Insight View for MIMO LTE Applications

Aysha Munir Sheikh[1] Kiran P. Singh[2]
[1]PG Student [2]Assistant Professor
[1,2]Department of Electronics & Communication Engineering
[1,2]G.I.T.S., Udaipur, Rajasthan, India

Abstract— This paper gives a discussion on various researches in the field of MIMO application. The aspects of different design, is under consideration to achieve maximum efficiency like LTE 1800 MIMO Antenna, LTE /WWAN MOBILE HANDSET ANTENNA, Quad Band Handset Antenna for LTE MIMO and WLAN Application and Orthogonal Hybrid LTE MIMO Antennas for the Smartphone. Its main focus is on the design and its effect on various characteristics of antenna.

Key words: MIMO; LTE; fabrication; antenna; mobile

I. Introduction

In radio, multiple-input and multiple-output, or MIMO is a method for multiplying the capacity of a radio link using multiple transmit and receive antennas to exploit multipath propagation. In modern usage, "MIMO" specifically refers to a practical technique for sending and receiving more than one data signal simultaneously over the same radio channel by exploiting multipath propagation. MIMO has become an essential element of wireless communication standards including IEEE 802.11n (Wi-Fi), IEEE 802.11ac (Wi-Fi) and Long Term Evolution (4G).

Although MIMO has been deployed for years in WLAN networks, it is a relatively new feature in commercial wireless networks. MIMO technology is a standard feature of next-generation LTE networks, and it is a major piece of LTE's promise to significantly boost data rates and overall system capacity. However, MIMO also represents a new challenge for network operators. Traditional cellular networks generally provide the best service under line-of-sight conditions. MIMO thrives under rich scattering conditions, where signals bounce around the environment. Under rich scattering conditions, signals from different transmitter take multiple paths to reach the user equipment (UE) at different times. In order to achieve promised throughputs in LTE systems, operators must optimize their networks' multipath conditions for MIMO, targeting both rich scattering conditions and high SNR for each multipath signal. This optimization process requires accurate measurement of these multipath conditions in order to achieve the best performance for a given environment.

II. Process

A. Theoretical Studies

Become familiar with PCB Fabrication Lab and Antenna Lab and all formalities. Note down the most important theoretic material, check papers about earlier solutions and familiarize with different software's like Ansys HFSS, IE3D, SEMCAD etc that will be needed for design and simulation.

B. Fabrication of Antenna

Take a standard design and go through the whole simulation, production and measurement process.

C. Design

Different approaches are implemented and checking its results by simulations. Final design is fabricated that includes series of optimization. The design goal focus on efficiency, SAR(Specific Absorption Rate) & HAC(Hearing Aid Compatibility).

D. Final Measurements and Analysis

Measurements to be done in Antenna Measurement Lab. Finally, compare the measured results with simulations.
The paper gives an insight view of different antenna design for MIMO LTE applications.

III. Design

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled.

Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

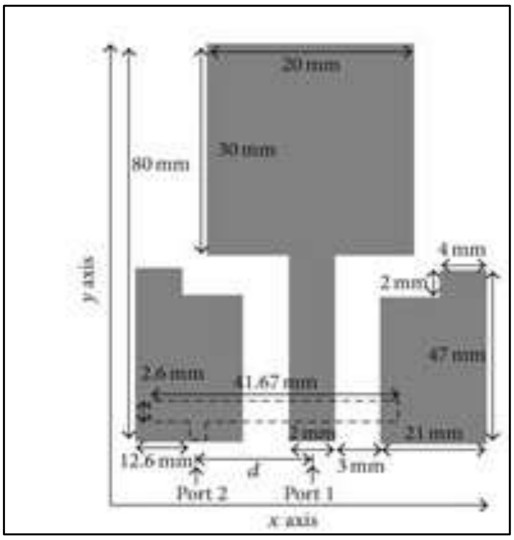
Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar.

A. LTE 1800 MIMO Antenna

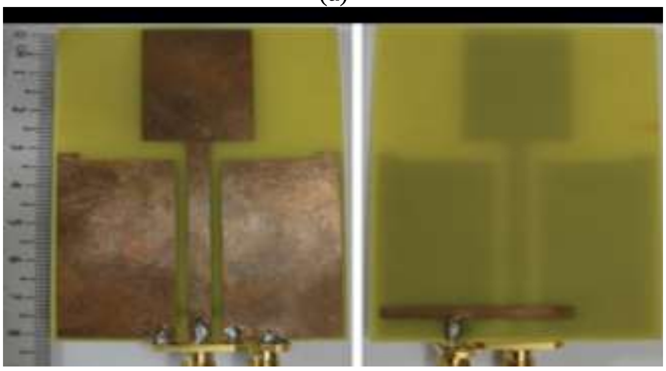
It comprises a printed microstrip antenna and a printed double-L sleeve monopole antenna for LTE 1800 wireless application is presented. The printed double-L sleeve monopole antenna is fed by a 50 ohm coplanar waveguide (CPW).

©IJSTE 2017 Published by IJSTE

A novel T-shaped microstrip feedline printed on the other side of the PCB is used to excite the waveguide's outer shell. Size of antenna is 80 × 50mm^2. The double L-shaped sleeve acts as a parasitic element to improve the bandwidth of the printed monopole antenna.



(a)



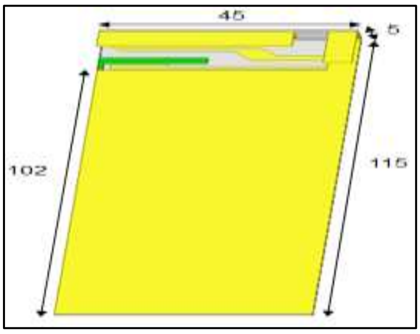
(b)

Fig. 1: (a) Structure and dimension of proposed MIMO antenna (b)Front and back view of MIMO antenna

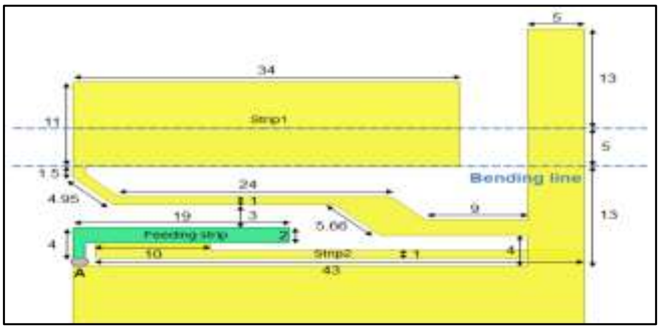
A T-shaped microstrip feedline is printed on the other side of the PCB. The T-shaped feedline is completely covered by the ground plane on the other side of the PCB. This structure allows efficient radiation properties. The combination of printed double-L sleeve monopole antenna and a T-shaped microstrip feedline antenna is chosen mainly because of current distribution characteristics.

B. LTE /WWAN Mobile Handset Antenna

A compact multiband antenna for LTE/WWAN handset applications is presented, which can provide a multiband operation of LTE700/2300/2500, GSM850/900/1800/1900, UMTS 2100, WLAN2400 with return loss better than 6 dB. The occupied volume of the antenna radiator is only 45 × 13 × 5 mm^3. The antenna comprises an inverted-L shaped feeding strip and two folded shorting strips. The antenna can adjust three different resonant frequencies by tuning the length of the strips. In order to fine-tuning the frequency more accurately, the simulated return loss for proposed antenna with different length of three parameters (L1, L2, W1) are shown in Fig.2. Changing the length of L1 (32, 34, 36 mm) leads to tuning the third resonant frequency. As the length L1 is increased, the third resonant mode is shifted to lower frequency, vice versa, and the second resonant frequency is decreased by increasing L2. Although L2 is changed, the higher band is preserved and the first resonant frequency is lower by increasing W1.



(a)



(b)

Fig. 2: (a) Geometry of the proposed antenna. (b) Detailed dimensions of the proposed antenna metal pattern.

Fig. 3: Photographs of the manufactured antenna: (a) front side; (b) back side

In this, a 50Ω mini coaxial line is used to feed in the antenna. The other end of the coaxial line has a SMA connector, which is used to connect to the test instrument.

C. Quad Band Handset Antenna for LTE MIMO and WLAN Application

A compact quad band antenna for long-term evolution (LTE) MIMO and WLAN application in the handset is presented, in which the proposed antenna comprises two symmetrical quarter wavelength radiating strips and a slotted ground plane. On the ground plane, a T-shaped slot is cut from the bottom. Two symmetrical P-shaped slots are etched at both sides of the ground plane. The radiating strips and slots generate a lower resonant at 780MHz and an upper resonant at 2.350GHz to cover LTE 700 Band , LTE 2300, 2.4GHz WLAN, and LTE 2500.

The novel isolating patch placed between the radiating strips reduces the mutual coupling between the two ports for over than 18 dB at the upper band. In Figure 5 Arms A, B, and C resonate at the lower band while Arm D resonates at the upper band. The total length of the three arms (A, B, and C) of the radiating strips is 48mm which is about quarter wavelength of 780MHz. Arm D has a length of 15mm that is around quarter wavelength of 2.350GHz. The current flow follows two independent circular paths inside the rectangular patch. The current waves from Port 1 will not flow to Port 2 which reduces the mutual coupling between the two ports.

Fig. 4: Front and back view of structure and dimension of proposed antenna.

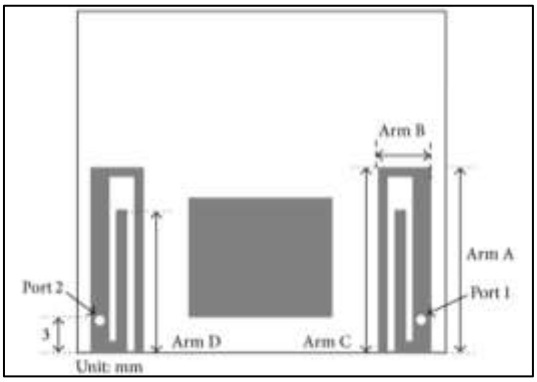


Fig. 5: Detailed front view of structure of proposed antenna

The proposed antenna has a small size, good isolation characteristics, and wide bandwidth. It is suitable to be used in handsets for LTE 700, LTE 2300, LTE 2500, and 2.4GHz WLAN application.

D. Orthogonal Hybrid LTE MIMO Antennas for the Smartphone

Two orthogonal hybrid antennas for the LTE MIMO operation in the Smartphone are presented. The two antennas (one open slot antenna and one inverted-F antenna) are disposed orthogonally to each other. The open-slot antenna comprises two open slots of different lengths and is disposed parallel and close to the bottom edge of the Smartphone. The open-slot antenna operates in the 698~960 MHz and 1710~2690 MHz bands as a main antenna for the LTE/WWAN operation. The inverted-F antenna has a total length of 90 mm and is disposed along one side edge of the device ground plane.

Owing to the orthogonal alignment of the two antennas, good envelope correlation coefficients of less than 0.07 are obtained. The ergodic channel capacity is calculated to reach about 9.3~10.7 bps/Hz at 20-dB signal-to-noise ratio. The side-edge antenna is able to cover the frequency ranges of 824~960 MHz and 1710~2690 MHz for the LTE operation such as in band 5, 8, 10, 25, and 40.

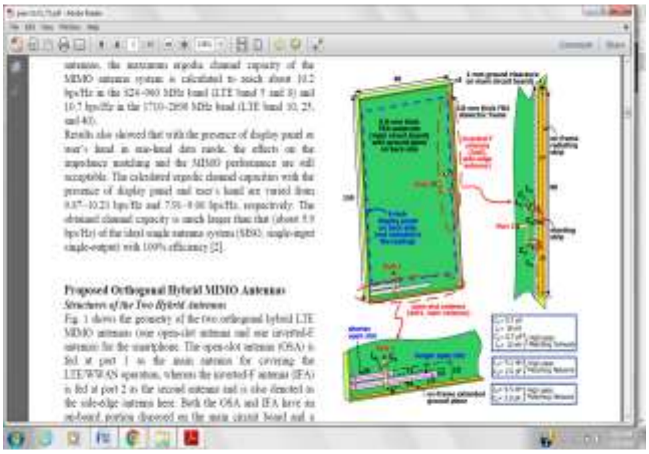


Fig. 6: Geometry of two orthogonal hybrid LTE MIMO antennas for the smartphone

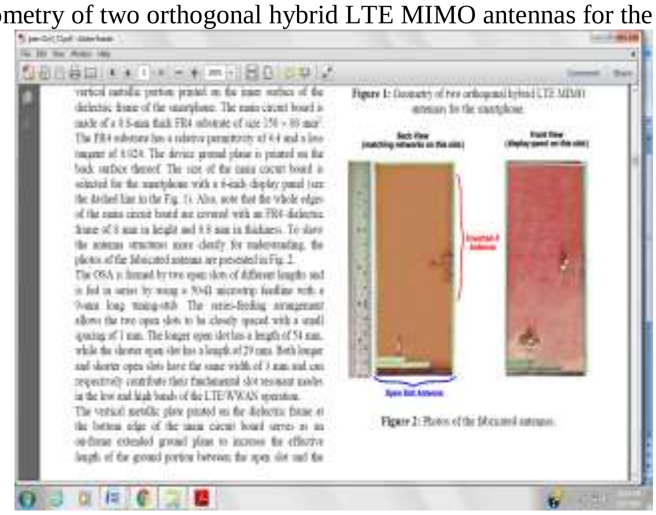


Fig. 7: Photos of the fabricated antennas

Based on the MIMO application requirements, two orthogonal hybrid LTE MIMO antennas consisting of an open-slot antenna (OSA) as the main antenna for the LTE/WWAN (wireless wide area network) operation and an inverted-F antenna (IFA) as the second antenna for the LTE operation. To analyze the MIMO performance of the hybrid MIMO antennas, the simulated ECC (envelope correlation coefficient) from the HFSS [19] and the calculated ECC from the measured complex electric-field patterns of the fabricated antennas. The calculated ergodic channel capacity from HFSS and measured results of the fabricated antenna in a 2 × 2 MIMO system.

IV. CONCLUSION

The double L-shaped sleeve acts as a parasitic element to improve the bandwidth of the printed monopole antenna. Two symmetrical P-shaped slots are etched at both sides of the ground plane. The radiating strips and slots generate a lower resonant at 780MHz and an upper resonant at 2.350GHz. Thus different slots, sleeves and other modification helps in optimization.

ACKNOWLEDGMENT

Authors like to give thanks to Rajeev Mathur, H.O.D. E.C.E. and Anurag Paliwal, M.Tech Coordinator, Geetanjali Institute of Technical Studies, Udaipur (Raj.), INDIA for their support.

REFERENCES

[1] A. Stamoulis, N. Al-Dhahir and A. R. Calderbank, “Further results on interference cancellation and space-time block codes," in Proc. 35th Asilomar Conf. Signals, Syst. Comput., pp. 257-262, Oct. 2001.
[2] A. Scaglione, P. Stoica, S. Barbarossa, G. Giannakis, and H. Sampath, “Optimal designs for space-time linear precoders and decoders," IEEE Trans. Signal Process., vol. 50, no. 5, pp. 1051-1064, 2002.
[3] H. Sampath and A. Paulraj, “Linear precoding for space-time coded systems with known fading correlations," IEEE Commun. Lett., vol. 6, no. 6, pp. 239-241, June 2002.
[4] J. Kazemitabar and H. Jafarkhani, “Multiuser interference cancellation and detection for users with more than two transmit antennas," IEEE Trans. Commun., vol. 56, no. 4, pp. 574-583, Apr. 2008.
[5] Y. Wu and A. R. Calderbank, “Code diversity in multiple antenna wireless communication," in Proc. IEEE International Symp. Inf. Theory, Toronto, Canada, July 2008.
[6] J. Kazemitabar and H. Jafarkhani, “Performance analysis of multiple antenna multi-user detection," in Proc. 2009 Workshop Inf. Theory Applications, Feb. 2009.
[7] C. W. Tan and A. R. Calderbank, “Multiuser detection of Alamouti signals," IEEE Trans. Commun., vol. 57, no. 7, pp. 2080-2089, 2009.
[8] F. Li and H. Jafarkhani, “Multiple-Antenna Interference Cancellation and Detection for Two Users Using Precoders," IEEE J. Sel. Topics Signal Process., vol. 3, no. 6, pp. 1066-1078, Dec. 2009.
[9] M. S. Al-Janabi, C. C. Tsimenidis, B. S. Sharif and S. Y. Le Goff, “Bit and Power Allocation Strategy for AMC-based MIMO-OFDMA WiMAX Systems”, IEEE 6th International Conference on Wireless and Mobile Computing, Networking and Communications, pp 575-579, 2010.
[10] S. Ajey, B.Srivalli and G.V.Rangaraj, “On Performance of MIMO-OFDM Based LTE Systems”, International Conference on Wireless Communications and Sensor Computing, pp 1-5, 2010.