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DESIGN OF 4 ELEMENT MIMO MICRO-STRIP PATCH ANTENNA FOR UWB APPLICATION

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Abstract - *In this paper four elements multiple inputs multiple outputs (MIMO) antenna system based on micro-strip patch elements has been presented in this paper. Design and simulation processes are carried out with the aid of the CST (Computer Simulation Technology) STUDIO SUIT. An antenna is a transducer that converts guided electromagnetic energy in a transmission line to radiated electro - magnetic energy in free space. Micro-strip patch antenna have more advantages and better prospects. In the present era of next generation. Networks, we require high data rate and small size devices. For success of all the wireless applications we need efficient and small antenna as wireless is getting more and more important in our life. The proposed antenna is designed over an operating frequency range of 4.9 GHz using the substrate material as FR-4 which has the dielectric constant of 4.3. with a dimension of 43 mm × 52 mm. The design is very simple and easy to fabricated. The gain at the 4.9GHz resonant frequency is 3.12 dB.*

Micro-strip antennas (MSA) have characteristics like low cost and low profile which proves Micro-strip antennas (MSA) to be well suited for WLAN/Wi-MAX application systems. Ultra Wide-Band (UWB) is one of the most promising technologies for short-range high data-rate wireless communication application.

***Key Words*: MIMO, WLAN, CST STUDIO SUIT, UWB**

1. INTRODUCTION

The ultra wide band (UWB) system has drawn more the attention of academicians and researchers from the last decades due to the advantages of wide bandwidth, high rate of data transmission and commercial application of lower power density spectrum. Concurrently, UWB technology in the past decade has developed quickly owing to its better features at lower power consumption suchlike as transmitting higher data rates. Still, like other wireless data communication systems, UWB also suffers the problem of multipath fading. To achieve compact multipath fading as well as higher data rates, the combination of MIMO and UWB offers an efficient solution. For UWB communication allocated the radio spectrum of unlicensed band from 3.1 to 10.6 GHz allocated by FCC in 2002[1].

In Micro-strip antenna, patch is made up of conducting material on a ground plane and they are separated by the dielectric material. Patch is generally made up of conducting material such as gold or copper[2].

MIMO technology requires multiple antenna systems. However, it is difficult to integrate two or more antennas in a mobile device because of limited space. So, the antenna elements must be compact and should be put very close to each other. But when antennas are placed very close, electromagnetic interactions between the elements lead to large mutual coupling which results in impedance mismatch, reduced radiation and increase in the antenna correlation coefficient [3]. Currently, the most commonly used WLAN system is the IEEE 802.11b System. A key requirement of WLAN system is that it should be low profile, where it is almost invisible to the user [4]. Depends upon the feeding techniques good impedance matching is achieved [5].

This paper presents a high gain four element micro-strip antenna based MIMO system to operate on 5 GHz. The antenna is fabricated on a substrate having a size of 43×52×1.6 mm^3. The antenna presented in this paper has a gain and directivity achieved is 3.184 dB and 7.107 dB respectively. These results show that the antenna presented in this paper is quite suitable for portable system applications and also very easy to fabricate. High gain and moderate size of this antenna can significantly reduce the cost of the wireless system.

2. MICROSTRIP ANTENNA DESIGN

The micro-strip patch antenna is designed which is resonating at 5 GHz as shown in Fig.1(a) and micro-strip feed line are printed on the same side of FR 4 substrate. In this study, the FR4 substrate used has a thickness of 1.6mm and dielectric constant of 4.3. The length and the width of the dielectric substrate are 24 mm x 28.4 mm. The width of the micro-strip feed line is fixed at 3.1mm to achieve 50 Ω impedance. The minimum return loss, high isolation (low mutual coupling), compact size, sufficient antenna gain, and specific WLAN application are the design guidelines behind the selection of the proposed antenna. Other parameter of micro-strip patch antenna {fig1(a)} is shown in table 1.

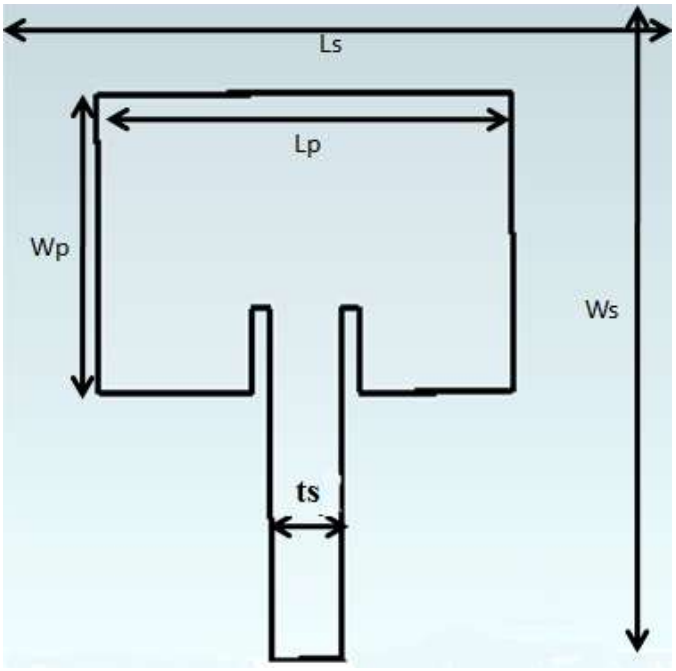

Fig1(a)

Table -1: Parameter Of Micro-Strip Patch Antenna

Parameter	Ls	Ws	Lp	Wp	ts
Value(mm)	28.4	24	18.4	13.9	3.1

3. MIMO MICROSTRIP ANTENNA DESIGN

Fig.2(a) shows the geometrical layout of the 2x2 micro-strip MIMO antenna system. The antenna elements are placed such that they have a port at two opposite side of substrate and require minimum size. The length and the width of the dielectric substrate are 43 mm x 52 mm. There is an isolation bar with the thickness of 1 mm. The MIMO system has been simulated using Computer Simulation Technology (CST) Studio Suit 2017.

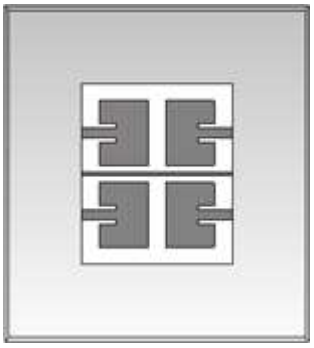

Fig2(a): Proposed Design Of MIMO Antenna

4. SIMULATION RESULT AND DISCUSSION

In this section, it deals about the antenna parameters such as S-parameter, VSWR, directivity, and gain.

4.1 S-PARAMETER

Scattering parameters or S-parameters (the elements of a scattering matrix or S-matrix) describe the electrical behavior of linear electrical network when undergoing various steady state stimuli by electrical signals [6].

Fig 3(a) shows the graph of s-parameter of MIMO patch antenna.

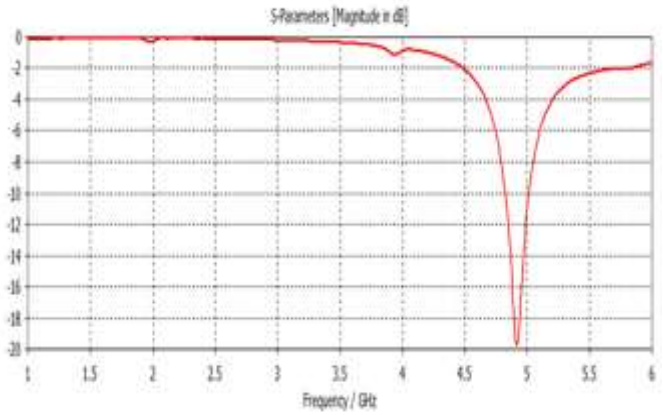

Fig 4(a): S-Parameter

4.2 VSWR:

It is a function of the reflection coefficient, which describes the power reflected from the antenna. If the reflection coefficient is given by r, then the VSWR is defined as [6,7]:

$$VSWR = \frac{1+|r|}{1-|r|}$$

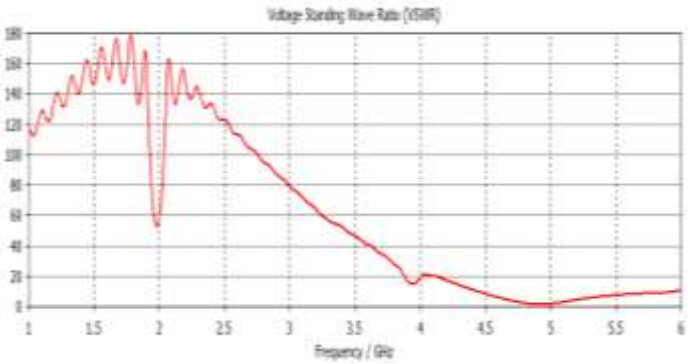

Fig4(b) : VSWR

The VSWR of this antenna is less than 2 (VSWR<2) which leads to well efficient antenna. Fig4(b) shows the VSWR of MIMO antenna.

4.3 DIRECTIVITY

According to the standard definition, The ratio of maximum radiation intensity of the subject antenna to the radiation intensity of an isotropic or reference antenna, radiating the same total power is called the directivity. From the below fig4(c), it is measured about 7.1 dBi.

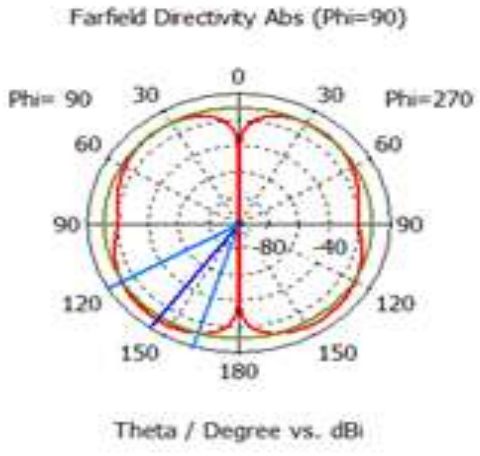

Fig4(c): Directivity

4.4 GAIN

Gain of an antenna is the ratio of the radiation intensity in a given direction to the radiation intensity that would be obtained if the power accepted by the antenna were radiated isotropically. Antenna gain describes how much power is transmitted in the direction of peak radiation to that of an isotropic source [8]**.** Fig4(d) show gain of MIMO antenna and vale of gain is 3.12 dB.

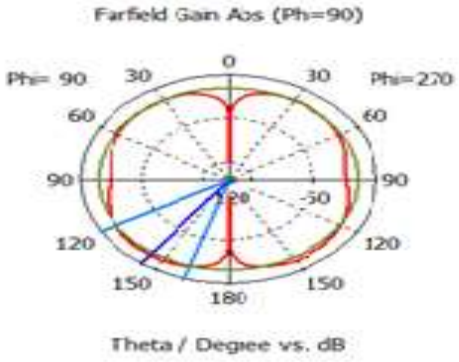

Fig 4(d) : Gain

5. CONCLUSION

Finally the proposed 4 element MIMO antenna is designed with FR-4 as a substrate material and micro-strip line feeding technique in CST studio suit over a operating frequency range of 4.9 GHz. The antenna parameters are simulated and analyzed. The antenna parameters such as VSWR, directivity and gain values are about - 1.897, 7.1 dBi and 3.12 dB respectively.

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