Design of Combined Antenna with Multiple Polarizations

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Abstract

In this paper, we present a design of new combined antenna, mixing both linear and circular polarizations, new antenna have to be able to cover several frequency bandwidths, including various radiation properties. From the different researches of antenna with various geometries, and regarding the complexity to combine in a single radiating element several types of polarizations. It is extremely important that the development of antenna used in Wireless Systems**.** The proposed antenna is simulated in CST Microwave Studio, which is from 2.9 GHz and 9.1 GHz.

Keywords
Miniature antenna, linear polarization, Circular polarization combined antenna, wireless LAN.

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1. Introduction

The general trend of smaller hand held devices with an increasing number of wireless functions significantly complicates the antenna selection and integration process. It is now common to have devices combining regular cellular communication capabilities with wireless LAN, GPS and Bluetooth; each system requiring its own antenna. The size reduction is a known problem for the individual performance of each antenna [1].

The polarization of an antenna in a given direction is defined as the polarization of the wave transmitted or radiated by the antenna [2]. When the polarization direction is not specified, It is considered in the direction of maximum gain. A wave is linearly polarized in a given point in space where the field vector electric (or magnetic) at this point is always oriented in the same straight line every time.

An electromagnetic wave is circularly polarized at a given point in space where the vector of the electric field (or magnetic) at this point describes a circle as a function of time. The rotation is always determined for an observer who sees the wave away before him.

A combination of antenna has linear polarization and circular polarization antenna meets a given standard or a single structure where one considers the different resonance modes [3].

2. Antenna configuration

2.1 Linear polarization antenna

In this first study, we focus on linearly polarized antennas. These antennas can be found in several forms. The most knowing and most used for this polarization are the dipoles antennas [4].

The structure is depicted in Fig1. The asymmetric "U" antenna is fed at the center of the U-shaped base by a coaxial probe. It is located in the center of a circular ground plane of 40 mm diameter.

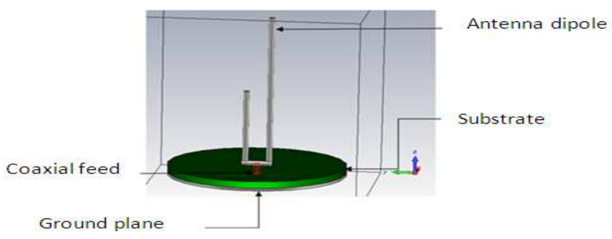
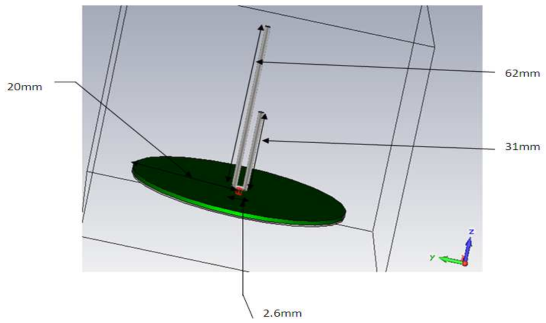
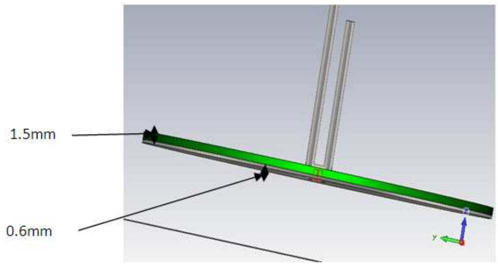


Fig.1 Linear polarization antenna

Fig 2 illustrates Arrangement of the antenna, the green top layer is made of a low permittivity and low-loss substrate, in order to optimize the antenna efficiency and bandwidth, where $\varepsilon_r = 2.32$, $\mu = 1$, thick copper layer is used as a ground plane for the antenna structure [5].



(a)



(b)

Fig .2 (a) Layer of the dipole U antenna (b) Arrangement of the antenna .

2.1.1 Radiation properties of antenna

The computed return loss of linear polarization antenna. The simulated antenna by CST Microwave Studio software is well adapted at three resonant frequencies of 1.32 GHz, 2.41 GHz, and 3.48 GHz. The reflected power reaches the values of -30.83 dB,-19.33 dB and -11 dB at these resonant frequencies respectively.

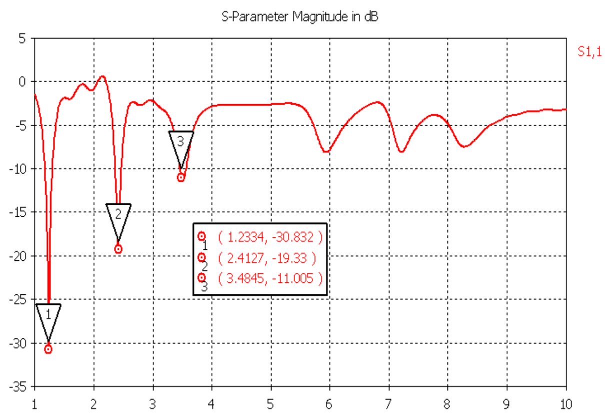


Fig.3 Computed return loss of the antenna

Fig .4 to Fig .7 presents the antenna directivity pattern measured at frequency of 1.23 GHz.

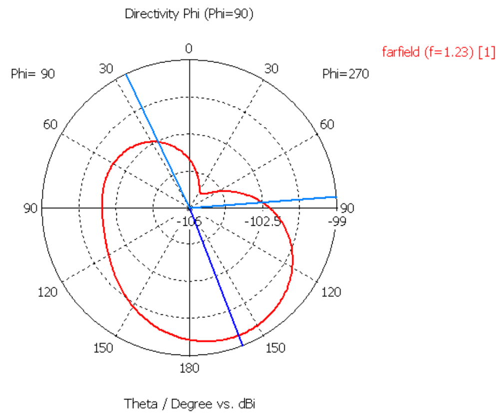


Fig .4 Polar diagrams (Phi=90°) at the frequency (f=1.2 GHz)

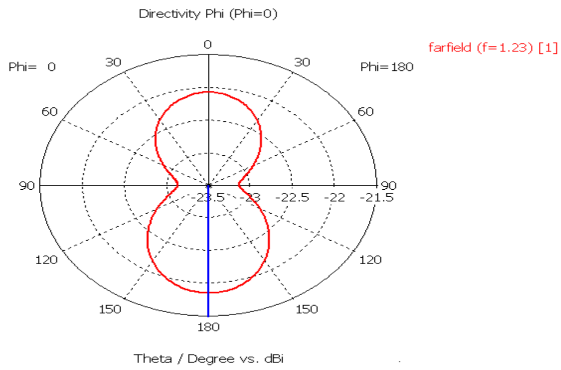


Fig.5 Polar diagrams (Phi=0°) at the frequency (f=1.2 GHz)

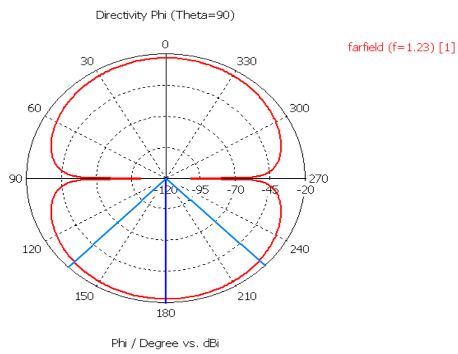


Fig. 6 Polar diagrams (Theta=90°) at the frequency (f=1.2GHz)

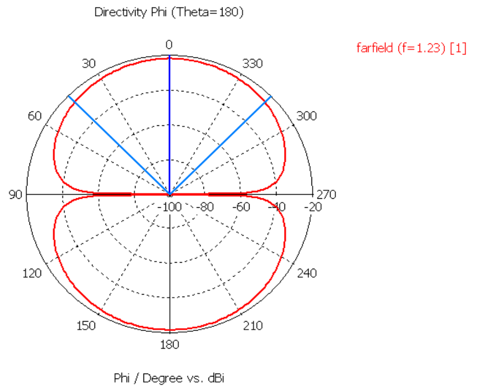


Fig .7 Polar diagrams (Theta =180°) at the frequency (f=1.2GHz)

2.2 circular antenna polarization

In this second study, we present the circular polarized antennas. We used the rectangle patch and providing a substrate permittivity εr = 2.3 [6].

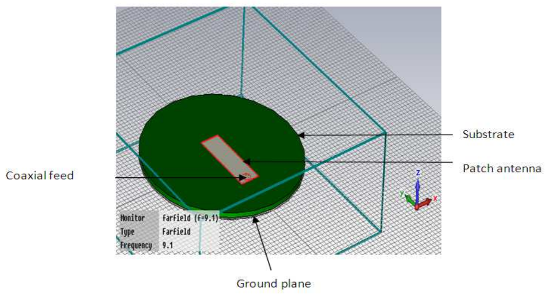


Fig .8 Circular antenna polarization

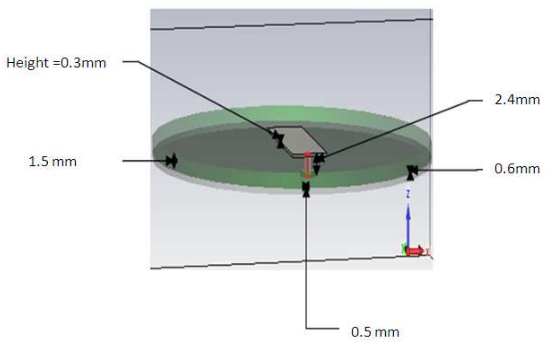


Fig. 9 Layer of patch antenna

Table1: Dimension of the patch

Height	0.3mm
lenght	32 mm
Wigth	10 mm

To generate circular polarization, we cut the two opposite corners of the antenna to create an asymmetry in the geometry; this particular geometry allows vector surface currents turn as two orthogonal modes are excited. Having cut these corners reduces path of the surface currents, resulting in increased frequency resonance. Corners cut are isosceles triangles whose sides measure 4mm.

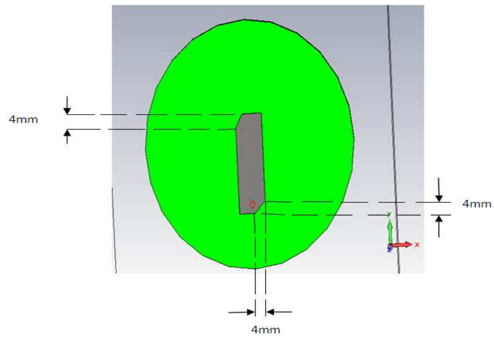


Fig .10 Path antennas with cut corners

2.2.1 Radiation properties of antenna

At the frequency of 9.6 GHz, a resonant mode and a good adaptation are observed. A peak appears at -13.95 dB.

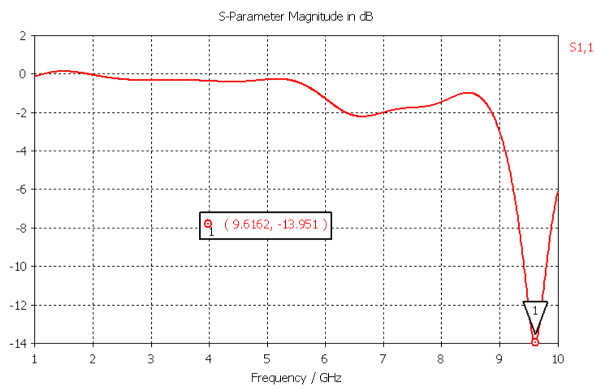


Fig. 11 Computed return loss of the antenna

Fig .12 to Fig .14 presents the antenna directivity pattern measured at frequency of 9.61 GHz.

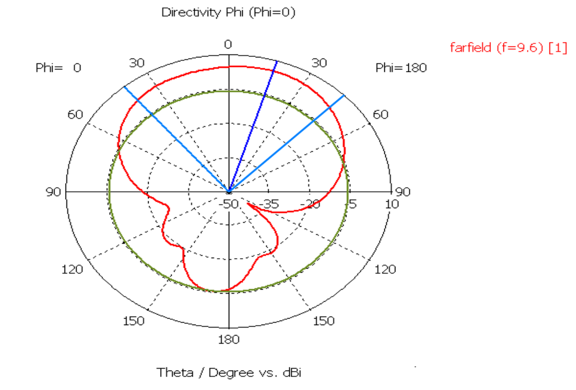


Fig. 12 Polar diagrams (Phi=0°) at frequency (f=9.6 GHz)

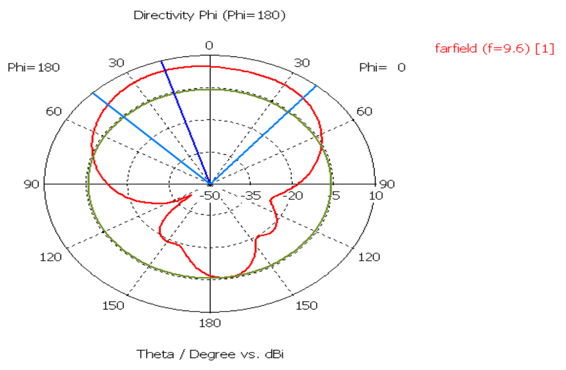


Fig. 13 Polar diagrams (Phi=180°) at frequency (f=9.6GHz)

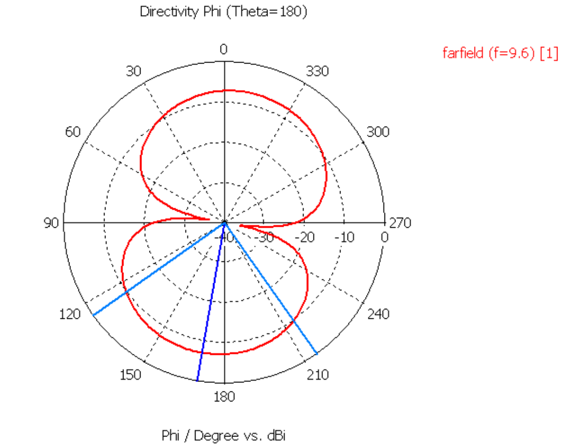


Fig.14 Polar diagrams (Theta=180°) at frequency (f=9.61 GHz)

2.3 Antennas combined

In the third study we will be find a way to combine linear polarized antenna with the circular polarized antenna without much degradation the performance of each antenna [7]. This feeding method couples made the resonances of each radiating element And excite it directly through which it passes [8].

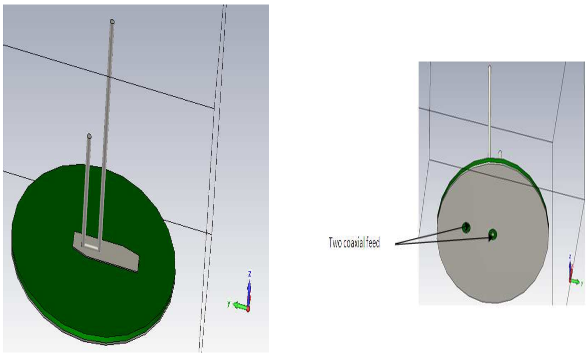


Fig. 15 Multi polarization Antenna

We integrate the antenna "U" asymmetric inside patch antenna for a multi-polarization antenna combined [9] .

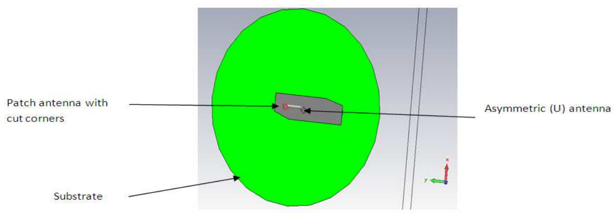


Fig.16 structure of the combined antenna

3. Radiation properties of the antenna

The computed return loss of our model is well adapted at two resonant frequencies of 2.91 GHz, 9.29 GHz. The reflected power reaches the values of -43.063 dB and -10.087 dB at these resonant frequencies respectively.

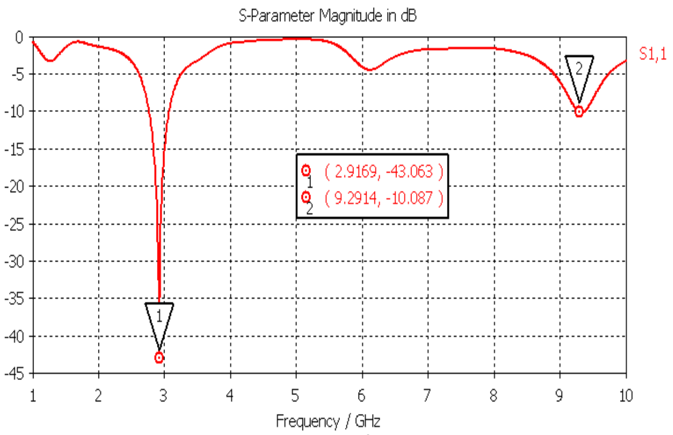


Fig. 17 Computed return loss of the antenna

The polar Radiation takes different forms in Fig.18 to Fig .24

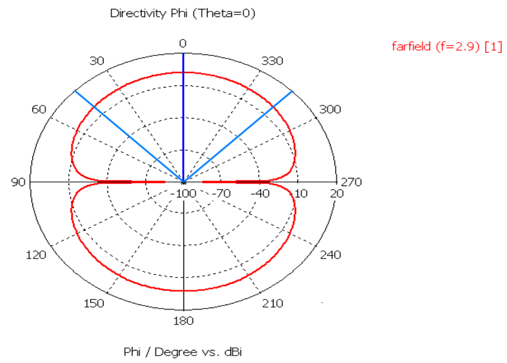


Fig .18 Polar diagrams (theta=0) at frequency (f=2.9Ghz)

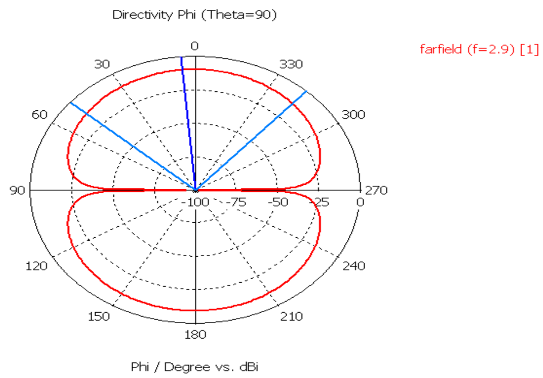


Fig.19 Polar diagrams (theta=90°) at frequency (f=2.9 GHz)

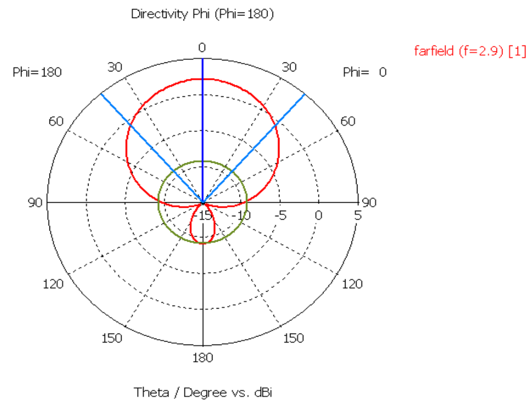


Fig.20 Polar Diagrams (phi=180°) at frequency (f=2.92GHz)

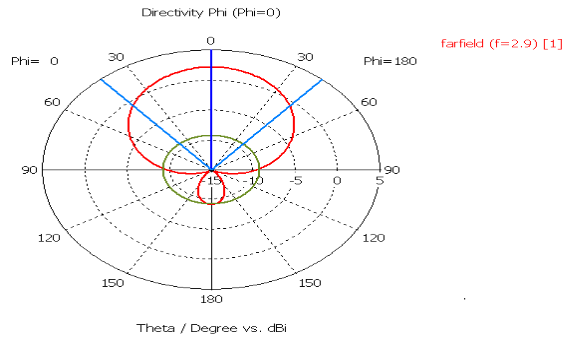


Fig .20 Polar diagrams (phi=0°) at frequency (f=2.9GHz)

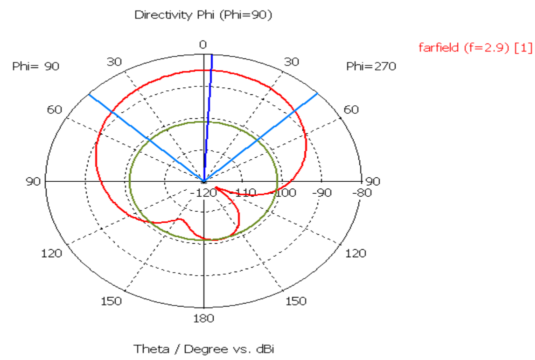


Fig .21Polar diagrams (phi=90°) at frequency (f =2.9GHz)

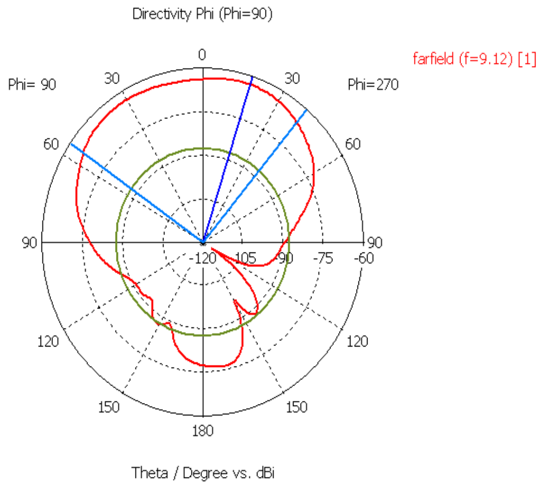


Fig.22 Polar diagrams (phi=90°) at frequency (f= 9.1GHz)

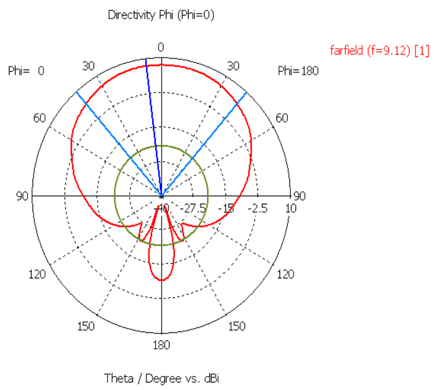


Fig.23 Polar diagrams (phi=0°) at frequency (f= 9.12GHz)

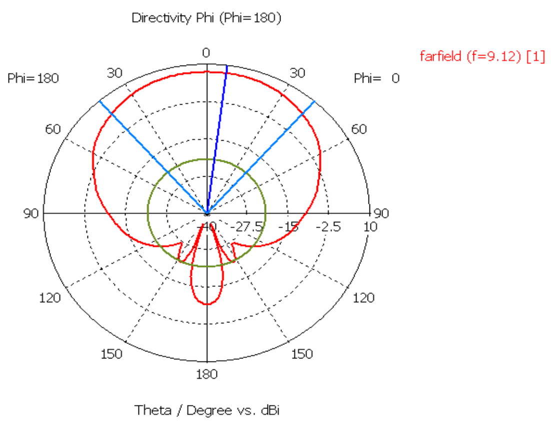


Fig.24 Polar diagrams (phi=180°) at frequency (f= 9.12GHz)

4. Conclusion

The main challenges when considering the implementation of multiple antennas into a mobile device have been covered [10].While the antenna size has to be reduced, the band width of operation needs to be increased. In order to maintain high system performances the interaction and coupling between the antennas themselves and other components must be minimized [2]. We conducted a circularly polarized antenna with printed technology and linear polarization antenna with an (U) asymmetrical antenna. The antenna combined exhibit good performance, especially in the WLAN and WIMAX bands [1].

5. Reference

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