Compact Flexible Frequency Reconfigurable Antenna for Heterogeneous Applications

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Abstract- This work presents a flexible frequency reconfigurable multiband antenna for heterogeneous applications with a compact size of 35mm × 25mm × 0.254mm, which correspond to 0.22λ0 × 0.11λ0 × 0.0007λ0. The antenna prototype is fabricated and validated experimentally. Simulated and measured results are in good coherence. Therefore, compactness, flexibility and reconfigurability of the proposed antenna ascertain the suitability of the design for current and forthcoming applications.

I. INTRODUCTION

Flexible electronics attains considerable attention since the past decade due to its numerous advantages including their flexibility, lightweight and durability, over rigid devices. To communicate effectively between flexible devices a flexible antenna becomes a natural demand, moreover, due to recent trends of compact devices, a huge demand arises for compact and flexible antennas [1]. However, the flexible antenna should be able to operate on multiband having wide operational bandwidth with Omnidirectional pattern [2]. The frequency reconfigurable antennas were preferable than multiband antennas due to the advantage of on-demand band switching which considerably overcomes the challenge of congestion of band spectrums.

A number of works have been reported by the researchers working on flexible and frequency reconfigurable antennas [3-8]. The work reported in [3] and [4] used copper tape instead of using the real diode which limits its use for practical applications. In [5] and [6] a single to dual-band frequency reconfigurable antennas were proposed, good results in terms of bandwidth and gain were achieved however these works have the drawbacks including bigger size and close-range frequency reconfigurability. In [7] a multi-mode antenna having a wideband mode and three dual-band modes was reported, although the presented work is compact as compared to other works, its operational region is limited form 2GHz to 4GHz. In [8] a dual-band frequency reconfigurable antenna was reported although the presented work covers a wide operational band with acceptable gain, but it also had the drawback of a larger dimension. Therefore, a compact size, flexible frequency reconfigurable antenna having a wide operational band is still a challenge for the researcher.

In this paper, a compact flexible frequency reconfigurable antenna having two dual-band mode and a tri-band mode is presented. The antenna geometry comprises of conventional circular radiator along with a stub to achieve a wideband. While rectangular and semi-circular slot are utilized to achieve a wideband mode and two dual-band modes. The geometry of the proposed antenna is inspired from the conventional circular monopole antenna, whose dimension can be calculated using the equations given in [9]. To overcome the set back of narrowband exhibited by conventional antenna...
a rectangular stub is employed which introduced additional reactive load and results in good impedance matching over a wideband. However, a notched band is observed from 3.28GHz to 4.94GHz. Thus, to mitigate the notch band and cover the whole wide band additional capacitive load is generated by etching a rectangular slot from the circular radiator. The resultant antenna exhibits an impedance bandwidth of 6.93GHz (2.9-9.3 GHz). At last, a semicircular stub was etched and two diodes were inserted to form a proposed frequency reconfigurable flexible antenna. The length of the semicircular slot can be adjusted as per user demand to mitigate the unwanted band.

B. Antenna Characterization
To validate the findings an antenna prototype is fabricated, as illustrated in the inset of Fig. 2, and various performance parameters are measured. Fig. 2 presents the comparison among simulated and measured S-parameters of the proposed antenna. It is observed that antenna exhibits two passbands in case-00 ranging 2.52-6.07GHz and 7.1-10.7GHz; three passbands in case-10 ranging 2.82-3.56GHz, 4.32-5.91GHz and 7.4-9.4GHz while two passbands are also observed for case-11 ranging 1.98-2.51GHz and 3.97-7.87GHz. A similar phenomenon is also observed when the antenna is bent along a circular shaped foam in both X-axis and Y-axis, as depicted in Fig. 3. Strong agreement between simulated and measured results along with the results under conformal and non-conformal conditions is observed. For the brevity of the manuscript the far-field results are not included, upon acceptance, the results will be presented at the conference.

III. CONCLUSION
This paper demonstrates a compact flexible frequency reconfigurable antenna having two dual-band mode and a tri-band mode. The antenna geometry consists of conventional circular radiator along with a stub to achieve a wideband. Moreover, rectangular and semi-circular slot is utilized to achieve multimode by switching the state of diodes. The presented antenna shows a good agreement between simulated and measured results for both conformal and non-conformal scenarios. This ascertains the proposed flexible reconfigurable antenna a potential contender for heterogeneous applications.

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