TRANSACTIONS ON ELECTROMAGNETIC SPECTRUM

Ultra Wideband Elliptic Monopole Antenna

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Abstract: In this paper, design and analyses of the elliptic monopole antenna is proposed. The designed antenna has a compact size of 15 x 25 x 1.6 mm. In the antenna design low cost FR4 dielectric material is used. The antenna works efficiently at the frequency band of 3.1 GHz- 10.6 GHz where the reflection coefficient values lower than -10 dB. In addition to this, the antenna has a minimum and maximum gain values of the 2.5 dBi and 9dBi respectively in the UWB range. In addition to this, the antenna has a minimum and maximum gain values of the 2.5 dBi and 9 dBi respectively in the UWB range. As a result, it can be said that, the proposed antenna can be used in the UWB applications.

Keywords: UWB monopole antenna, Elliptic antenna, HFSS antenna design

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1. INTRODUCTION

Ultra Wide Band (UWB) realize the faster communication by the help of the higher bit rates and lower complexity systems in the wide frequency ranges. The antenna design for the UWB frequency range challenges to the other type of antenna which ones operates on the narrower or wider bands. Because UWB antenna should be evaluated both in the frequency domain and in the time domain.

The main aim of the UWB antenna design is to combine the multiple resonances for obtaining wider impedance matching by the proper ways or techniques. In addition to this, it is important issue for the antenna operating in the UWB band range to block possible interferences with the existing IEEE802.11a and HIPERLAN/2 systems.

When the literature is examined that there are various antennas with the different geometries and shapes work on the UWB frequency range. for instance, the shapes of the main radiator can be rectangular, circular, triangular or elliptical. When the elliptical UWB antenna examined, the major and important studies can be listed as follows:

A novel semi-elliptic monopole slot antenna for the aim of using in the UWB applications was presented by Gopikrishna et al. [1]. The antenna has an extensive bandwidth from 2.85 to 20 GHz which one consist of the coplanar waveguide feeding network, semi-elliptic radiating element and an altered ground plane.

In another work, an elliptic-card UWB antenna works in the frequency range of 3–11 GHz was designed by Bahadori et al. [2]. The antenna has an elliptic shaped radiating structure and a rectangular shaped ground plane with the novel feeding mechanism. In addition to this, the antenna has a compact size and WLAN band rejection property.

A low cost UWB elliptic antenna was presented by Karoui et al. [3]. The antenna is placed on the FR4 dielectric material which one has a compact size of $21 \times 27 \times 1.6$ mm^3. It has an impedance bandwidth of 16.26 GHz with a maximum Gain of 6 dBi.

A novel, compact microstrip-fed UWB antenna is proposed by Sarkar et al. [4]. The antenna has a WiMAX, WLAN and X band rejection characteristic using the two elliptic single CSRR and two rectangular split-ring resonators.

The novel elliptical and circular shaped UWB monopole antenna was presented by Abbosh et al. [5]. In the analyses, three type of the substrates materials with the different specifications such as dielectric constant and thickness were used in the electromagnetic packet program. The designed antennas have the eligible radiation efficiencies and Omni-directional patterns in the UWB range. s

In another work, the novel UWB monopole antenna which is made up of the Sierpinski triangle iterations was presented by Leyva-Hernandez et al. [6]. The antenna has a lower and upper operating frequencies of 700 MHz and 9 GHz in the UWB band range respectively. The main contribution of the fractal shapes in the patch is to minimize the antenna size.

A novel, compact ultra wideband monopole antenna which one has the band rejection property was presented by Kang et al. [7]. The band rejection property of the antenna at the frequency range of 5.12GHz to 5.99 GHz is achieved by the using of the U shaped slot placed in to the elliptical shaped radiating element. In addition to this, the antenna has a quasi-omnidirectional radiation pattern.

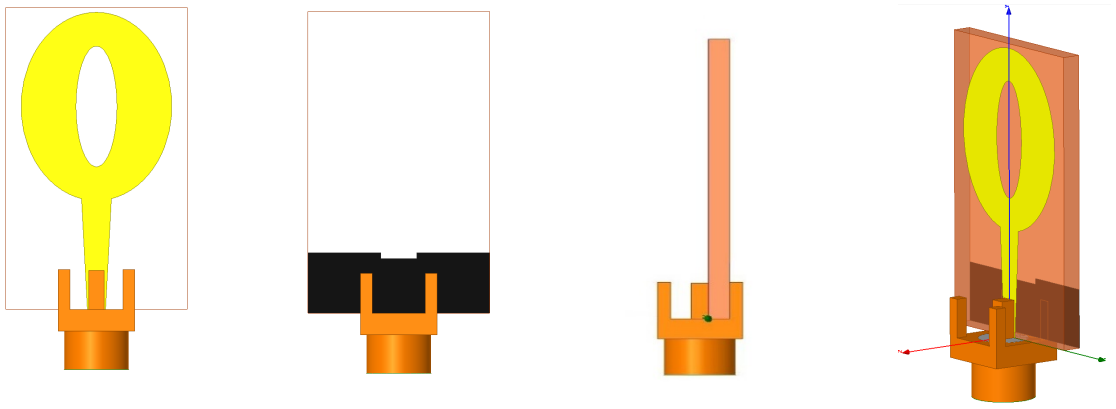
In this paper, the design and analyses of the novel elliptical monopole antenna is presented. In the next section, the geometrical specifications, simulation results are presented. In section 3, conclusion is given.

2. THE DESIGNED ANTENNA

The general geometry of the proposed antenna is given in Fig. 1. The dielectric material is chosen as a FR4 with the height of 1.6 mm, dielectric constant of the 4.4 and loss tangent value of the 0.02. According to the figure, it is clear that, the proposed antenna has a radiating patch at the top of the FR4 substrate.

The radiating patch consist of the elliptical structure which has an elliptical slot inside it. The outer major and minor radius of the radiating element is 7.8 mm and 6.24 mm respectively. The elliptical slot also has the 5 mm and 1.7 mm major and minor radius values respectively. The feeding of the antenna has made by the tapering transmission line which one has the widths of 1.5 mm at the bottom and 2.5 mm at the top. The length of the feeding line is nearly 9 mm.

At the bottom of the substrate, the antenna has a defected ground structure with the size of 15 mm x 5 mm. in addition to this, the minor slot is etched on the top of the ground plane for increasing the impedance matching of the antenna at the higher frequencies. The slot in the ground has a size of 3 mm width and 0.5 mm length.



a) front view *b) bottom view* *c) side view* *d) perspective view*

Figure 1. Proposed UWB elliptic monopole antenna.

The refleciton cofficient graph of the proposed antenna is presented in Figure 2. The proposed antenna has a bandwidth value of the 7.5 GHz which starts from the nearly 3.1 GHz and ultimates at the 10.6 GHz. This graph prove that the proposed antenna covers the entire UWB frequency band.

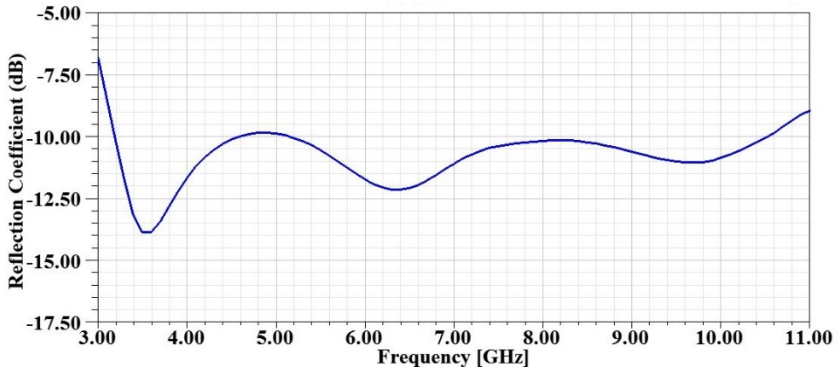
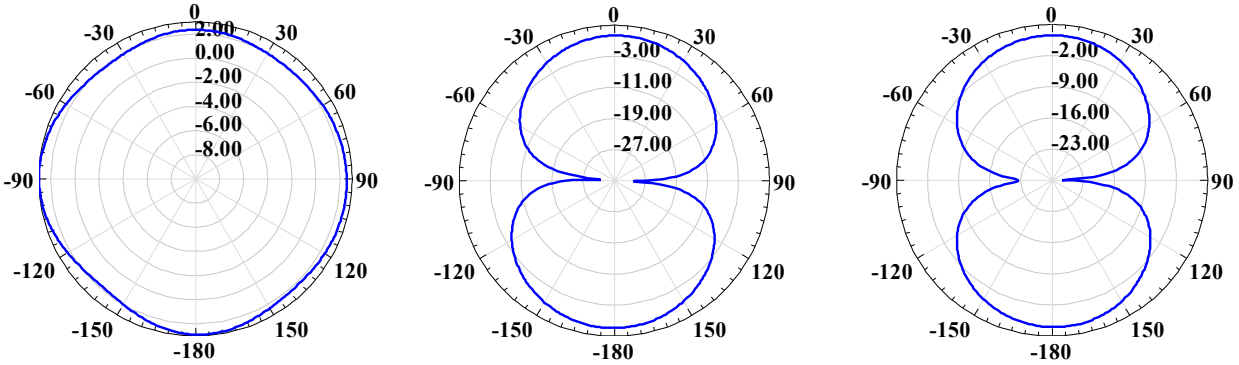


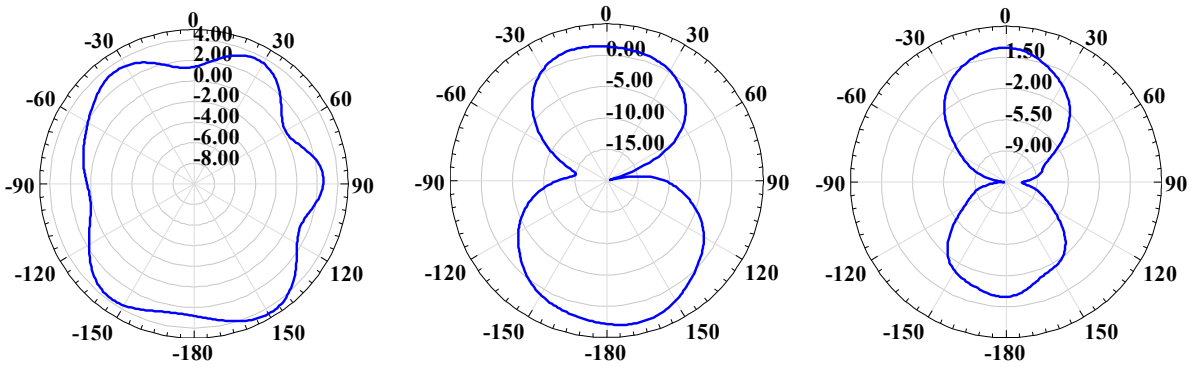
Figure 2. The reflection coefficient of the proposed antenna.

The radiation patterns of the antenna at the 3.5 GHz and 5.5 GHz bands are given in the Fig. 3 and Fig. 4 respectively. The antenna has a maximum gain of 3.5 dBi at the 5.5 GHz band.



a) Phi=0 *b) Phi=90* *c) Theta = 90*

Figure 3. The radiation patterns of the proposed antenna at 3.5 GHz



a) Phi=0 *b) Phi=90* *c) Theta = 90*

Figure 4. The radiation patterns of the proposed antenna at 5.5 GHz.

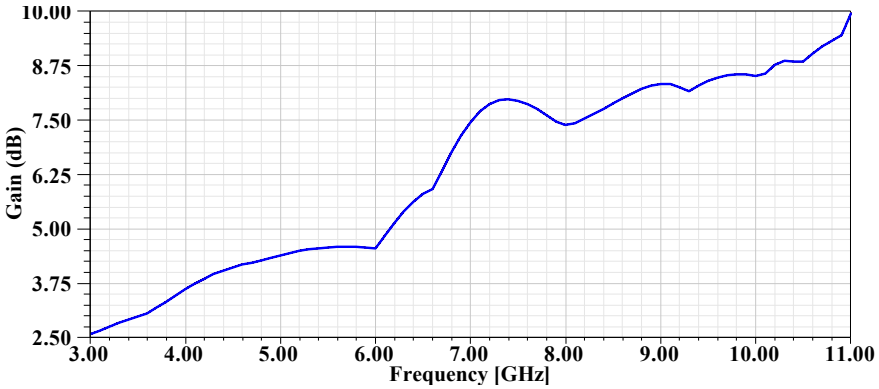


Figure 5. The maximum gain of the proposed antenna versus frequency.

3. CONCLUSION

In this paper, the design and analyses of the novel elliptical shaped monopole antenna was presented. The antenna has a compact size of size of 15 x 25 x 1.6 mm. In the antenna design low cost FR4 dielectric material is used. The antenna works efficiently at the frequency band of 3.1 GHz- 10.6 GHz where the reflection coefficient values lower than -10 dB. In addition to this, the antenna has a minimum and maximum gain values of the 2.5 dBi and 9 dBi respectively in the UWB range. As a result, it can be said that, the proposed antenna can be used in the UWB applications.

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