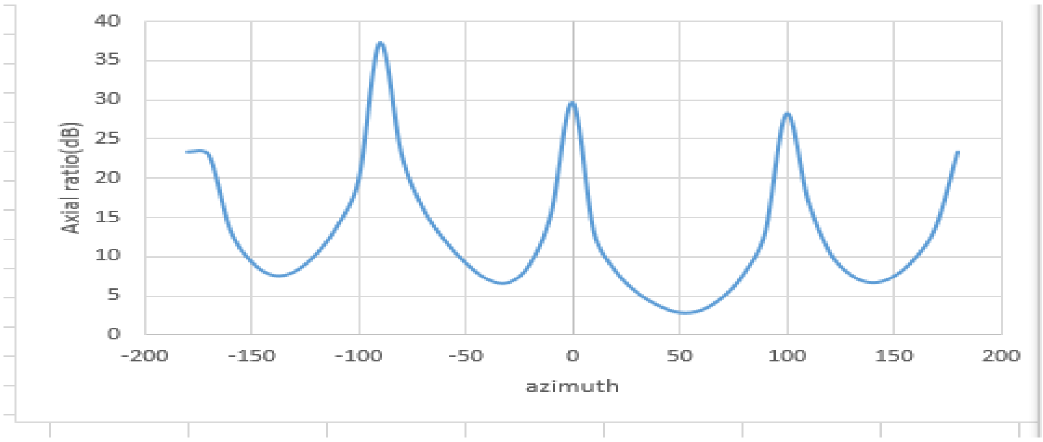

Fig.6.axial ratio plot for proposed self-complementary bow-tie antenna

The figure6 shows the simulated axial ratio plot for proposed self-complementary bow-tie antenna. The x-coordinate is azimuth angel and the y-coordinate is the axial ratio value in dB and it is clear that the axial ratio value is less than 5dB over the band so the propose antenna exhibits circular polarization.

5. ADVANTAGES

The planned antenna during this paper is simpler in style and implementation, smaller in size, wider in bandwidth; neither has it required baluns nor resistance matching sections as a result of it's fed directly via a (50 Ω) right-angle rectangular Microstrip line. any improvement will be achieved on this new bow-tie by implementing a form repetition of the triangular form. The modification will be applied on each arms of the bow-tie (patch and its complementary slot), manufacturing a form self-complementary Bow-Tie antenna (FSCBT-Antenna), which can offer higher come back loss performance.

6. CONCLUSIONS

A new self-complementary bowtie SCBT-antenna has been incontestable and also the self-complementary principle is verified. an easy technique has been applied to relate the lower frequency of the operation band to the antenna dimensions. This antenna overcomes the matter of restricted band of the standard bow-tie TBT-antenna that wants difficult matching sections to widen its information measure to the UWB needs. Not like the traditional bow-tie antennas the planned antenna is of easy structure, easier style, appropriate for the straightforward fifty Ω port feeder, and befits UWB needs. Ansoft HFSS package has been used as a tool for the simulation results. The SCBT-antenna was fictitious and tested. Experimental validations for the come back loss and radiation patterns showed smart agreement with simulation results. The mensuration of the utmost gains of SCBT-antenna valid its comparatively high gain.

7. FUTURE WORK

Future Scope on this bow-tie antenna will be through form self-similarity repetition of the triangular form on every of the patch and its complementary slot. The simulation studies of this may be done by the HFSS package and might be verified by experimental measurements.

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