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Dual Band Coupled-fed MIMO antennas for WLAN Application

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Abstract

This paper presents a design of dual band coupled-fed MIMO antennas for WLAN application. The proposed MIMO antenna system consists of two planar symmetrical element and coupled-fed. The structure is uncomplicated and the antenna system area occupies only 12 x 60 mm^2, and the resonance bandwidth can cover ISM2.4 and ISM5.2/5.8 bands. The proposed MIMO antennas have the isolation characteristic value of about 20 dB at the required bandwidth and the obtained envelope correlation coefficient (ECC) is lower than 0.1 from the measured S-parameters. The method can be accurate operation at WLAN communication system.

Keywords： MIMO、WLAN、Coupled-fed、ECC

1. Introduction

The increasing demand for the wireless communication quality has induced the development of multi-antenna systems such as multiple-input multiple-output (MIMO) systems [1-4]. To realize an effective MIMO system, it is necessary to have a challenge to place multiple antennas within a small area to maintain the good isolation between antenna elements since the antennas are strongly coupled to each other.

In this article, we propose the method to improve the isolation performance of two-antenna systems for ISM2.4 and ISM5.2/5.8 bands. The proposed MIMO antenna system consists of two parallel loop antennas and using a coupled-fed to improve the isolation characteristic. Details of the design considerations and experimental results of the MIMO antenna using coupled-fed will presented and discussed later.

2. Antenna Design

Figure 1 shows the MIMO antenna system structure of this paper. The antenna was printed on the FR4 substrate (thickness of 0.8 mm, relative permittivity of 4.4, loss tangent of 0.0245) [3]. The MIMO antennas are printed symmetrically on the no-ground portion (12 x 60 mm^2) at the top edge of the smart phone and the PCB ground plane is printed at the bottom edge, the size is 108 x 60 mm^2. The printed antenna comprises a coupling feed patch and an inductive shorting strip. It is capable of generating a wide operating bands to cover the ISM2.4 (2.42–2.48 GHz) and ISM5.2/5.8 (5.15–5.85 GHz) operation, respectively. The detailed dimensions of presented antenna are given in Figure 1(b).

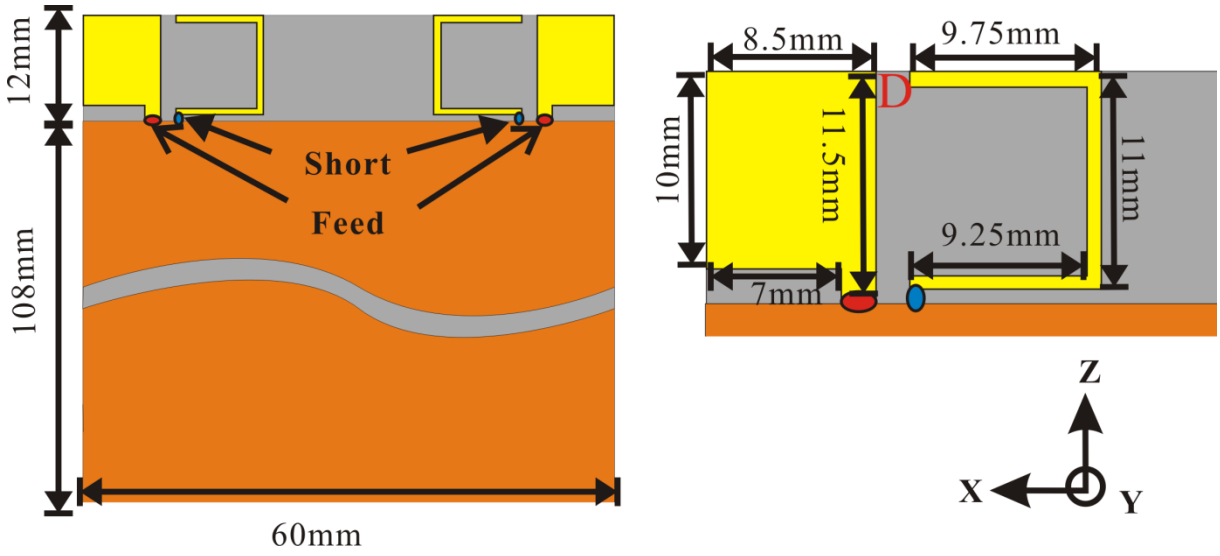


Figure 1: (a) Configuration of the proposed MIMO antenna; (b) Detail dimensions of antenna

3. Experimental Results and Discussions

Results of the measured and simulated return loss for the proposed MIMO antenna are shown in Fig. 2(a). It is seen that three separate resonant modes are excited with good impedance matching and become a wideband which cover the ISM2.4 (2.42–2.48 GHz) and ISM5.2/5.8 (5.15–5.85 GHz) operation, respectively. For the S_{21} (isolation between Port 1and Port 2), the isolation are obtained simultaneously to ensure that its value are all less than -20dB at the operating frequency. A simple formulation for computing the ECC from the S-parameter is presented.

$$\rho = \frac{\left|S_{11}^{*}S_{12} + S_{21}^{*}S_{22}\right|^2}{(1-|S_{11}|^2-|S_{21}|^2)(1-|S_{22}|^2-|S_{12}|^2)}$$

The ECC of two antennas is given by the obtained ECC is lower than 0.1 from the measured S-parameters and is sufficient for MIMO applications. Agreement between the measured data

and simulated results obtained using Ansoft HFSS [5] is also obtained.

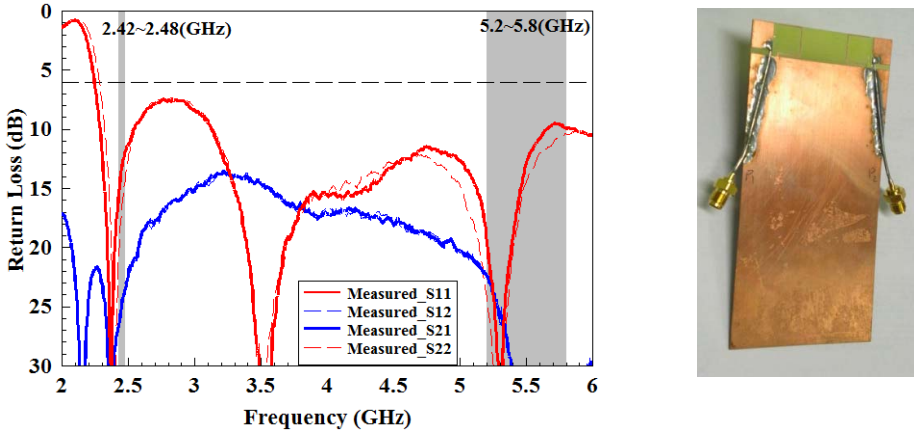
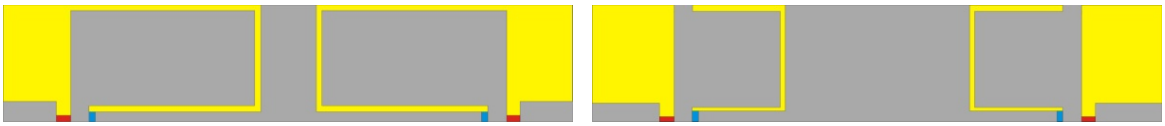


Figure 2: Measured of return loss results

To analyze the operating principle of the antenna, Figure 3 shows a comparison of the proposed antenna (coupled-fed) and the Ref antenna (direct-fed), Note that the corresponding resonant frequency of Ref antenna is the same as the proposed antenna, Both of them are covering ISM band (2.4 GHz and 5.2/5.8 GHz) and can applied to WLAN application. For Ref antenna, it seems like a loop antenna direct-fed and a simple shorted strip connects to ground plan.



(a) Ref antenna (direct-fed) (b) proposed antenna (Coupled-fed)

Figure 3: Structure of proposed antenna (Coupled-fed) and Ref antenna (direct-fed)

Figure 4 shows the simulated results of the proposed and Ref antennas. In the return loss, it seems that coupled-fed in the 2.4 GHz band has better performance than the Ref model, and 5.2 GHz – 5.8 GHz band covering range, return loss gain also about 15dB and can reduce the area occupied of antenna. Using the coupling feed can really improve the isolation problem in requires frequency band of WLAM system, the isolation gain can achieved to 20 dB. The values in line with the present study the isolation of academic research [1] [2] [4].

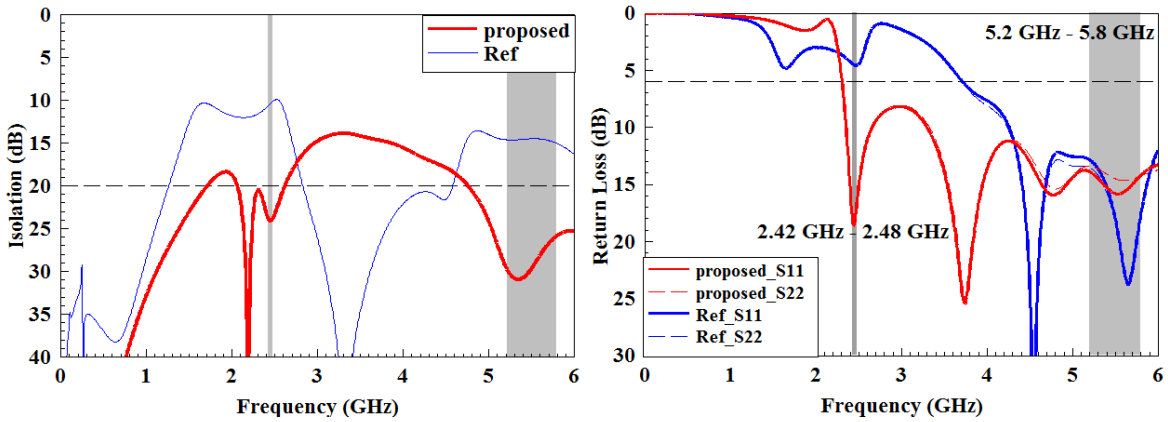


Figure 4: Simulation results of the proposed and Ref antennas

4. Conclusions

In this paper, dual band coupled-fed MIMO antennas for WLAN application is developed The MIMO antennas allow the array to receive a wide range of multipath signals, thus increases the SNR of MIMO systems is important. By simulation and measurement, it is found the proposed antenna has an excellent performance under the MIMO propagation environment, the isolation below -20 dB and the ECC less than 0.1. All of performance confirmed that the proposed MIMO antenna should be useful for WLAN application.

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