A MODIFIED E SHAPED PATCH ANTENNA FOR MIMO SYSTEMS

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Abstract: **A compact E shaped patch antenna is proposed in the present work, which can be used for Multiple Input Multiple output (MIMO) systems. The modified E shaped patch antenna proposed in this paper offers improved directivity, bandwidth, and return loss characteristics compared to normal E shaped antenna. The antenna system resonates at 5.36GHz and 5.89GHz frequencies for VSWR≤2 which can be used for WiMAX (Wireless interoperability for microwave access) applications. The simulation results of return loss, VSWR, gain and radiation pattern are presented.**

KEYWORDS: E shaped patch antenna; MIMO systems; return loss; bandwidth.

I. INTRODUCTION

MIMO technique is one of the leading technologies in wireless communication for improving the data rates by using multiple no. of antennas at the transmitter and receiver side. The upcoming 4G wireless communication methods require larger data rates with high speed, quality of transmission and accuracy. In [1], Foschini predicted that increasing the no. of antennas at the transmitter and receiver improves the channel capacity on logarithmic scale. Since then, tremendous research activity is going on in the area of MIMO systems. The primary research emphasizes data encoding, DSP algorithms, channel characteristics, receiver design and antenna design [2].

The antenna design is one of the major concerns in MIMO technology. Diverse reception is the main requirement, even though the antennas are closely spaced. However, when multiple antennas are involved at the same frequency the technical challenges are more complex.

The basic aim of MIMO antenna design is to minimize the correlation between the received signals [3]. One of the important parameters that describes the performance of an antenna is bandwidth as it signifies the range of frequencies where the antenna radiates more efficiently. By calculating the bandwidth, one can analyze the resonant frequencies where the antenna elements of a MIMO system are operated. Mutual coupling is another important parameter which signifies the isolation between the elements of an antenna array. Higher mutual coupling may result in higher correlation coefficients leading to lower antenna efficiencies. The effect of mutual coupling on capacity of MIMO wireless channels is studied in [4].

The main feature of a MIMO antenna can be accomplished by integrating multiple radiating elements in an electrical and geometrical configuration, forming an antenna array. The amplitude and phase excitation (weighting vectors) at each individual radiating element are adjusted to form the beam (beam forming) of the antenna to the desired direction. The required parameters are computed by the digital signal processor (DSP) and a software algorithm to bring the intelligence to the antenna.

In designing MIMO sysem, dipole, horn, waveguide slot or microstrip antenna can be used as radiating element. However, microstrip antennas have been proven to be preferable over other types of radiating element due to its compactness and non-electrical characteristic. Microstrip antennas are low profile and lightweight. They are also can be made in various types and well suited to integration with microwave integrated circuit. In terms of fabrication, such system offers easiness, which allows mass production and cost-effective manufacturing as well as high performance [5,6]. However, a normal patch antenna suffers from very narrow bandwidth and this pose a challenge for the engineers to meet the proposed broadband of wimax applications.

In the present paper, a modified E shaped patch antenna is proposed which can be operated at dual bands. The designed antenna resonates at 5.36GHz and 5.89GHz respectively, which is suitable for WiMAX (Wireless interoperability for microwave access) applications. The designed antenna also gives an improved bandwidth of 16% which is better than a normal E shaped antenna giving a bandwidth of only 7%.The antenna design is simulated using the EM simulator. In section 2, the proposed antenna geometry is presented and in Section 3 the results are presented. The final conclusion of the paper is given in Section 4.

II. ANTENNA DESIGN

The E shaped patch antenna can be constructed by cutting two rectangular slots at the edges on a rectangular patch as shown in Fig1.The various parameters of the patch can be modified to get different resonant frequencies. The base model is modified with further improvements by incorporating two more slots at the edges of the patch as shown in Fig.2. The patch antenna is designed with the following dimensions on a ground plane of dimensions 27.2×30 mm^2 (all dimensions are taken in mm).

(L, W, h, Ls) = (17.2, 20, 3.2, 10)
W1=5.9, Wt=6.2, Ws=1.0

The dimensions d1 and d2 of the patch in the proposed E shaped antenna are taken as 2mm and 4mm respectively.

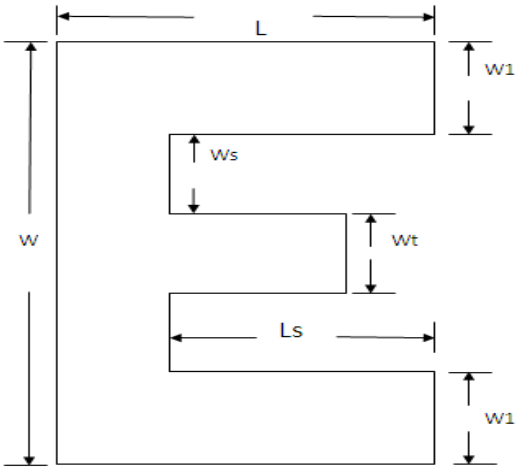

Fig 1. E shaped patch antenna

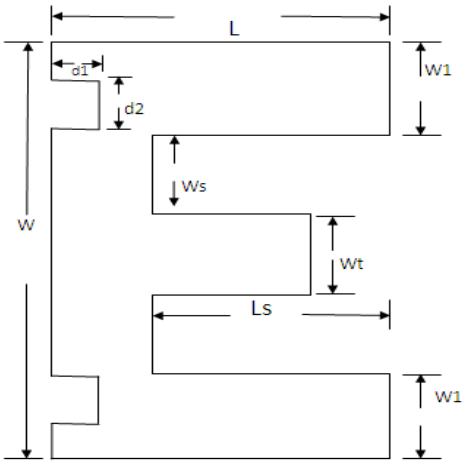

Fig 2. Modified E shaped patch antenna

The feed point is taken at the distance of 10.2 mm and 15mm from the edges of the ground plane using a coaxial feed of diameters 4.7mm and 1.3mm respectively. For the design of this antenna, a substrate of thickness 3.2mm and with low permittivity (ε_r=2.2) value is selected. The entire substrate is kept on a copper plate of thickness 1.0mm. Due to the extra slots taken at the edges of the patch antenna the bandwidth and performance of the antenna are improved. The results are discussed in the following section.

III. RESULTS

The proposed modified E shaped patch antenna is designed using an EM simulator which works on principle of FIT.The simulation results of the return loss of both the antennas are compared in Fig 3. From the figure we can conclude that the modified E shaped patch has S_{11}values of -28dB at the resonant frequency 5.36GHz and -30dB at the resonant frequency 5.89GHz.The impedance bandwidth is also improved from 7% to 16% which excellently meets the bandwidths of MIMO systems[7]. Hence, the proposed patch antenna is better in all the aspects compared to the normal E shaped antenna.

The radiation patterns of the modified E shaped patch antenna are shown in fig 4 and fig 5 for the resonant frequencies 5.36GHz and 5.89GHz respectively.

The VSWR of the proposed antenna is presented in the Fig 6.The plot gives the satisfactory results of VSWR at the resonant frequency. The VSWR value is observed as ≤ 2 providing improved matching conditions.

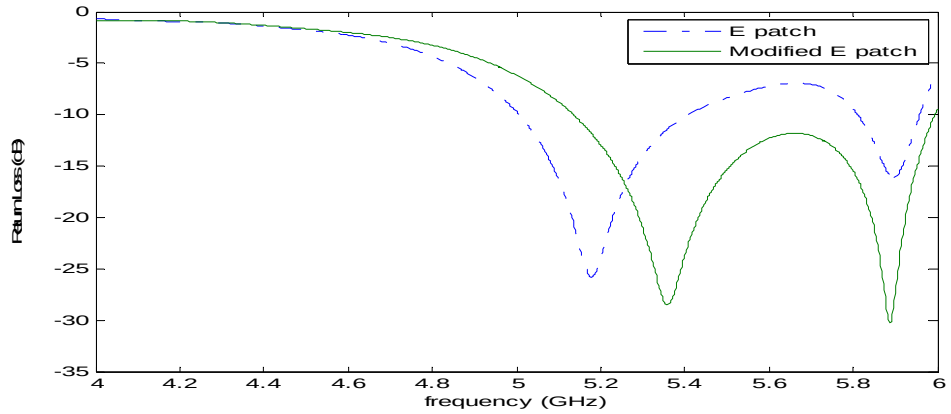

Fig 3. Comparison of Return loss between the normal E patch and modified E patch antenna

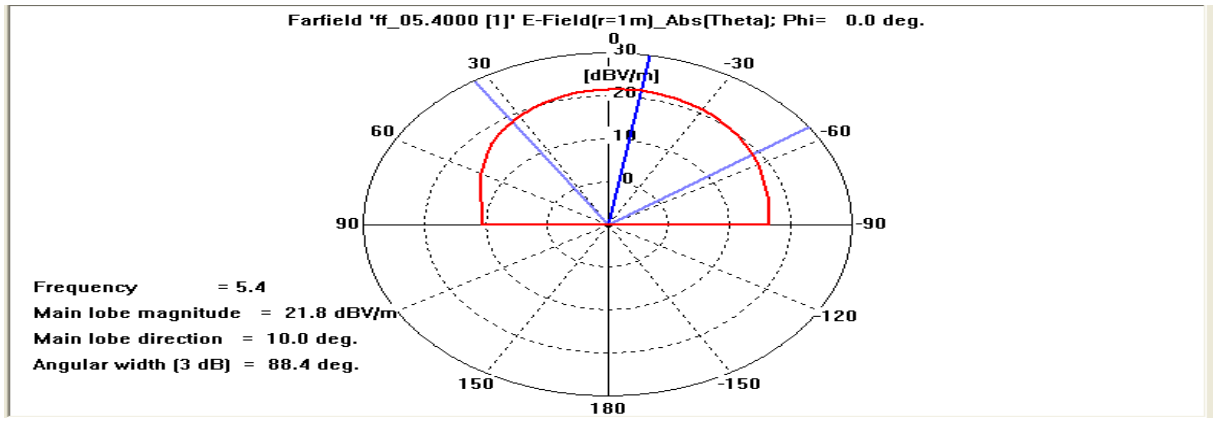

Fig 4. Radiation pattern of the proposed patch antenna at 5.4GHz

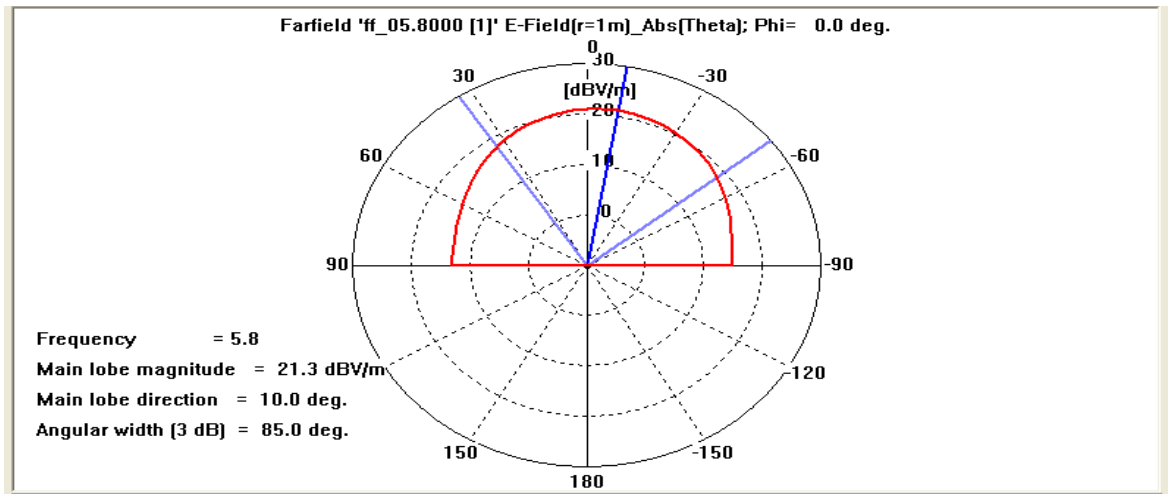

Fig 5. Radiation pattern of the proposed patch antenna at 5.8GHz

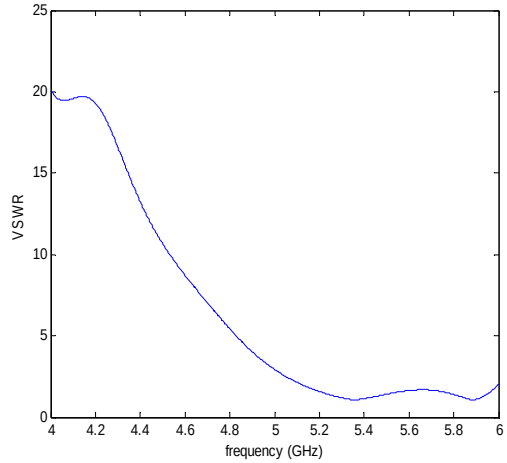

Fig 6. VSWR plot of the proposed antenna

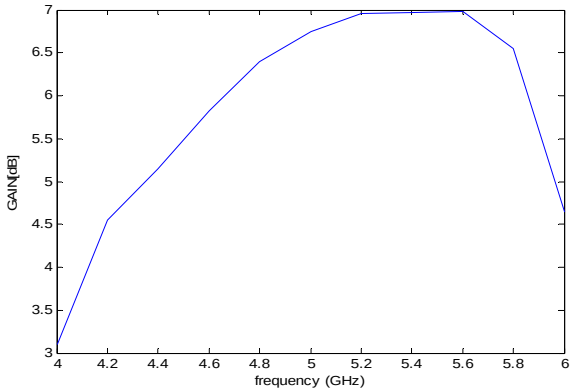

Fig 7. Gain plot of the proposed antenna

The gain plot of the modified E shaped patch antenna is shown in fig 7. The gain has a maximum value of 7dBi which is well suited for MIMO applications.

IV. CONCLUSION

In this paper, a modified compact E shaped patch antenna is proposed which can be used for MIMO arrays. Since, the antennas used in the MIMO array demand for high bandwidths, the main objective of the design are considered to achieve improved return loss characteristics and effective impedance bandwidth. The proposed antenna array resonates at 5.36GHz and 5.89GHz with an impedance bandwidth of 17%.These dual band frequencies are suitable for wimax applications employing MIMO techniques.

V. REFERENCES

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