Compact Reduced Mutual Coupling Of Meander Antenna Array For MIMO Application

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Abstract- The meandered antenna operates at 2.4GHz, and in order to avoid mutual coupling, we must isolate the antennas by increasing their distance from one another. By comparing its operating frequency, the meander line antenna's length can be calculated to be λ/2. Because of its compactness, it was chosen. Electrically, a meander line resonator is a tiny antenna. Electrically tiny antennas have a number of advantages, including a limited bandwidth, efficient polarization, and improved directivity. Here we also discuss about the mutual coupling in antenna. Mutual coupling reduction improves the efficiency and performance of antenna. The slot is included in-between the antenna to enhance the antennas performance and to increase the gain and bandwidth of meandered antenna.

Keywords-: Mutual coupling, Meander line, MIMO.

I. INTRODUCTION

Reduced reciprocal coupling between closely spaced patches for a WLAN application is the major goal of the study (4.94 – 4.99 GHz)[1]. By arranging two ML slots in a complimentary point symmetric way, here the frequency mismatch is done between S11 and S22.Hence it is brought on by the asymmetrical structure of a single ML slot has been analyzed. Photolithography and electro deposition were used to construct the ML slots on the ground plane. To minimize mutual coupling, new micro fabricated point symmetrical meandered line slots (ML) were introduced on the ground plane. This design has two antenna elements which are arranged in a H pattern [2]. The antenna is operated in sub-1 GHz bands with a compact construction using the downsizing techniques of meandering slot-line and reactive loading, resulting in an antenna size of 0.008 o for its least working band. The 0.665–1.113 GHz, 1.415–2.005 GHz, 2.42–3.09 GHz, and 3.18–3.89 GHz bands are where the antenna functions. Using varactor diodes, the design is accomplished by loading the slots.

In this paper[3], a flexible wideband array of meandered antenna is presented for a wearable electromagnetic head imaging system.The antenna consists of a 50- coaxial connector, a full ground plane, and two sections of meander-lines. The proposed antenna functions efficiently in the frequency range of 0.45-3.6 GHz, according to the measured reflection coefficient |S11| on a human skull.The development of two closely spaced printed meander line antennas (MLA) with reduced mutual coupling is achieved by applying meta material loading techniques[4].In comparison to similar arrays made on traditional substrates, the antenna array constructed on the meta material substrate demonstrated a substantial size reduction and less mutual interaction. The approach makes use of (E-SRRs) arranged in a row between each antenna element and the ground plane, horizontally between the patch and the ground plane.

Two concepts for planar LPDA are described and contrasted in this paper[5].The frequency range of the first design is 2-4 GHz, and it uses a scheme of dipoled linear planar. The second design studies the usage of meandered linein the shape of rectangular planar. They are appealing for a variety of communication applications, including radio signal identification and commercial broadcast.

Two meander-line-structured monopoles make up the MIMO antenna system. The aforementioned technique is utilized to lessen reciprocal coupling, and it also improves return loss and MIMO system isolation[6].It covers the 5.2 to 5.8 GHz range of Wi-Fi frequencies. The constructed antenna's directional efficiency exceeds 89% for the working band. The reduced efficiency loss demonstrates how well-designed the antenna is. To minimize the mutual coupling between two monopoles, defective ground structures (DGSs) are created using two U-shaped slots.

For sub-6GHz applications, a straightforward dipole-like antenna of a compact size has been suggested[7]. The suggested antenna uses a semi-circular ring patch coupled to meander lines and is fed via a micro strip line Applications for 4.8-5GHz sub-6GHz communication can employ the circular ring's size and the meander line's length to alter the resonance frequency.

A single element of the antenna produces a maximum gain of 13.8 dBi at 62 GHz. A maximum radiation efficiency of 79% and a maximum aperture efficiency of 88% are increased using the aforementioned method[8]. In order to increase gain in the forward direction and decrease BLL radiation, this study first introduces a SIW bow-tie antenna that is loaded with two H-shaped resonators and an array of meander-line H-shaped unit cells

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The structural model has a meander line structure and an aperture coupled microstrip antenna (consists of two substrate layers separated by ground plane)[9]. To decrease mutual coupling between adjacent elements, the patch element of the antenna construction is etched using the meander line slot structure. To minimize mutual coupling, a meander line slot is suggested for the design of an antenna array construction.

In preparation for upcoming 5G wireless communication applications, this research presents the isolation between two radiating I-shaped patch antennas operating at a millimeter wave frequency of 60 GHz [10]. To decrease antennas' mutual coupling The line structure is a slotted meander. To increase the level of isolation between two planar monopole patch antennas, a straightforward meander line slot is utilized. The software uses computer simulation techniques to simulate the antenna (CST).

Antennas play a crucial role in communication systems, but it can be difficult to miniaturize a wearable antenna while still maintaining its low profile, straightforward design, simple integration with circuits, and desirable bandwidth.A series of horizontal and vertical lines make up the meander line antenna's structure. Efficiency improves as the number of turns increases. If meander spacing is increased in a meander line, resonance frequency lowers .Mutual coupling alters the properties of the antennas in an array, which lowers the performance of MIMO systems in an array. In a MIMO system, the mutual coupling of the twin antenna elements depends on the direction that the electricity is flowing over their area. The mutual coupling rises if the current is flowing in the same direction on the neighboring sides of both antennas. Mutual coupling reduction can be done using DGS, Where the ground is placed at λ/2 distance to reduce the back radiation and to improve the gain and bandwidth of an antenna .The Mutual coupling reduction can also decreased by EBG structure, where the ground is placed above this structure, the meandered lines are drawn in an array. The slot is placed in between the array of an antenna. The ground plane now features an electromagnetic Band Gap structure to improve gain and improve other radiation properties while reducing back radiation. The ground plane is distanced from the EBG structure by a certain amount. As isolation was enhanced by utilizing a divider at the ground plane but back radiation was not, the EBG structure was applied to the final construction to lessen back radiation and increase gain. The slot is included in-between the antenna to enhance the antennas performance and to increase the gain and bandwidth of meandered antenna. The improvement of mutual coupling and isolation of an antenna is discussed below.

II.PROPOSED WORK

The meander antenna is designed using CST software. The antenna is designed for 2.45 GHz with the FR-4(ε_r = 4.4) substrate material. The antenna dimensions are calculated by using the below design considerations.

A. SISO

Single Input Single Output is what SISO stands for. A single antenna is utilised for transmission and reception in a SISO system. SISO devices only use one polarisation to transmit their entire RF power. SISO devices are unable to interpret and enhance many signals received at once, thus a single chain device can only broadcast one data stream at a time. Radio, satellite, GSM, and CDMA systems all make use of it. The values of SISO is listed as table below,

TABLE I.CALCULATED VALUES OF SISO

S.NO	Parameters	Values
1	W	20
2	Ws	2
3	Wh	2
4	Lg	90
5	Wg	70
6	Number of turns	4

Table 1 represents the calculated values of SISO using Meander antenna at 2.45GHz using FR4 substrate

B. Layout Design of SISO

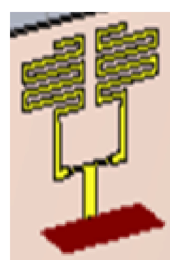

Fig 1. Design of SISO

The above fig 1. represents the design of SISO in meander antenna, which is designed and operates at the frequency of 2.45GHz for MIMO applications, using FR4 Substrate is used with relative permeability of (ε_r = 4.4) and it is simulated in the CST software.

C. Simulation of SISO

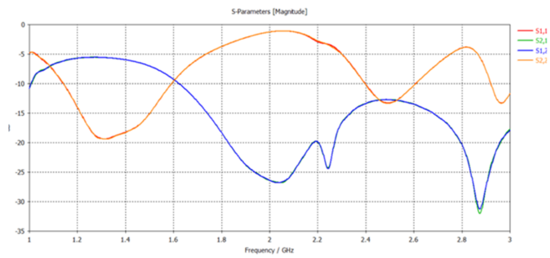

Fig 2. Simulated result for SISO.

D. MIMO

MIMO (multiple input, multiple output) (receiver), An RF link's signal quality and strength are increased using various antennas in this instance of antenna diversity. At the transmission point, this data is divided into various data streams that are then reconfigured by a second MIMO radio with the same number of antennas on the receive side. The receiver is built to account for any additional noise or interference, lost signals, and even the little lag in timing between each signal's receipt.

E. Layout Design of MIMO

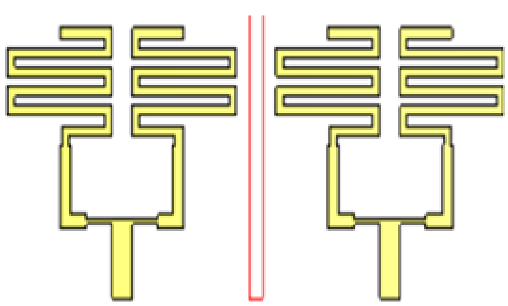

Fig 3. Proposed antenna design of MIMO

The above fig 3 represents the proposed mimo antenna using meandered antenna and it is simulated using cst software.

TABLE II.CALCULATED VALUES

S.NO	Parameters	Values
1	Wl	20
2	Ws	2
3	Wh	2
4	Lg	90
5	Wg	70
6	Number of turns	4

The table 2. represents the calculate values of MIMO using meandered lines by using cst software.

F. Simulation of MIMO

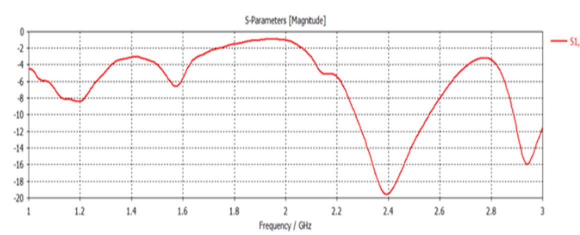

Fig 5. Simulation result of return loss

The above fig 5 represents the simulated output from cst where in this the return loss is about 31.225 dB for the frequency of 2.45GHz.

G.Radiation Pattern and Antenna Parameter for Proposed Work

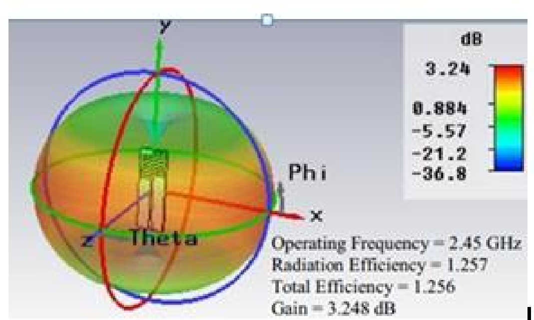

Fig 6 Gain of MIMO

The above fig 6 represents the gain for the MIMO using meandered antenna.The gain and the directivity of an antenna is given as 2.75 dBi and 5.09 dBi for the proposed design and has achieved about 58% of the radiation efficiency for the proposed method.

H.Comparison Of S11 parameters of MIMO

TABLE III.COMPARISON TABLE OF s11 MIMO

S.NO	Resonant frequency	VSWR	S11(at 2.45GHz)
1	2.4 GHz	1.514	-12.33 dB
2	2.25 GHz	1.239	-11.05 dB
3	2.3 GHz	1.68	-10.05
4	2.4 GHz	1.25	-12.33 dB

From the above comparison table 3shows the s11 of MIMO. The gain and directivity is 2.75 dBi and 5.09 dBi for the proposed design and has achieved about 58% of the radiation efficiency for the proposed method.

III.CONCLUSION

The ground plane now features an electromagnetic Band Gap structure to improve gain and improve other radiation properties while reducing back radiation. The ground plane is distanced from the EBG structure by a certain amount. As isolation was enhanced by utilizing a divider at the ground plane but back radiation was not, the EBG structure was applied to the final construction to lessen back radiation and increase gain. The slot is included in-between the array of an antenna to improve the efficiency and performance of an antenna. The slot in-between the antenna array is used to improve the gain of an antenna and helps to reduce the back radiation. The structure of an antenna is done in the CST software at 2.4GHz of operating frequencies using MIMO applications. Thus the mutual coupling is reduced by using the EBG structure the ground is placed above the distance of λ/2 to reduce the back radiation and the slot is introduced in between the antenna to reduce mutual coupling.

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