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Design Of 2-Parasitic micro strips antenna by reducing mutual coupling

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Abstract: A compact of 2 Parasitic microstrip antenna array by reducing mutual coupling in Multiple Input Multiple Output (MIMO) micro strip antenna is integrated with inverted Parasitic microstrip resonators and line resonators is presented at 5.8GHz to 7.8GHz frequency band. MIMO antenna system suffers a serious problem caused by strong mutual coupling. Parasitic Microstrip resonators to reduce the mutual coupling between closely spaced antenna elements. A distance of 0.5λ is kept between adjacent path elements in order to achieve multiple-input-multiple-output structure. The simulation results shows that the introduction of resonators of electric length 2λg between antenna elements leads to suppression of mutual coupling by -40dB at resonance frequency between horizontal antenna elements. The length, width & distance between the two arms of the two parasitic microstrips are optimized to achieve minimum mutual coupling. The antenna has been fabricated, measured and a good agreement between simulation and measured results are observed. In addition the proposed system also has good impedance matching, isolation, and peak gain and radiation patterns.

***Keywords*—Multiband, multiple-input–multiple-output (MIMO) antenna, peak gain, bandwidth.**

Introduction: Many methods have been proposed for reducing return loss, mutual coupling between the antennas. Various designs have been introduced to achieve low mutual coupling and return loss by changing shape of antenna. In this paper we design micro strip MIMO antenna to further reduce the return loss parameter S_{11} (dB) and Mutual Coupling parameter S_{12} (dB) compared to original design. We also observe the experimental results. The various geometrical parameters of the antenna are the dimensions of the patch and ground planes and the separation between them and it also includes the dielectric constant of the substrate material. The parametric study also contains the study of different techniques for optimizing the different parameters of antenna to get the optimum results and performance. This is a simulation based study. The design and simulation of the antenna is carried out using CST microwave Studio simulation software. Four antennas with different types of shapes were designed which cover the entire UWB range. The First designed antenna has two half rectangular patches which are overlapped to each other. A narrow rectangular slit is added to the patch to improve the performance of antenna. In now a days it is essential for an antenna designed for a system to avoid the interference from the other existing wireless system. The antenna should possess a band reject characteristic at interfering frequency bands. Then three compact UWB antenna designs with different notches for the various applications like WLAN, WIMAX, downlink X-band satellite communication and INSAT/Super Extended C-band are proposed been implemented in electronic circuitry and applied to various practical applications in communication systems, such as shortening or reducing delay lines, efficiency enhancement of a feed forward linear amplifier, bandwidth enhancement of feedback linear amplifier, and beams quantimization in phased array antenna systems [3–6, 11].The group delay (GD)characteristics in circuit can be investigated by examining phase variation of forward transmitting scattering parameter. Using the deferential-phase GD (τg) relation, $g = -d\varphi d\omega$, (1) the presence of NGD in circuit is equivalent to an increasing phase (positive phase slope) with frequencies.

- (WiMAX) operating in 2.3-4.7 GHz,
- (WLAN) for IEEE 802.11a 5.8-7.85 GHz,
- Downlink X-band satellite communication systems in 7.85 - 9.5 GHz.
- 3.0-5.8 GHz INSAT / Super-Extended C-Band (Indian National Satellite systems).

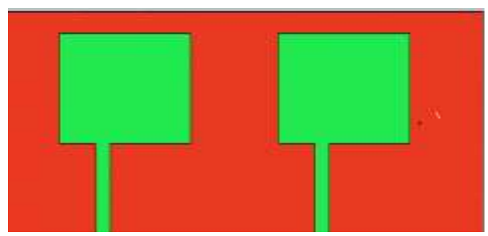
The goal of this thesis is to study how the performance of the antenna depends on various parameters of microstrip patch antenna. This is a simulation based study. CST Microwave studio software, one commercial 3-D full-wave electromagnetic simulation software tool is used for the design and simulation of the antenna. Then, the antenna parameters are varied to study the effect of variation of the antenna parameters on the antenna performance.

Proposed antenna array structure :

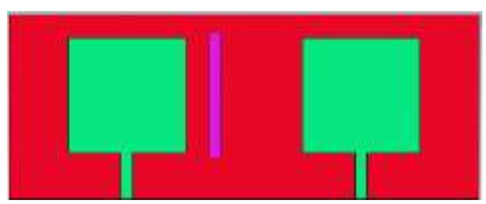
The top view and side view of the structural configuration of the proposed antenna is illustrated in fig 1 , which consists of two rectangular patches respectively fed by 50-Ω coaxial probes, two parasitic micro strips and the ground plane. The two rectangular patches are radiating elements printed on a substrate of thickness h_1 =3.2mm.The Bottom layer is the ground plane. Two parasitic micro strips are etched onto the top layer over two patches ;the same dielectric substrate with permittivity ε_r=2.2 is placed between the top layer and the bottom layer , h_2 is a thickness of the top layer . The optimized dimensions of the proposed antenna array:

II. Antenna Geometry and design: All the design antennas are fabricated on an inexpensive dielectric substrate FR-4 with relative permittivity of 4.4 with thickness of 1.6 mm. The simulation results of band notch antennas indicate that the proposed antenna fulfils the excellent band notch characteristics for various frequency band and showing the good return loss and radiation patters in the interested UWB.

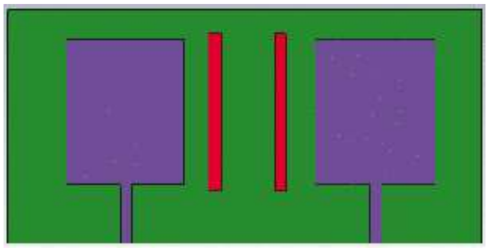
The proposed MIMO antenna array in this paper is rectangular shaped microstrip antenna has been designed at the center frequency of 7.88GHz.The antenna geometry is shown in fig 1. The Two channel MIMO antenna we are designing for this we are using material for substrate is lossy and ground patch, strips, and slots we are using the material is PEC. The MIMO antenna has two patches one is mirror to another one and we are adding strips to the patches in fig 1. The 2-parasitic without MIMO antenna & figure of step by step process also.



Antenna#1



Antenna #2



Antenna #3

Fig 1. Step by Step Process in MIMO

The fig 1.2 is MIMO antenna with parasitic we are putting the strips in between the two patches we are also design the 2-parasitic MIMO antenna in step by step process also.

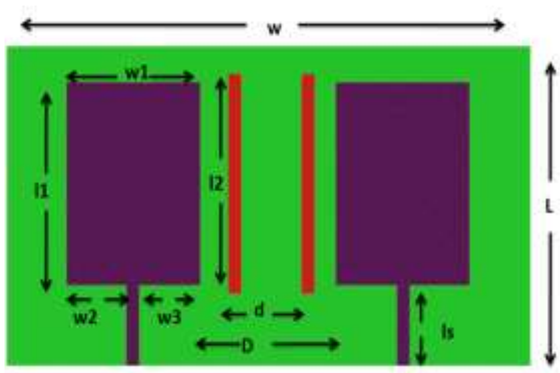


Fig1.2: Design of 2-Parasitic MIMO antenna

And dimensions are shown in table we are using software for simulation is CST(computer simulation technology).

Table Dimensions of the 2-microstrips MIMO antenna

Symbol	Dimension
L	80
W	40
l1	25
l2	27
w1	20
w2	9
w3	9
D	40
d	9
ls	10

Two basic and mostly used microstrip patch Rectangular and is discussed this chapter also deals that how the design parameters are calculated and their effect on the antenna performance. This proposed antenna structures are simulated in CAD software Microwave Studio in Computer Simulation Technology Simulator (CST).

The radiations from antennas are varies when we go apart from the antenna. The field regions can be categorized in Far field region and Near Field (Fresnel) Region.

III. SIMULATION RESULTS

The simulation results of proposed MIMO antenna are shown in below figures we are also designing the proposed MIMO in step by step process . In fig 3.1&3.2 shows the s11 and S12 comparison of proposed MIMO with two parasitic microtrips operate at 5.8GHz.. while the center frequency of antennas with two parasitic microstrips shifts 5.82GHz to 7.88GHz.Thus it indicate that the antenna array demonstrates a strong mutual coupling of -39.6dB frequency 8.74GHz without microstrips., and that the mutual coupling is greatly suppressed by adding two micro strips ,the mutual coupling value decrease from -39.6dB to -24.4dB. it is increasing the -10dB impedance band width is less than that of the antenna array without the two microstrips this may be explained as a band stop filter by adding parasitic microstrips, which can result in mismatching of the antenna input impedance. Electric and magnetic

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fields of MIMO antenna are shown in fig 3.10& 3.11 the radiation pattern of proposed MIMO antenna is Shown in fig. 3.12 there are used in the applications if WiMAX ,WLAN and radar applications.

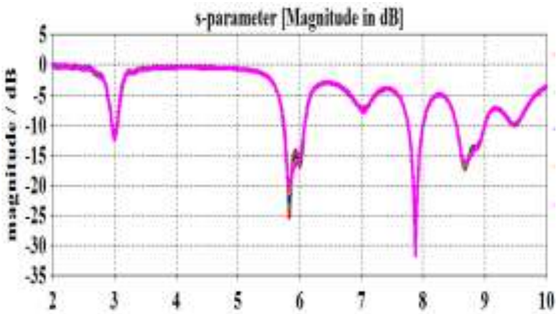

Fig.3.1 S11 comparisons of MIMO antenna in step by step process

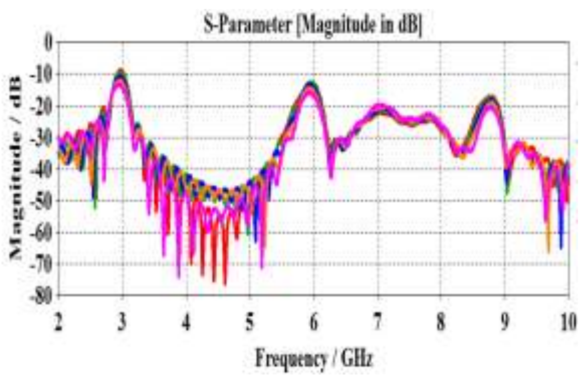

Fig.3.2 S12 comparisons of MIMO in step by step process

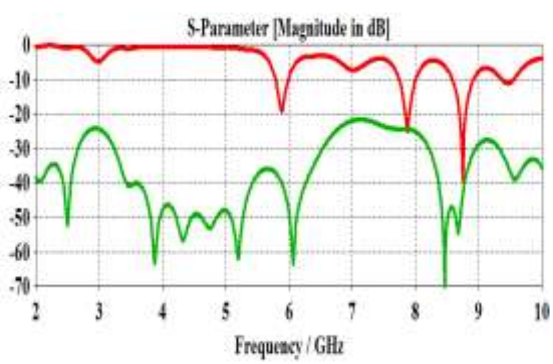

Fig. 3.3 S11 and S12 comparisons without micro strips

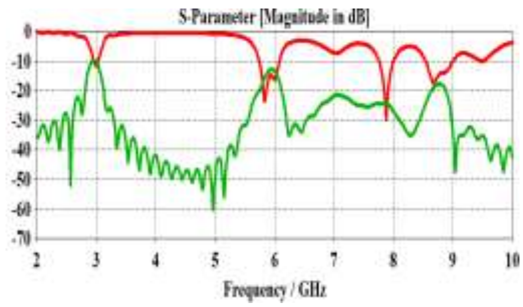

Fig. 3.4 S11 and S12 comparisons of with micro strips

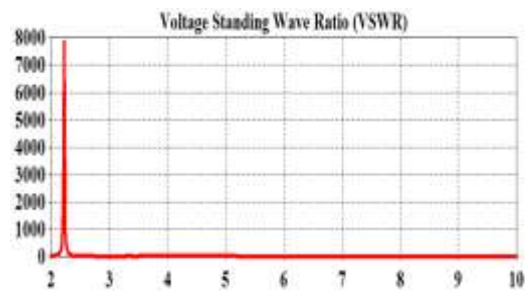

Fig. 3.5 VSWR of MIMO without parasitic

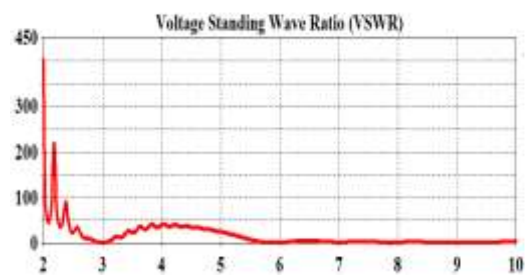

Fig. 3.5 VSWR of MIMO with parasitic

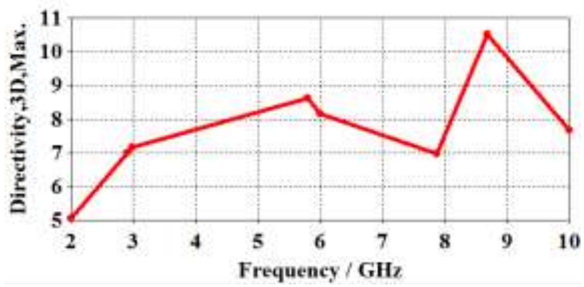

Fig. 3.6 Directivity of proposed antenna

Directivity is a fundamental antenna parameter. It is a measure of how 'directional' an antenna's radiation pattern is. An antenna that radiates equally in all directions would have effectively zero directionality, and the directivity of this type of antenna would be 1 (or **0 dB**).

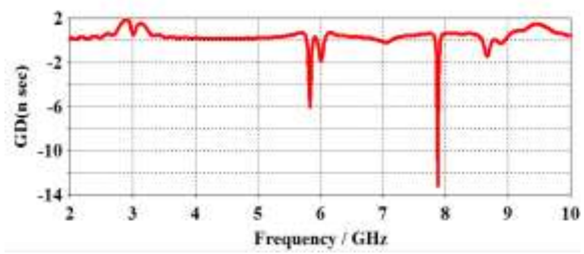

Fig.3.7 Group delay of proposed antenna

The delay variation means that signals consisting of multiple frequency components will suffer distortion. This changes the shape of the signal in addition to any constant delay or scale change. A sufficiently large delay Group delay is a useful measure of time distortion, and is calculated by differentiating, with respect to frequency of 5.8&7.9GHz, the phase response of the device under test (DUT):

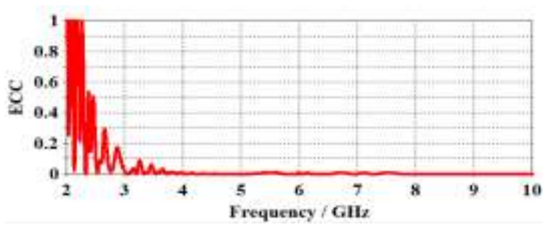

Fig.3.8 Envelop correlation coefficient of proposed antenna

This means you have a radio capable of transmitting and receiving multiple data streams simultaneously.

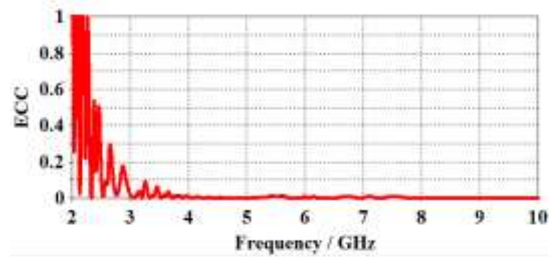

Fig. 3.9 Diversity gain of proposed antenna

The diversity gain is how much the transmission power can be reduced when diversity scheme is introduced without loss of performance.

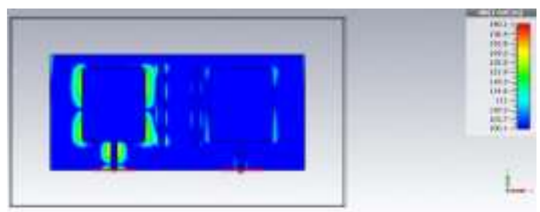

Fig. 3.10 Electric field distribution of MIMO antenna with microstrips

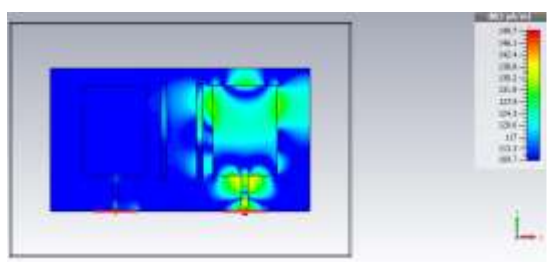

Fig. 3.11 Magnetic field distribution of MMO antenna with microstrips

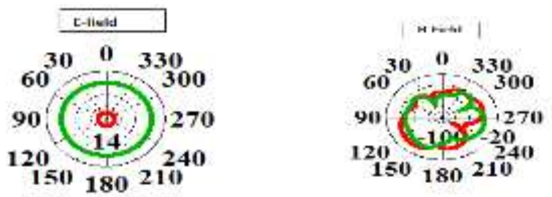

Fig. 3.12 Radiation Pattern of MIMO

CONCLUSION:

In this project, a compact 2-micro strip antenna array by reducing mutual coupling in mimo antenna structure micro strip patch antenna using FR-4 (lossy) substrate has been designed, simulated, optimized and analyzed using CST 2014 software. A parametric study is presented with the results showing that the antenna can be operated at dual-band frequencies at 5.8 GHz and 7.8 GHz. Other parameters such as gain, S_{12} and VSWR also have been improved. The return loss(S_{11}) of the proposed structure is -40dB and coupling coefficient S_{12} is -24.79 dB .The VSWR of the proposed structure is less than 2 over the entire band of operating frequencies.

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