A Triband MIMO Antenna for WLAN / WiMAX Applications

Yong Yun Deng, Xi Wang Dai, Guo Qing Luo*
Key Laboratory of RF Circuits & System of Ministry of Education, Institute of Antennas and Microwave Technology, Hangzhou Dianzi University, Xiasha High Education Park, Hangzhou, 310018, China

***Abstract*—A novel tri-band monopole antenna for multi input multi output (MIMO) application is presented. The MIMO antenna is designed on FR4 substrate, whose triband performance is generated by two orthogonally placed E-type monopoles. The compact triband MIMO antenna can work at 2.45/3.5/5.2GHz frequencies. I-type branches on the ground act as a reflector to isolate the radiation beams of the two monopole elements. Thus mutual coupling is reduced and isolation is improved to less than -15 dB within its working frequency range.**

Keywords—Tri-band antenna; MIMO antenna;

I. Introduction

With the rapid development of wireless communication, MIMO antenna becomes more popular, which is used to increase channel capacity. The miniaturization, multi-band, and high isolation technologies of MIMO antennas are the research focus. Various methods of the coupling reduction of MIMO antenna have been proposed. The monopole MIMO antenna with an isolation of about 40dB is presented in [1]. By decoupling the floor loaded structure, an ultra-wideband isolation more than 15dB is proposed in [2]. By introducing a slot structure into the floor, a high isolation is obtained [3]. Decoupling networks used to achieve high isolation of MIMO antenna is shown in [4]. By introducing a neutralization line on the floor and extending the length of the ground, the isolation of antenna over ultra-wideband frequency is greater than 20 dB [5]. EBG structure is used to suppress the propagation of surface waves and thus improves the antenna isolation [6]. Frequency range with high isolation of the proposed antenna is enhanced in [7, 8].

II. Antenna Structure Design

A. Design of the Tri-band MIMO antenna

The plane of the antenna is shown in Fig. 1, two vertically placed E-type monopole antennas are printed on the front side of a FR4 dielectric board. The back side of the dielectric board printed a ground plane with width of 5mm, length of 16 mm, and I-type branches can reduce mutual coupling, improve the isolation. The monopole antennas are fed by a 50 Ω microstrip transmission line having width of 1.5 mm. The other side of the dielectric board has ground planes with width of 5mm and length of 16 mm.

According to the theory of the monopole antenna, we know that three parallel monopoles can produce three resonant paths. The lengths of the three metal strips are 24mm, 15mm and 8.5mm, which are correspond to 1/4 wavelength at frequencies of 2.45GHz, 3.5GHz, 5.2GHz (WLAN/ WiMAX) respectively. I-type branch loaded on the ground acts as a reflector and is used to isolate the radiating beams of the two monopole elements. Then the mutual coupling is reduced and the isolation is improved to less than -15dB.

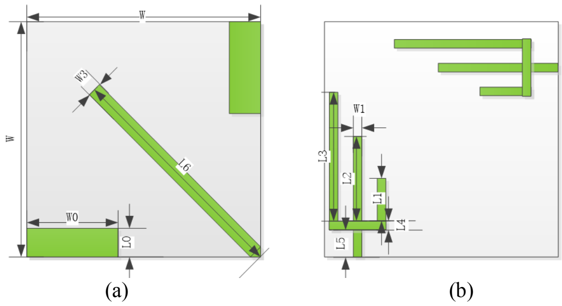


Fig. 1. Schematic view of the proposed MIMO antenna (a) Back (b) Front. Dimensions: W=42mm, W0=8mm, W1=1.5mm, W2=6mm, W3=1mm, L0=5mm, L1=24mm, L2=15mm, L3=8.5mm, L4=1.5mm, L5=6mm.

B. Analysis of the structure

The resonance point of the antenna can be adjusted by changing the length of the E-shaped metal strip. Fig. 2 shows the simulated reflection coefficients of the proposed tri-band MIMO antenna.

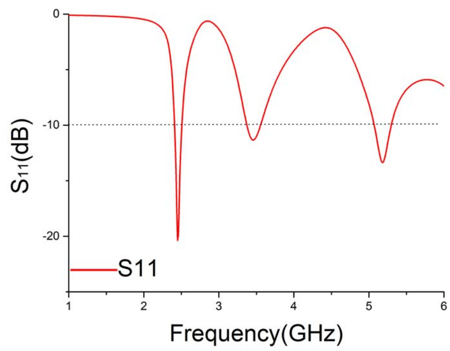
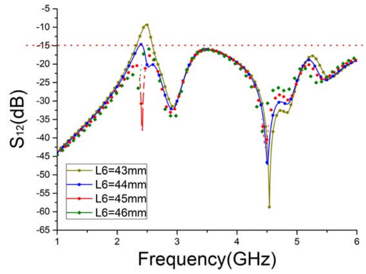
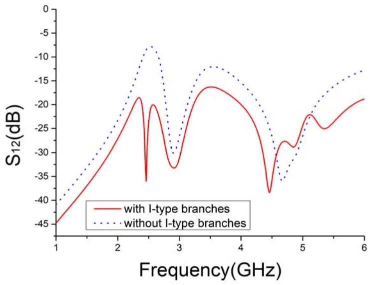


Fig. 2. Simulated S11 of the proposed antenna.

The mutual coupling of MIMO antenna reduces radiation efficiency. In order to reduce mutual coupling of the MIMO antenna at working frequencies, an I-type branches is loaded behind the antenna and the I-type branch is at an angle of 45 to the edge of the dielectric substrate. The I-type branch can be viewed as a reflector that reduces mutual coupling by changing the current path. Fig. 3 shows the effect of I-type branches on antenna isolation. As shown in Fig. 3 (a), the influence of the length of I-type branch on isolation is given. The best length of I-type branch is 45mm and the MIMO antenna has isolation less than -15dB at working frequencies. The isolation of MIMO antenna with and without I-type branch is shown in Fig. 3 (b). It can be seen from the figure that the I-type branch on the back side of the dielectric board plane can improve the isolation of the MIMO antenna.

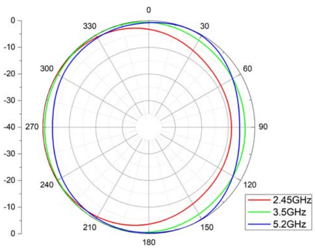


(a)

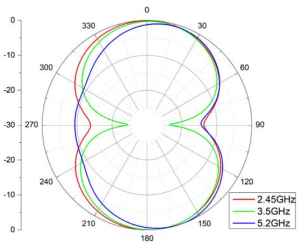


(b)

Fig. 3. (a) Simulated S_{12} with diffident length of I-type branch. (b) Simulated S_{12} of the antenna with and without I-type branch.



(a)



(b)

Fig. 4. The simulated radiation patterns of the proposed tri-band MIMO antenna (a) xoz plane. (b) yoz plane.

III. Simulated Results And Discussion

Fig.4 illustrates the triband MIMO antenna radiation characteristics at 2.45, 3.5, 5.2GHz. Due to the symmetry of the antenna, Port 1 is rotated by 90 degree with respect to the direction of Port 2. The Port 1 and Port 2 are approximately symmetrical with each other at 45 degree along the X-axis. Due to the influence of isolated branch, Port 1 generally shows omnidirectional radiation in the H plane (the yoz plane for port1 and the xoz plane for port2). It shows that both ports can radiate vertically and horizontally polarized waves. The two polarizations are orthogonal to each other lead to a reduced correlation coefficient and improved signal independence of the system.

IV. Conclusion

A new tri-band MIMO antenna was presented in this paper. In the antenna design process, E-type antenna element is used to achieve triband performance. The isolation of the MIMO antenna can be improved by loading the I-type branch. There are many advantages of this tri-band MIMO antenna such as the small volume, light weight and easy integration, low cost, easy fabrication. It has good application value in modern wireless communication systems.

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