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Band Enhancement of a Compact Flexible Antenna for WLAN, Wi-Fi and C-Band Applications

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***Abstract* – Design and analysis of a wideband compact flexible antenna is presented in this paper. The bandwidth enhancement of conventional triangular quarter wave monopole antenna is achieved by utilizing the combination of a fractal structure along with open ended stub. Moreover, the flexibility analysis was studied to show the stability of presented work for conformal analysis. Furthermore, compact size, wideband, stable performance in flexibility condition makes the proposed work potential candidate for WLAN, Wi-Fi and C-band Applications.**

***Keywords* — Compact size, flexible antenna, WLAN, Wi-Fi, C-band.**

I. Introduction

Ultra-Wideband (UWB) systems are working efficiently, since the past few decades, due to their numerous advantages that are not limited immunity against multipath effects, high data rate transfer and easy implementation. As a result of this, UWB systems are widely used for radar imaging, location precision and data collection applications [1]. An efficient antenna having UWB operational bandwidth becomes a necessity for effective communication, which is nullified by researcher via proposing various design for UWB systems [2]. However, the recent trends of compact and flexible devices mitigate the usage of previous rigid UWB antenna [3]. Thus, researcher once again put effort to design an UWB antenna with minimum possible design having maximum achievable gain and efficiency [4-6].

In [4] a polydimethylsiloxane (PDMS) fabric material based conformal UWB antenna was proposed. Although the antenna covers wideband of 3.8–8.3 GHz having a notch band of 5–6 GHz, it suffers from set back of a bigger dimension of 70 × 68 mm^2. Another interesting work based on PDMS substrate was reported in [5]. The antenna offers much wider band as compared to work reported in [4], at the cost of bigger dimension of 80 × 67 mm^2. Contrary to above, a compact antenna was presented in [6], where researchers use polyimide substrate to design a wideband antenna. Antenna although offers a much wideband as compared to related work, but the distorted radiation pattern limits it usage for most of applications. Thus, based upon the aforementioned discussion a compact flexible antenna having wideband is still challenging for researcher. Therefore, the presented work focusses on the design of compact flexible antenna for modern day applications.

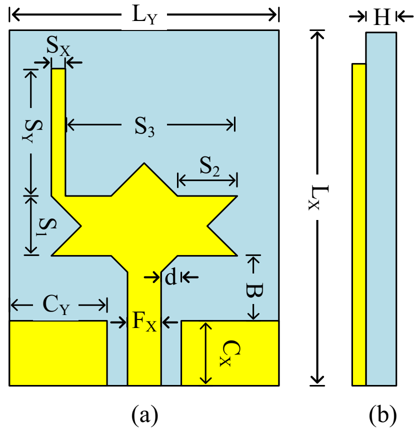

Fig. 1. Configuration of proposed flexible wideband antenna (a) top-view (b) side-view.

II. Antenna Design and Results

The structure of proposed compact flexible antenna is depicted in Fig. 1. The proposed antenna was designed using ROGERS RT/duroid 5880, that belongs from a flexible natured material. The selected thickness was 0.254mm to utilize the advantage of flexible nature along with compact size. The radiator consists of a Co-Planar Waveguide (CPW) fed star shaped structure loaded with open ended stub, as depicted in Fig. 1 (a). Designing as well as performance parameters were analyzed using High Frequency Structure Simulator (HFSS).

The antenna was designed using three major steps. In step-I, the basic monopole radiator were designed using the methodology explained in [ref]. The triangular shaped quarter wave monopole antenna offers a broadband ranging 4.4–6.4 GHz having central frequency of 5.2 GHz, as depicted in Fig. 2. Afterwards, to further improve the impedance bandwidth of the antenna, fractal geometry was utilized. An inverted triangular patch was inserted at the center of the radiator designed previously. The loading of this patch increases the effective area of the antenna resulting in improved matching of antenna over wideband. The results shows that the antenna now start offering a wideband of 3.1 GHz (4.1–7.3) GHz, as shown in Fig. 2.

In last step, an open-ended stub was loaded at the left top corner of the radiator. Due to insertion of the stub, the surface current redistribute itself and find more path to flow on radiator. This effect causes the shifting of resonating frequency toward lower side along with improvement in impedance matching, [ref] shows present detail discussion on stub loading and its effects on performance of antenna. Stub loading improve the bandwidth of the antenna and optimized antenna show a wide $|S_{11}| < -10$ dB impedance bandwidth of 4.9 GHz ranging 3.9–7.8 GHz, as shown in Fig. 2. The optimized parameters of the proposed wideband antenna are: $L_X = 20; L_Y = 15; C_X = 5; C_Y = 6; F_X = 2; d = 0.5; B = 2.5; H = 0.254; S_X = 1; S_Y = 7; S_1 = 5; S_2 = 4.5; S_3 = 12$ (units = mm).

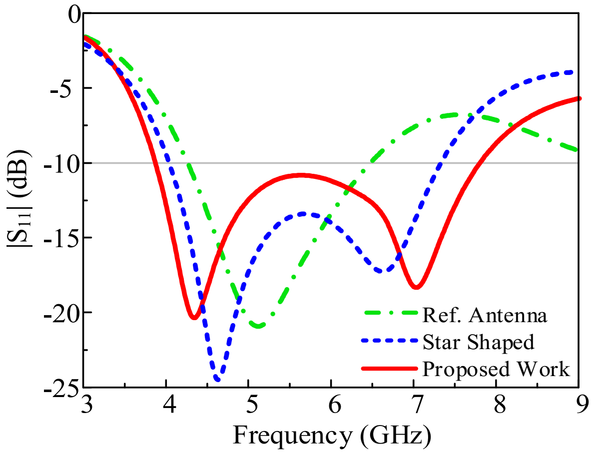

Fig. 2. Return loss graph of various steps utilized to design presented antenna.

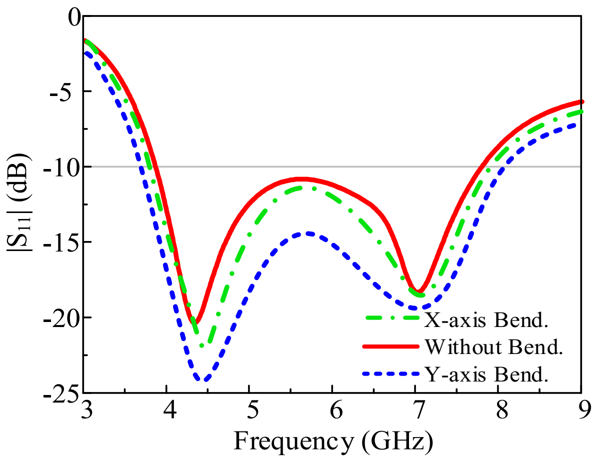

Fig. 3. Return loss comparison among antenna without bend and in bending condition.

To show the potential of proposed antenna for flexible applications, conformability analysis was performed as results were shown in Fig. 3. The antenna was bended along both X-axis and Y-axis, around a cylinder having a radius 20mm. It can be observed clearly that the antenna offers very good agreement between antenna under bending condition to that of without any bend. In fact, a slight band enhancement along with improved impedance matching was observed for bending cases, as depicted in Fig. 3.

III. Conclusion

The article presents the design and analysis of a compact sized flexible antenna. The antenna was designed on flexible material having an overall dimension of 15 × 20 × 0.254 mm^3. The antenna structure was inspired from a quarter wave triangular monopole antenna which was further modified using inverted triangular patch and open-ended stub. The resultant antenna offers a wide impedance band width of 4.9 GHz (3.9–7.8GHz). Moreover, the strong comparison of antenna performance parameters in both flatten and bend condition shows the performance stability and makes the proposed work a potential candidate for both conformal and non-conformal applications.

Acknowledgment

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