Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 05, May-2016

Compact Circular Co-Radiator MIMO Antenna

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***Abstract*— A compact circular co-radiator multiple input multiple output (MIMO) antenna operating in the dual frequency was proposed. This antenna is different from traditional MIMO antennas, the radiator is shared by two antenna elements, which greatly reduce the overall size of the MIMO system. High level of matching is achieved by etching a dumb-bell shape in the radiator and extending a stub on the ground and the shared radiator is fed by two perpendicular feeding structures. The diversity antenna is printed on FR4_epoxy substrate with dielectric constant of 4.4 and the loss tangent of 0.02. The overall volume is 11×11×1.6mm which operates in a dual frequency at 2.8GHz and 5.8GHz with good return loss of nearly 25dB. The proposed antenna is used in wireless video operation/wireless CCTV and WLAN applications respectively.**

Keywords*— Compact; coradiator; MIMO; dual frequency, CCTV, WLAN.

I. INTRODUCTION

Antenna (radio), also known as an aerial, a transducer designed to transmit or receive electromagnetic (e.g. TV or radio) waves. MIMO (Multiple Input Multiple Output) antenna systems have multiple transmitter and receiver antennas with perfect channel estimates at Transmitter and Receiver, decomposes into independent channels. MIMO results in four major Performance improvements like Array Gain, Diversity Gain, Spatial Multiplexing Gain and Interference Reduction Gain.

Disadvantage of using single antenna to transmit and receive signal is the mutual coupling which occurs when the signals with different amplitudes and phases combine destructively at the receiver which can be solved by adopting diversity technology by using Diversity/MIMO antenna. So, the concept of Compact Coradiator Circular MIMO Antenna is introduced with more compactness and with high level of matching.

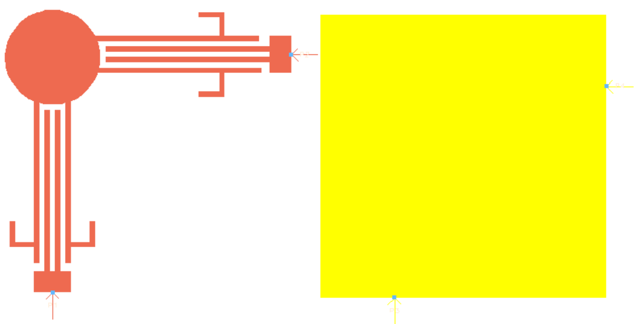
In recent years, great interest was focused on microstrip antennas for their small volumes, low profiles, good integration, low costs and good performance. With the continuous growth of wireless communication service and the constant miniaturization of communication equipment, there are higher and higher demands for the volume of antennas, integration and working band. Many papers have presented multiple microstrip antenna array with multiple bands for wireless communications system application which are suitable for various combinations of WiMAX (Worldwide Interoperability for Microwave Access) and wireless local-area network (WLAN, wireless video operation) applications.

Above several papers on dual band antennas for IEEE standards have been reported [1-2] proposed printed double T-monopole antenna can cover the 2.4/5.2 GHz WLAN bands and offers narrow band width characteristics and planar branched monopole antenna for DCS/2.4GHz. For WLAN it can provide excellent wide frequency band with moderate gain. [3] The proposed planar monopole antenna is capable of generating good Omni directional monopole with radiation in all the frequency bands. [4-5] proposed printed dipole antenna with parasitic element and Omni-directional planar antenna for WiMAX applications, can operate either in wide band or dual band, which cover 3.25-3.85,3.3-3.8 and 5.15-5.85 GHz with return loss of -10dB. [6] Broad band printed L shaped antenna for wireless communication is reported with good radiation patterns and better return loss. [7] physical design features proper geometry and dimension for microstrip antenna array using transformer λ/4 for the feed line matching technique. [8] proposes compact terminal antenna incorporates open-end slots in the ground plane, which reduces size and operates at acceptable band width. [10] use of various feeding techniques can give dual or multiband operations.

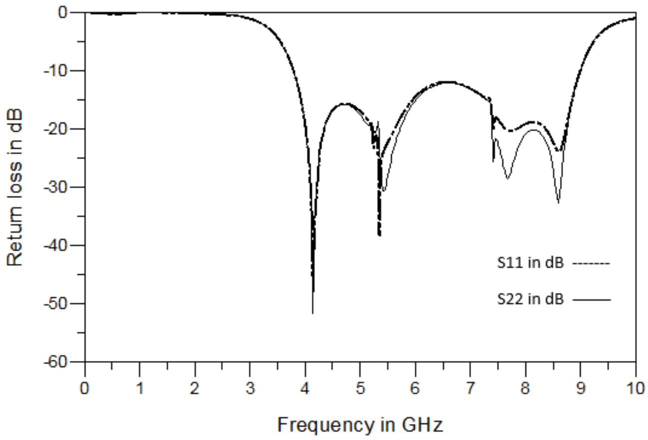
II. DUAL ELEMENTS MIMO ANTENNA DESIGN

A. Development Of MIMO Antenna

Fig. 1. Shows the MIMO antenna design with finite ground plane which yields wideband from 4-9GHz.



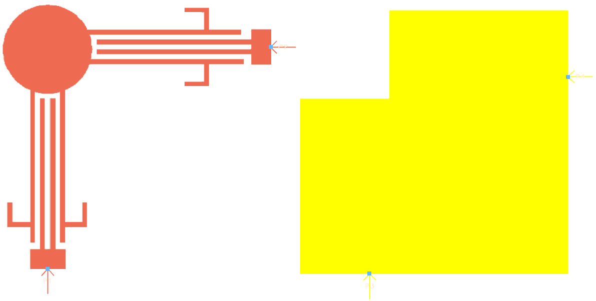
(a)



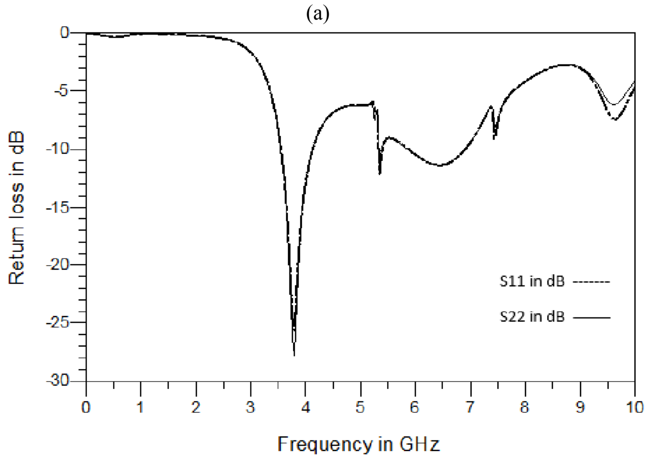
(b)

Fig. 1. Layout of MIMO antenna (a) and its simulated return losses (b).

Fig. 2. Shows the MIMO antenna design with semi-infinite ground plane which yields wideband from 3-5GHz.



(a)



(b)

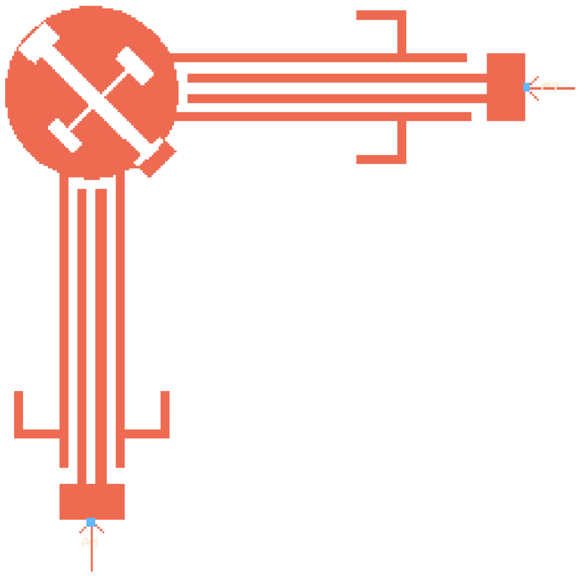
Fig. 2. Layout of MIMO antenna (a) and its simulated return losses (b).

A. Dual Element MIMO Antenna Design

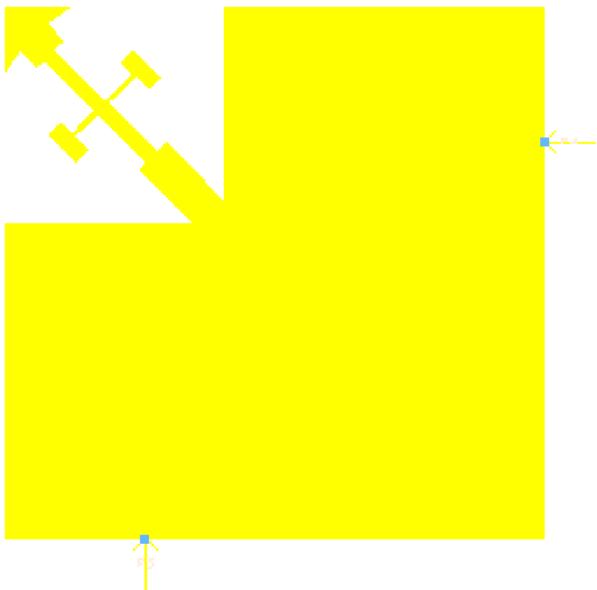
Fig. 3. shows the configuration of the two-unit MIMO antenna. The diversity antenna is printed on FR4_epoxy substrate with dielectric constant of 4.4 and the loss tangent of 0.02. The overall volume is 11×11×1.6mm. The MIMO system consists of two antenna elements but only one circular radiator, which is fed by two perpendicular feeding structure. The layout of shared radiator is to reduce the volume of diversity antenna. The diversity antenna is symmetric by the axis of angle of 45 degrees. To reduce the mutual coupling between two ports, a metal branch is extended on ground plane, which can be viewed as a reflector, to reduce the electromagnetic coupling so that the matching is perfect.

Besides, the metal branch can decrease the current on the ground flowing between the two antenna elements. In addition, a dumb bell-shaped slot is etched in the radiator to increase matching. The process of designing and optimization is conducted by Advanced Design System (ADS).

Fig. 3. shows the configuration of the two-unit compact circular coradiator MIMO antenna.



(a)



(b)

Fig. 3. The configuration of MIMO antenna (a) Top and (b) Bottom.

Fig. 3. shows the proposed antennas front and back view. When port 1 is excited, port 2 is terminated with a 50 Ohm load. The simulated S11 with tangent loss of 0.02 and observed S11 and S22 is presented in Fig. 4. and

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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Fig. 5. It is observed from simulated S11 that the loss of antenna with tangent loss 0.02 is higher. Dielectric loss of the substrate can reduce the port reflection coefficient inevitably in the high frequency, because much energy is lost in loss dielectric substrate.

Fig. 4. and Fig. 5. shows the simulated S11 and S22 result of MIMO antenna. The antenna operates at dual frequency 2.8GHz and 5.8GHz frequencies with return loss of nearly 25dB.

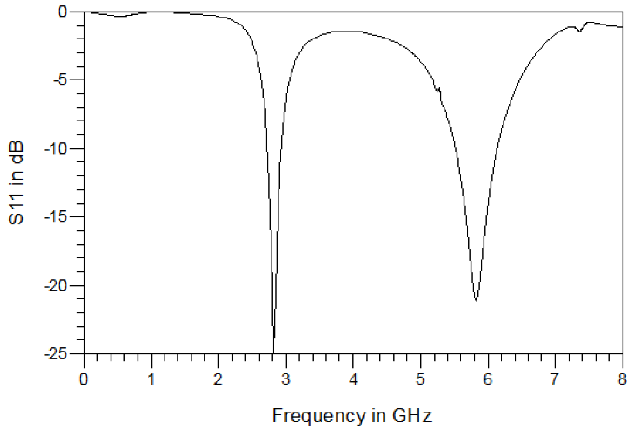

Fig. 4. Simulated S11 result of MIMO antenna.

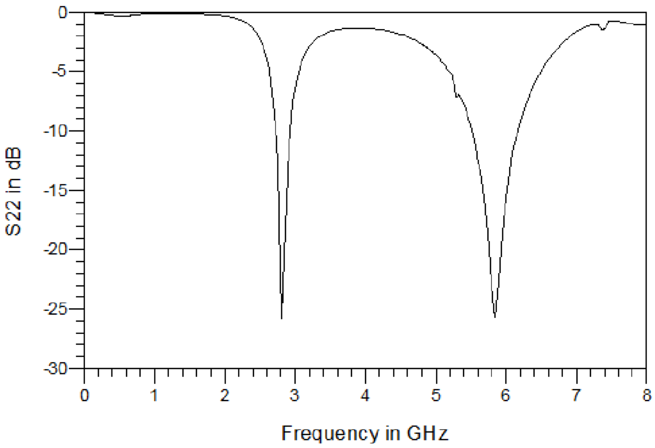

Fig. 5. Simulated S22 result of MIMO antenna.

The below figures shows the radiation pattern, gain and directivity of the MIMO antenna. The Fig. 6. shows that the radiation pattern is bidirectional which is obtained due to the two antenna elements on both sides. With the directional antennas, you can divert the RF energy in a particular direction to farther distances. Therefore, you can cover long ranges, but the effective beam width decreases. This type of antenna is helpful in near LOS coverage, such as covering hallways, long corridors, isle structures with spaces in between, etc. However, as the angular coverage is less, you cannot cover large areas. This is a disadvantage for general indoor coverage because you would like to cover a wider angular area around the AP. The Fig. 7. Shows the gain and directivity of the antenna which are positive which shows that the antenna performs well at the operating frequencies.

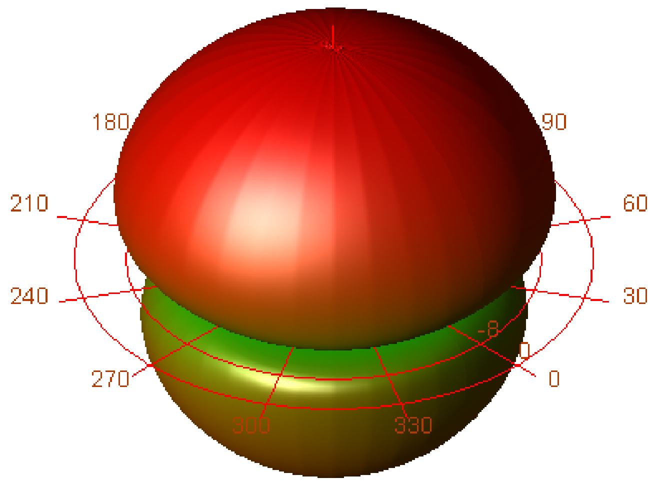
Fig. 6. 3D Radiation Pattern.

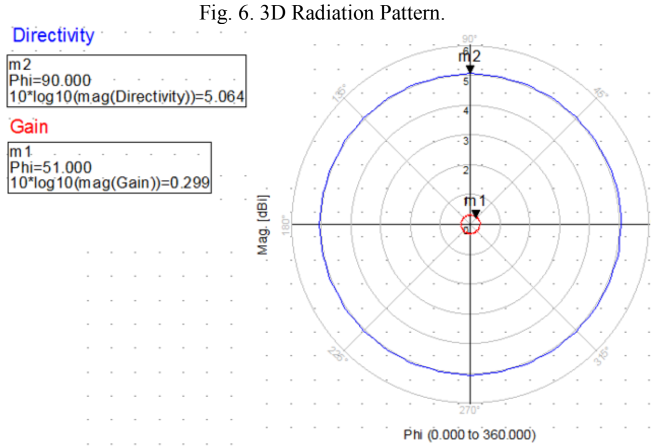

Fig. 7. Gain and Directivity of MIMO antenna.

IV. CONCLUSION

A compact circular coradiator multiple input multiple output (MIMO) antenna operating in the dual frequency is designed and implemented. Matching was found to be nearly 25 dB for dual frequency. The obtained results of S11 and S22 shows that the proposed MIMO antenna system can work well in extremely dual frequency and it is found suitable for wireless application. Two compact coradiator with four element MIMO antennas operating in the multiband frequency with dual polarization can be done in future which can be used for high frequency wireless applications operating at greater than 20GHz and isolation to be achieved in future by following mechanism like neutralization line techniques.

REFERENCES

[1] G. J. Foschini and M. J. Gans, "On limits of wireless communications in a fading environmnent when using multiple antennas," *Wireless Personal Commun.*, no. 6, pp. 311–335,1998.

[2] T. Bolin, A. Derneryd, G. Kristensson, V. Plicanic, and Z. Ying, "Twoantenna Receive Diversity Performance in Indoor Environment," *IEEE Electron. Lett.*, vol. 41, no. 10, pp. 1205–1206, Oct. 2005.

[3] L. Dong, H. Choo, R. Heath, Jr., and H. Ling, "Simulation of MIMO channel capacity with antenna polarization diversity," *IEEE Trans. Wireless Commun.*, vol. 4, no. 4, pp. 1869–1873, Jul. 2005.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 05, May-2016

[4] P. S. Kildal and K. Rosengran, "Correlation and capacity of MIMO systems and coupling, radiation efficiency, diversity gain of their antennas: Simulations and measurements in a reverberation chamber,"*IEEE Commun. Mag.*, vol. 42, no. 12, pp. 102–112, Dec. 2004.

[5] S. C. K. Ko and R. D. Murch, "Compact integrated diversity antenna for wireless communications," *IEEE Trans. Antennas Propag.*, vol. 49,no. 6, pp. 954–960, Jun. 2001.

[6] "First Report and Order in the Matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems FCC," ET-Docket 98-153, 2002.

[7] T. P. See and Z. N. Chen, "An Ultrawideband Diversity Antenna,"*IEEE Trans. Antennas Propag.*, vol. 57, no. 6, pp. 1597–1605, Jun.2009.

[8] C. Sturm, M. Porebska, E. pancera, and W. Wiesbeck, "Multiple antenna gain in ultra-wideband indoor propagation," in *Proc. 2nd Eur.Conf. Antennas Propag.*, 2007, pp. 1–4.