International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-6, Issue-6, June 2020
ISSN: 2395-3470
www.ijseas.com

Design of Reconfigurable Monopole Antenna for Cognitive Radio Application

A.Yogeshwaran[1], Dr.K.Umadevi[2]
Department Of Electronics and Communication Engineering[1, 2]
Dhanalakshmi Srinivasan Engineering College, Perambalur[1], Sengunthar Engineering College, Tiruchengode2
er.yogesh85@gmail.com[1],

Abstract

A compact frequency reconfigurable UWB antenna for cognitive radio application is presented in this paper. The proposed structure has a simple design and easy construction. The antenna is made reconfigurable, by enabling or disabling the parasitic element coplanar to the main radiator. The resonance frequency of the proposed antenna operates in two configurations which is achieved by employing three ideal switches. This antenna is operational in the practically whole UWB spectrum. Antenna parameters in terms of current distribution, return loss and radiation pattern are also presented. Experimental results successfully validate the proposed design methodology in this work. The simulations were carried out in the Agilent Advance Design System (ADS).

Keywords—Microstrip antenna, cognitive radio, reconfigurable, wideband antenna, UWB,

I. INTRODUCTION

Antenna is an interface between transmitter and free space for radiation of electromagnetic energy. Shape and structure of antenna defines the radiation characteristic and hence interface efficiency [1]. Various popular antennas include dipole, bow tie and horn etc, usually there are various parametric constraints on antennas for radiation. These include size, shape and feeding structure etc [2].

In the last decade the ultra wideband (UWB) communication has been in the focus of various studies relating to mobile communication. As per FCC regulations, they use license exempt RF spectrum in the range from 3.1 GHz 10.6 GHz [3]. Moreover the expanded enthusiasm for these systems is because of their points of interest, for example, high data rates, low operating costs, low power spectral density, ease of antenna construction and wider bandwidth [4]. As a result, a significant number of researchers have dedicated their urge to the improvement of the UWB antenna. With the introduction of LTE/LTE-advance mobile communication standards the cognitive radio communication systems have begun to obtain a lot of consideration. Numerous designs and architectures have developed. To use the same antenna for both detecting and communication by reconfiguring (UWB) sensing antenna pass on into various frequency band, is one of the strategies to use reconfigurable antenna in cognitive radio devices [5].

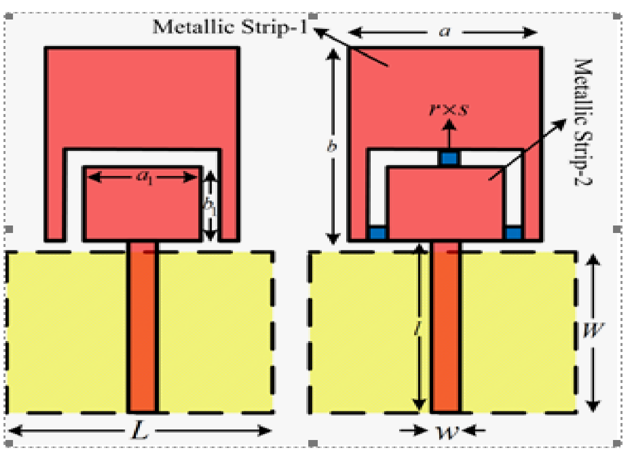


Fig. 1.Reconfigurable UWB Monopole Antenna.

Reconfigurability in UWB antennas has been studied in [6]. Majority of the literature on UWB reconfigurability uses multiple antennae and then switch between multiple configuration using micro-electro-mechanical system (MEMS), p-i-n diodes [7], [8] and ideal switches [9] - [11]. Ideal switching scheme has also been implemented using stepper motor which rotates distinctive patches in to different configuration.

In this communication, a compact reconfigurable UWB monopole antenna with wide band switchable is presented. A reconfigurable structure is formed using three ideal switches. To the best of our knowledge such design has not been reported in the literature. For a full coverage of the UWB spectrum, two rectangular metallic strips are used which are separated from each other by etching some portion from the middle of the radiator which is shown in Fig.1. The simulated impedance bandwidth with a return loss below -10 dB of antenna covers 3-5 GHz in configuration-I and 6-9 GHz in configuration-II. The current distributions between these two configurations are also observed from the proposed antenna as well as radiation pattern in E and H-planes are obtained.

The remainder of this paper is as follows: Antenna geometry is discussed in section II and section III presents experimental results in detail. Section IV concludes the paper.

II. ANTENNA DESIGN

Fig. 1 shows the proposed reconfigurable UWB monopole antenna. A rectangular metallic strip-1 with dimension a and b is responsible for the lower frequency band when the switches are in ON state. Rectangular metallic strip-2 with dimension a' and b', is used to switch to high frequency when these switches are in OFF state.FR4 substrate is used for printing of antenna which have a thickness of 1.6 mm and ε_r = 4.6. The dimension of ground plane beneath the feed line are L and W. To attain 50 Ω impedance microstrip feed line has a length l and a width of w.Three symmetrical ideal switches (e.g., placing copper pads to resemble an ON switch state and eliminating it for the OFF case) are placed between the two metallic strips to achieve reconfigurability having a dimension of r and s. The optimized dimensions of proposed design after parametric study as listed in Table 1.

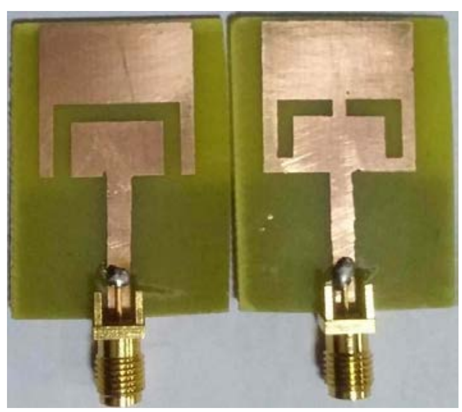
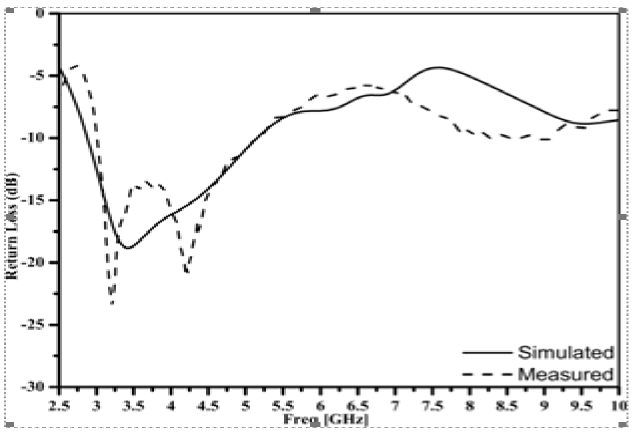


Fig. 2. Prototypes of UWB Monopole Antenna.

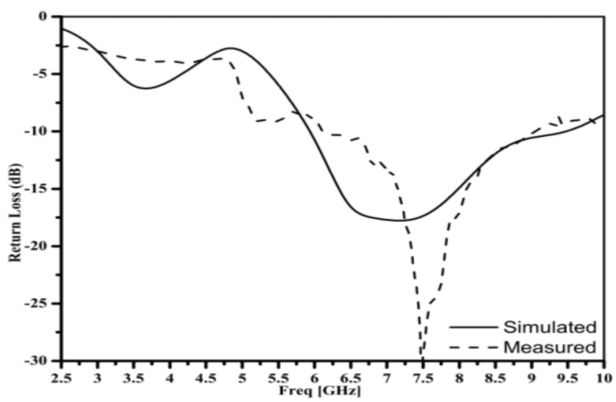
III. RESULTS AND DISCUSSION

Fig. 2 shows the prototype of proposed antenna. Fig. 3(a) and (b) shows the simulated and measured return loss for two different configurations. There is slight difference between simulation and measured results that can be accounted for fabrication tolerances. In configuration-I the antenna operates at the lower band of UWB that is 3-5 GHz when all three switches are ON, and the antenna is used to scan the whole lower band of UWB spectrum as demonstrated in Fig. 3(a). When all these switches are OFF configuration-II is achieved, the antenna is operated as a higher band of UWB that is 6-9 GHz as shown in Fig. 3(b).

The measured results demonstrate a good agreements with the simulated results, since it has a good impedance matching for both the configuration so that it can be used for cognitive radio application. Since the standardization of cognitive radio system is not yet done [12]. The thought is to incorporate the biggest conceivable number of frequency bands.



(a)

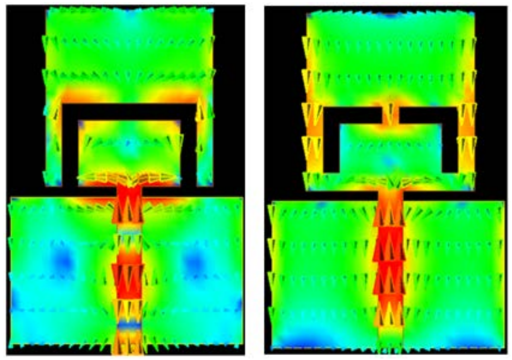


(b)

Fig. 3. Return Loss:(a) Configuration-I and (b) configuration-II.

Fig. 4 shows the current distributions of configuration-I and configuration-II. It is clearly shown from the figure that in OFF state, there is no connection built between these two metallic strips and current is concentrated in the smaller radiator. But in ON state current starts flowing through metallic strip-2 which increases the antenna size and hence shift to lower resonance, i.e., configuration-II.

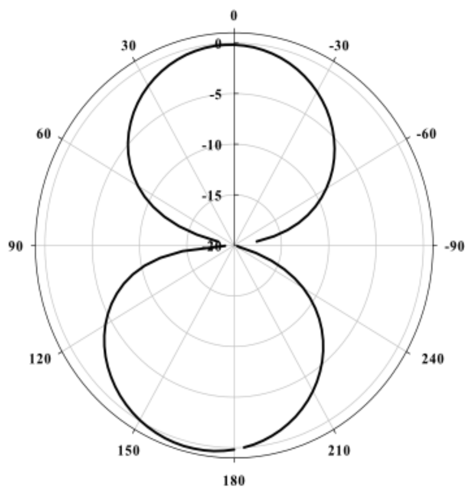
Fig. 5 illustrates the radiation pattern of the presented antenna design at configuration-I with center frequency of 4 GHz and configuration-II with center frequency of 8 GHz respectively.The key role of the radiation patterns is to discover that the antenna actually radiates in omnidirectional pattern.



(a) **(b)**

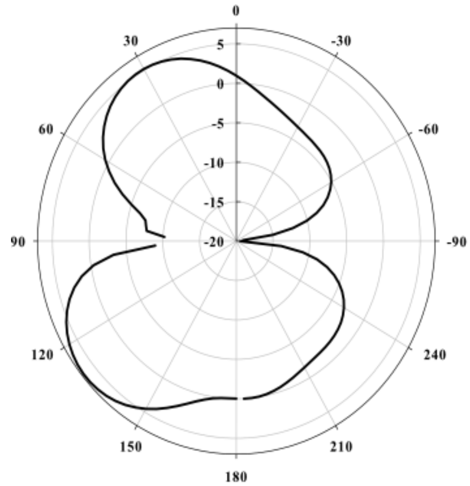
Fig. 4. Current distributions at (a) 8 GHz and (b) 4 GHz.

It can be understood that the radiation patterns are approximately omnidirectional in both lower and upper UWB bands.

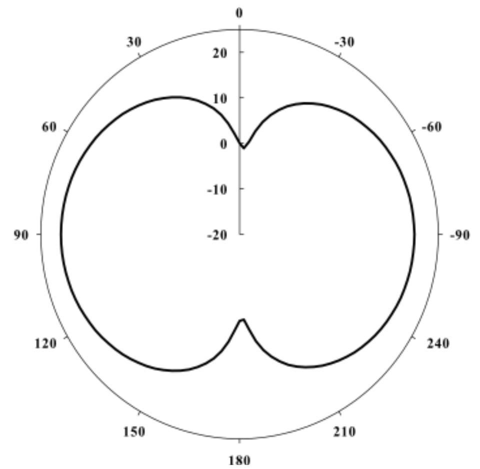


(a)

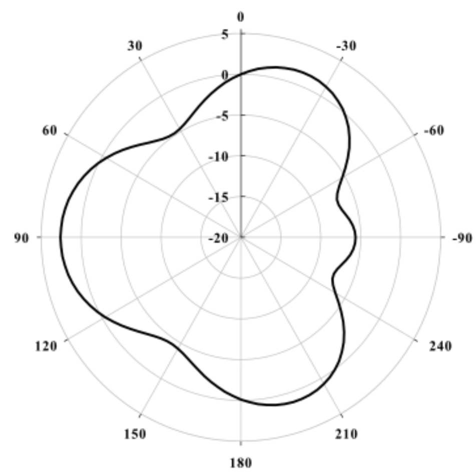
International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-6, Issue-6, June 2020
ISSN: 2395-3470
www.ijseas.com



(b)



(c)



(d)

Fig. 5. Simulated radiation pattern (a), (b) E-plane at 4 GHz and 8 GHz and (c), (d) H-plane at 4 GHz and 8 GHz.

IV. CONCLUSION

In this communication a reconfigurable UWB monopole antenna has been proposed for cognitive radio application. By separating two rectangular metallic strips and implementing an ideal switch inside of that etched area between two metallic strips we can achieve two configuration. The proposed antenna design is fabricated and the measurement showed good agreement with simulation results.

Current distribution, return loss and radiation patterns values were calculated for two different operating configuration of the proposed reconfigurable UWB monopole antenna. This antenna can be employed in verity of UWB application as cognitive radio and other communication system.

Reference

[1] C. A. Balanis, Antenna theory: analysis and design. John Wiley & Sons,2005, vol. 1.

[2] A. Jazeel and M. Susila, "Compact reconfigurable ultra-wide band antenna design for wireless communication," in Advanced Communication Control and Computing Technologies (ICACCCT), 2014International Conference on, 2014, pp. 734–737.

[3] S. Vahid, P. Rezaei, A. Shahzadi, and M. M. Fakharian. "A planar UWB antenna based on MB-OFDM applications with switchable dual band-notched for cognitive radio systems." International Journal of Microwave and Wireless Technologies 8, no. 01 (2016): 95-102.

[4] Z. Mei, G. Fu, J.-G. Gong, Q. Li, and J. Wang, "Printedmonopole UWB antenna with dual band- notched characteristics," in Ultra-Wideband (ICUWB),2010 IEEE InternationalConference on, vol. 2, 2010, pp. 1–3.

[5] P. S. Hall, P. Gardner, J. Kelly, E. Ebrahimi, M. R. Hamid, F. Ghanem,F. J. Herraiz-Martinez, and D. Segovia-Vargas, "Reconfigurable antenna challenges for future radio systems," in Proc. 3rd Eur. Conf. Antennas Propag., Berlin, Germany, 2009, pp. 949–955.

[6] T. Aboufoul, A. Alomainy, and C. Parini, "Reconfiguring UWBmonopole antenna for cognitive radio applications using GaAsFET switches," vol. 11, pp. 392–394, 2012.

[7] M. S. Narlawar, and S. L. Badjate. "A Circular Monopole with a Rectangular Microstrip Antenna for Cognitive Radio Applications." International Journal of Innovative Research in Science & Engineering 2.4 190 194, 2014.

[8] K. Nishant, P. A. Raju, and S. K. Behera. "Frequency reconfigurable microstrip antenna for cognitive radio applications."Communications and Signal Processing (ICCSP), 2015 International Conference on. IEEE, 2015.

[9] M. Hamid, P. Gardner, P. Hall, and F. Ghanem, "Vivaldi antenna with integrated switchable band pass resonator,"vol. 59, no. 11, pp. 4008–4015, 2011.

[10] J. R. Kelly and P. S. Hall, "Integrated wide-narrow band antenna forswitched operation," microwave and optical technology letters, vol. 52, no. 8,pp. 1705–1707,2010.

[11] S. Nikolaou, N. Kingsley, G. Ponchak, J.Papapolymerou, and M. Tentzeris, "UWB elliptical monopoles with a reconfigurable band notch using MEMS switches actuated without biaslines," vol. 57, no. 8, pp. 2242–2251, 2009.

[12] E. Grayver, "Standardization efforts for software defined radio", IEEE Aerospace Conference, pp. 1-8, Mar. 2010.