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Comparative Study and Analysis of Reflect Array Antenna with Cavity Resonator

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ABSTRACT: Design of Patch antenna and Planar Inverted F antenna(PIFA) which has been used as an array element for the performance investigation of the reflect array antenna is being evaluated here in the proposed framework.The antenna is designed to be an efficient and simplified antenna model and to compare their parameters like gain,return loss, and also 3d radiation plots . Matlab R2019b latest version is used here to design and, simulate the designed antenna. This software is proposed especially for User Interface System for basic parameter calculations. It provides many toolboxes for visualizing the antenna parameters that part will be handled in the backend. The design is more compact, short and the designer cancontrol the impedance matching without any matching components.

KEYWORDS: Patch antenna, Planar Inverted F antenna,3d radiation plot, gain , return loss, impedance.

I.INTRODUCTION

An Antenna is a passive device that electrically connected to the transmitter or receiver. It plays a vital role in Radio Communication Systems. Antenna has high gain capability that increases the signal strength [1]. Reflect array antennas have special attention for implementing high gain antennas[2].In this paper we are designing Printed Antenna and Planar Inverted F Antenna and going to analyse MU-MIMO technology. We are using common model of Printed Antenna called patch Antenna. Patch Antenna plays an important role in Wireless Communication Systems. Constructions are simple, compact size, less weight and it contains radiating patch on one side of Dielectric substrate and ground plane on other side[3].PIFA is one of the most compact antenna. It is evolved from patch antenna by introducing a shorting pin from the patch to the ground. The shorting pin provides parallel inductance to antenna impedance [4].It is a low profile antenna and reduces backward radiation.

II.SYSTEM MODEL AND ASSUMPTIONS

A. PATCH ANTENNA

The patch antenna consists of three basic parts: the radiating patch, the dielectric substrate and the ground plane . The dielectric substrate (FR4) is sandwiched by the radiating patch and the ground plane. The radiating patches made of any conducting material like copper or gold and it can take up any shape depending on the design requirements. The ground plane is a metal plate bonded to one side of the dielectric substrate[5]. For good antenna performance, a thick dielectric substrate having a low dielectric constant isdesirable since this provides better efficiency, larger bandwidth and better radiation [6]. However, such a configuration leads to a larger antenna size. In order to design a compact patch antenna, substrates with higher dielectric constants must be used which are less efficient and result in narrower bandwidth. Hence a compromise must be reached between the antenna dimensions and antenna performance.The coaxial feed (fig:2.1)is used in which the feed can be placed at any desired location inside the patch in order to match with its input impedance. This feed method is easy to fabricate and has low spurious radiation. Patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane.

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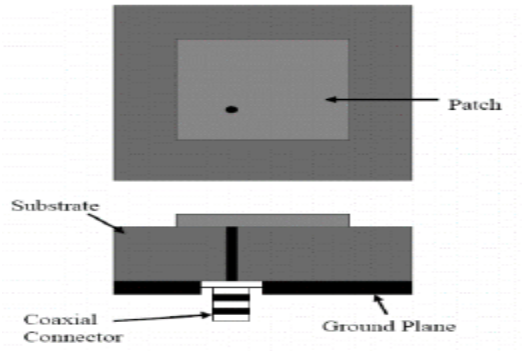

Fig. 2.1 : Coaxial Feed Patchantenna

B.PLANAR INVERTED F ANTENNA (PIFA)

PIFA consists of 5elements: a large metallic ground plane, a resonating metallic plane, a substrate, a shorting plane or pin, a feeding mechanism.The dielectric substrate (RO4725JXR) is sandwiched in between patch and ground plane. The shorting pin and feed are placed inside the slot for good impedance matching. Thus by reducing the distance between the shorting pin and feed,the impedance matching can be done[7].

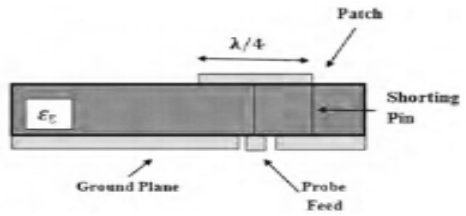

Fig. 2.2 :Probe Feed Pifa

Based on the block diagram the inputs given are : permittivity, height of the antenna, width of the antenna, frequency and impedance. It calculates the Guided wavelength, feed length, feed width, radiation position, conductance and gap of feed. These paramaters are calculated separately for the Patch Antenna and Planar Inverted F Patch Antenna. Finally, the output will be shown in the form of Radiation Pattern and Impedance Plot.

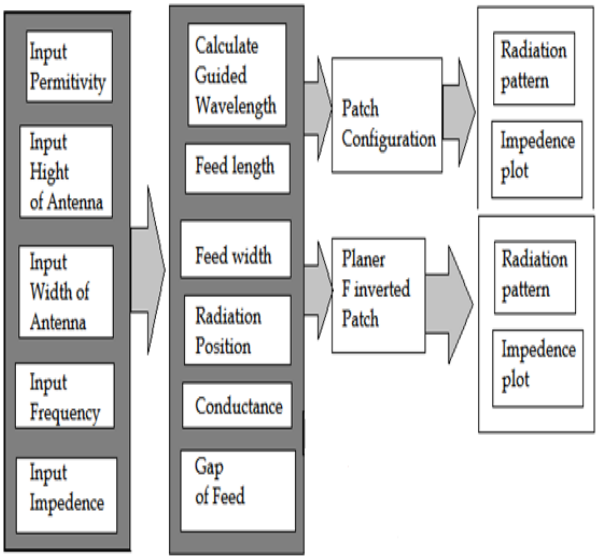

Fig.2.3 BLOCK DIAGRAM

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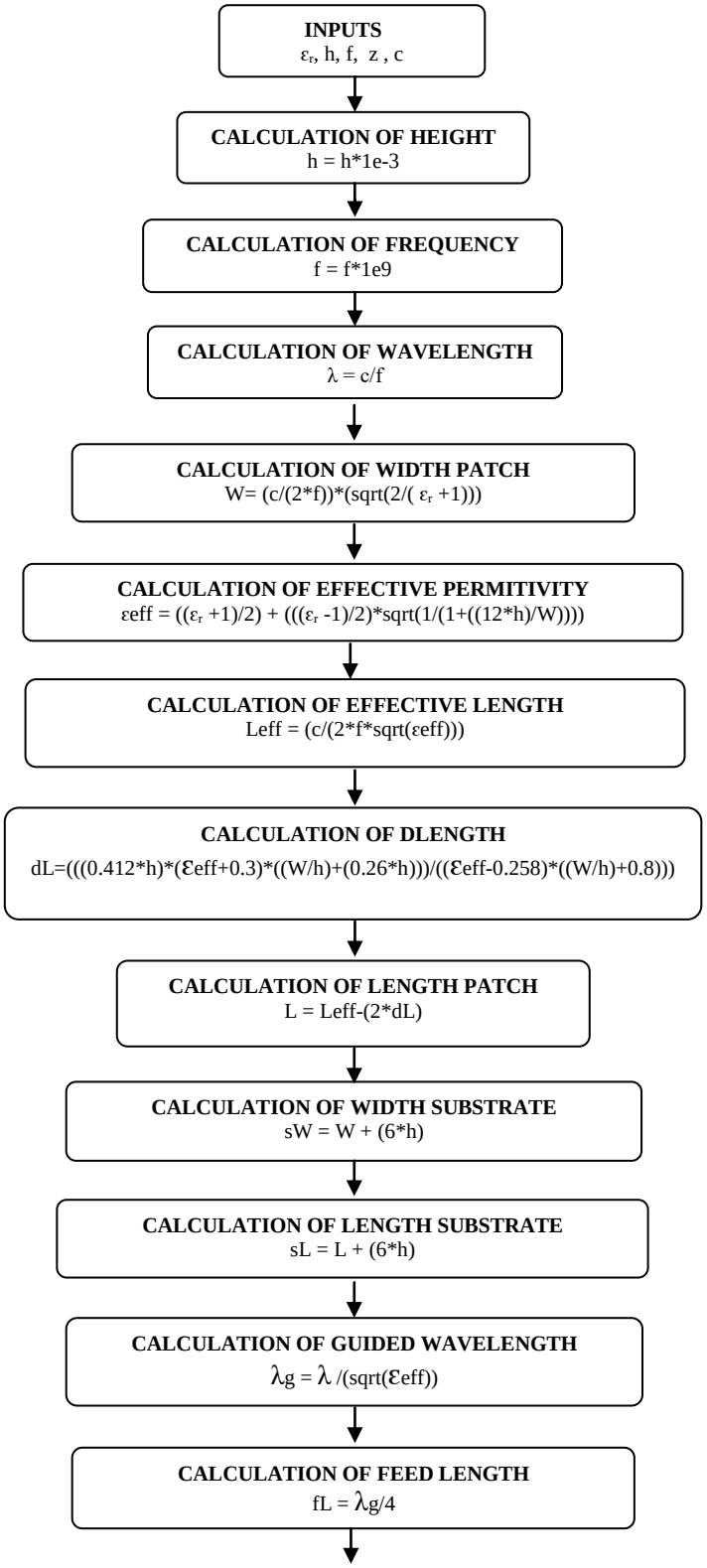
III.DESIGN CONSTRAINT

This is a user application so that anyone can change height, width, length based on the required application[8].



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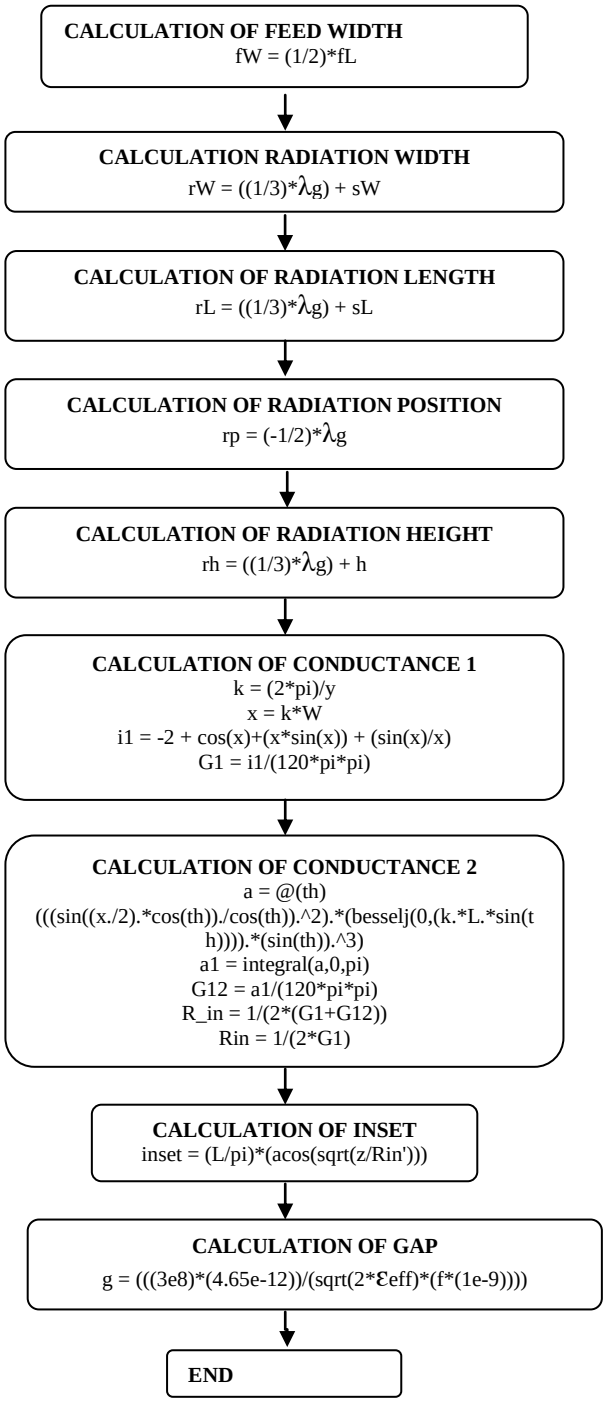

The performance investigation of reflectarray antenna design have been developed from a array of printed patch element which was designed using the design constrain is placed on the flat dielectric substrate.

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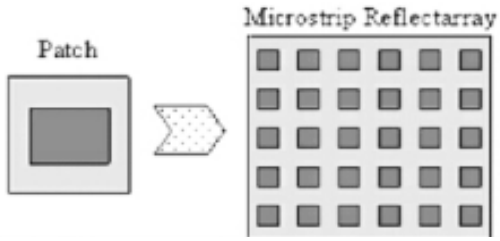

FIG.3.1: MICROSTRIP REFLECTARRAY

The detailed analysis and development of above phenomenon has been provided by MULTI USER MIMO(MU-MIMO)

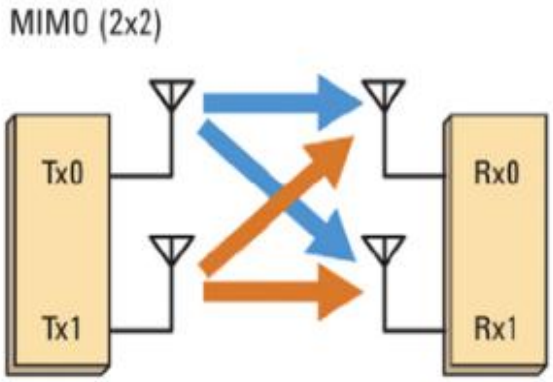

FIG.3.2:MU-MIMO

The ever growing demand for high data rate and more user capacity increases the need to use the available spectrum efficiently.MU-MIMO improves the spectrum efficiency by allowing a base station(BS) transmitter to communicate simultaneously with multiple mobile stations(MS) receivers using the same time-frequency resources.This process includes channel coding ,bit mapping,splitting of the individual data streams to multiple transmit streams and beamforming for all the transmit antennas employed.The set of configurable parameters includes the number of users,number of data streams per users,number of transmit or receive antenna elements ,array locations and channel models. Adjusting these parameters you can study the parameters individual or combined effects on the overall system.

IV. RESULT AND DISCUSSION

A. PATCH ANTENNA

The patch antenna has been designed for the dimension of length 75mm,width 37mm, groundplane length 120mm,groundplane width 120mm as shown below:

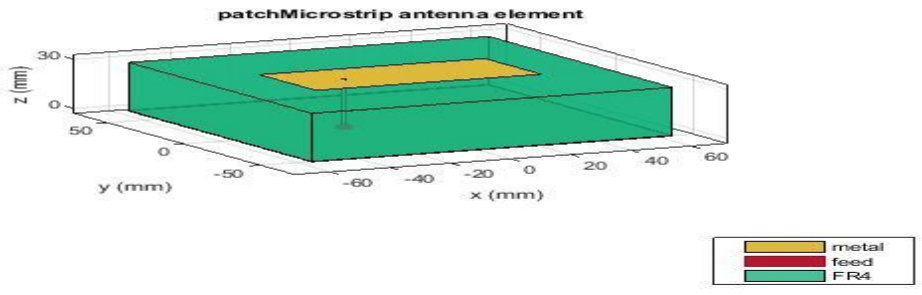

Fig.4.1:Design Of Patch Antenna

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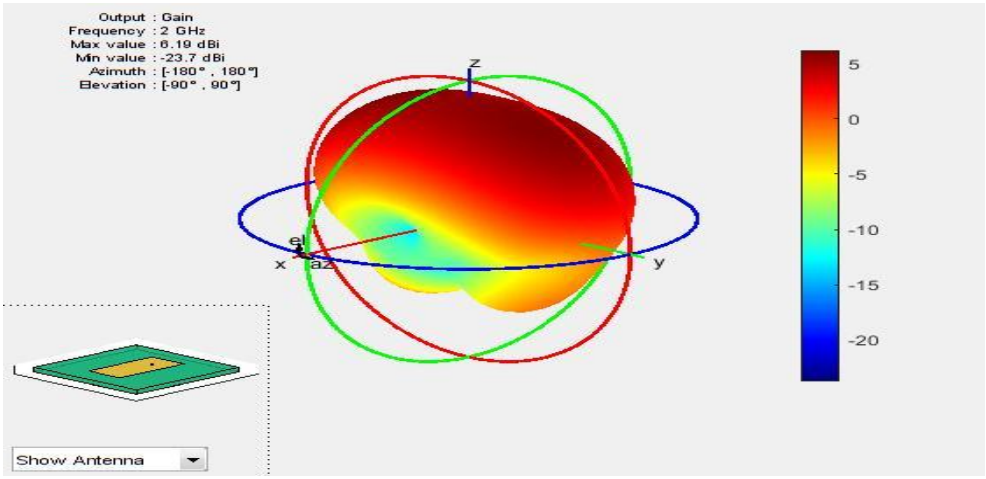

Fig.2:3D Radiation Pattern

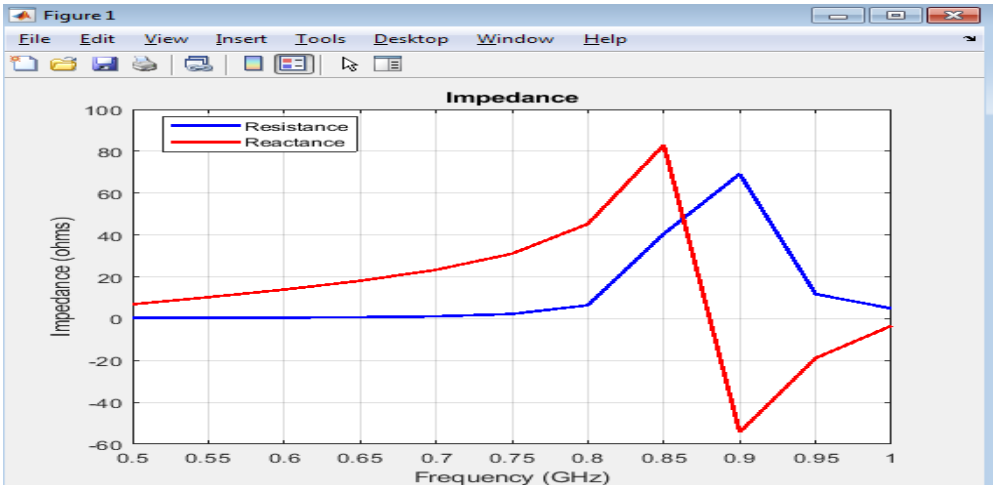

Fig.3:Impedance Plot

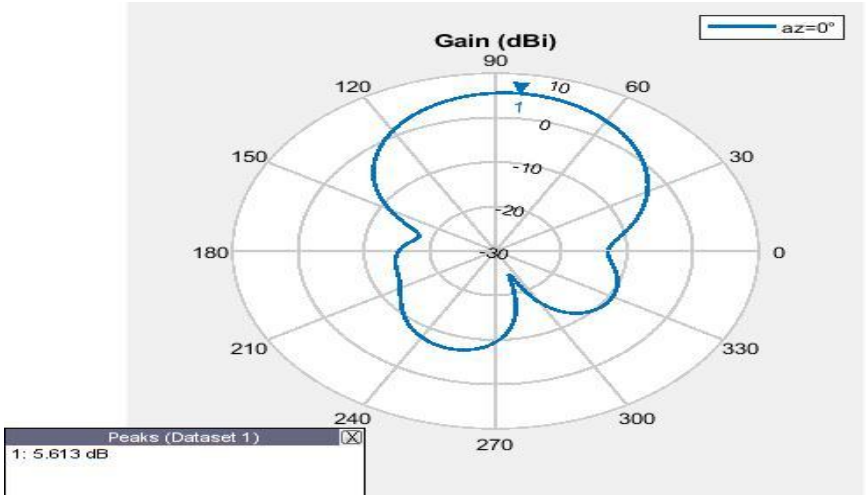

Fig. 4:Gain in DB

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For passive device,the return loss is positive representing the reduction in amplitude of the reflected wave in comparison to the incident wave,it will always have an amplitude less than one.

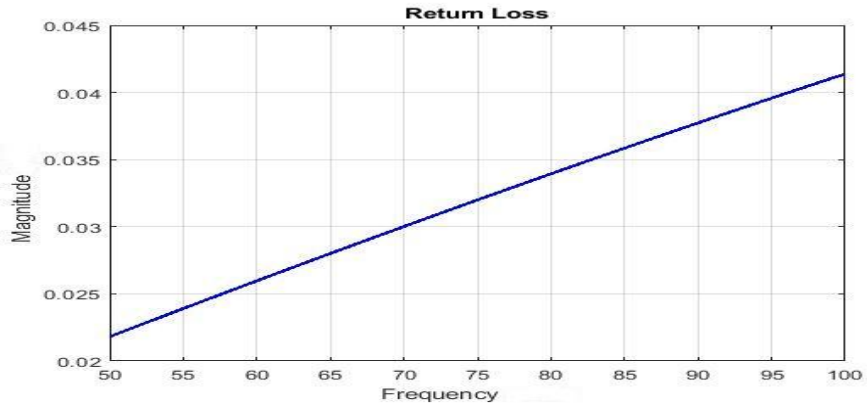

Fig.5.Return Loss

B.PLANAR INVERTED F ANTENNA

The PIFA has been designed for the dimension of length 30mm,width 30mm,height 0.006,ground plane length 35mm,ground plane width 35mm.

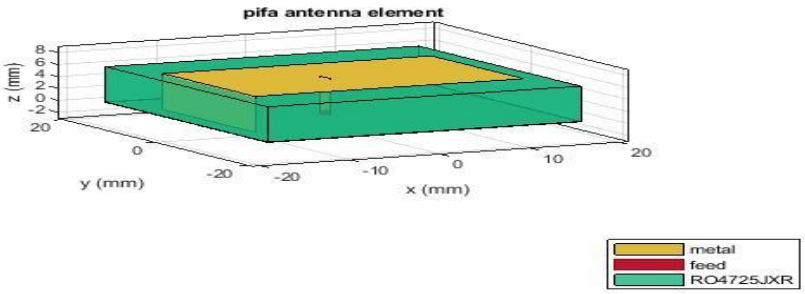

Fig.6:Design of PIFA

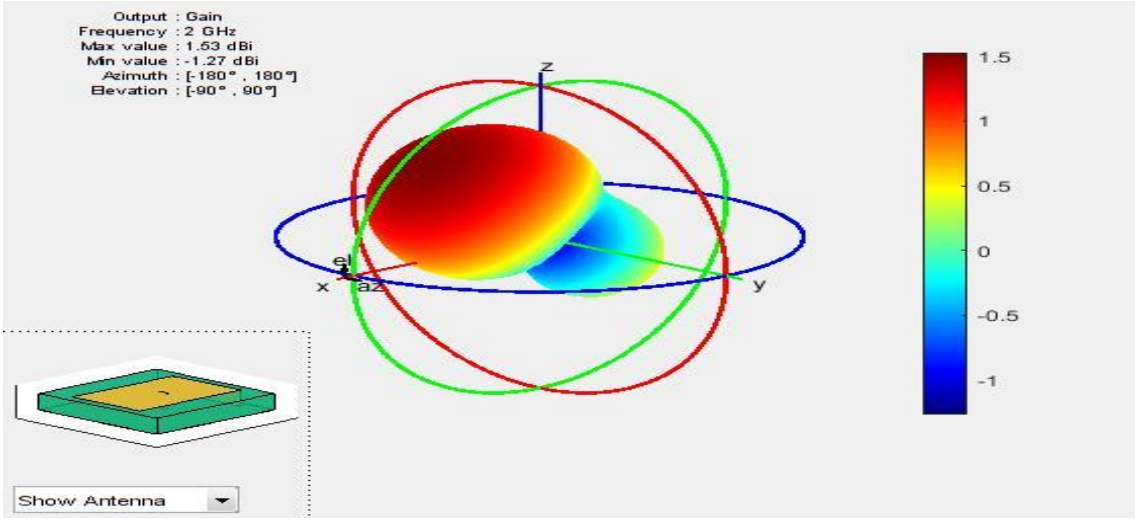

Fig.7:3D Radiation Plot

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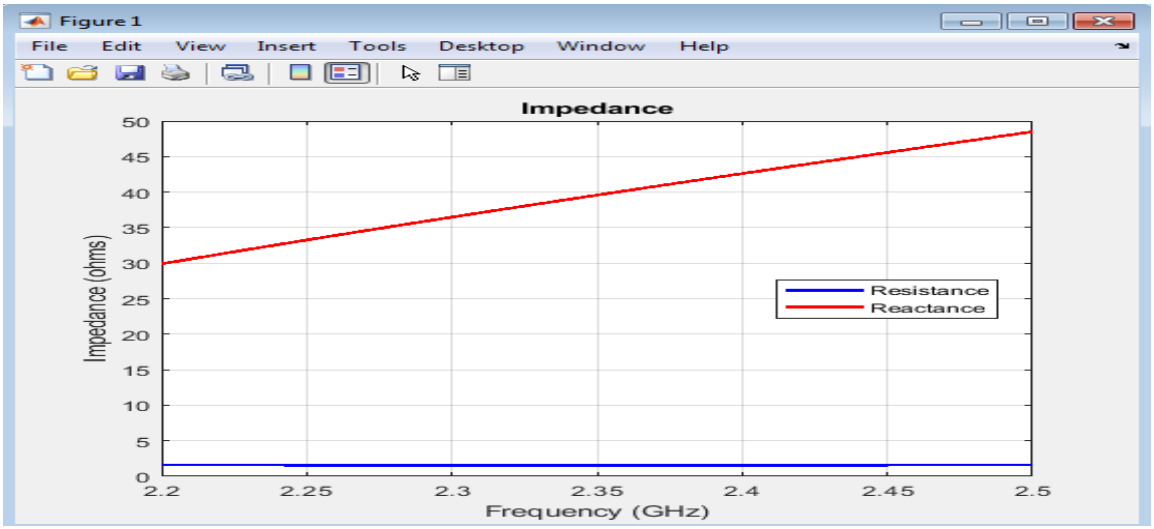

Fig.8:Impedance Plot

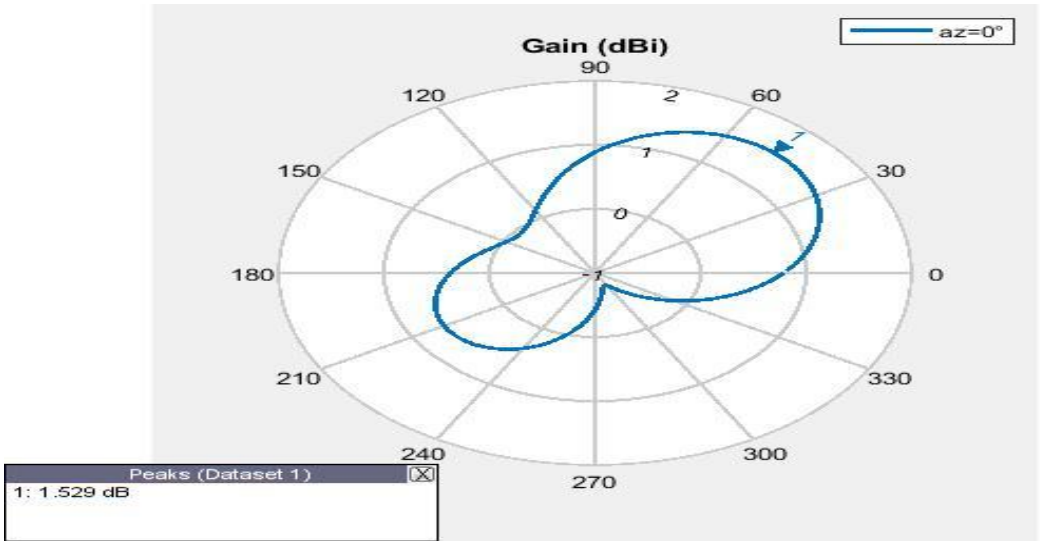

Fig.9:Gain In Db

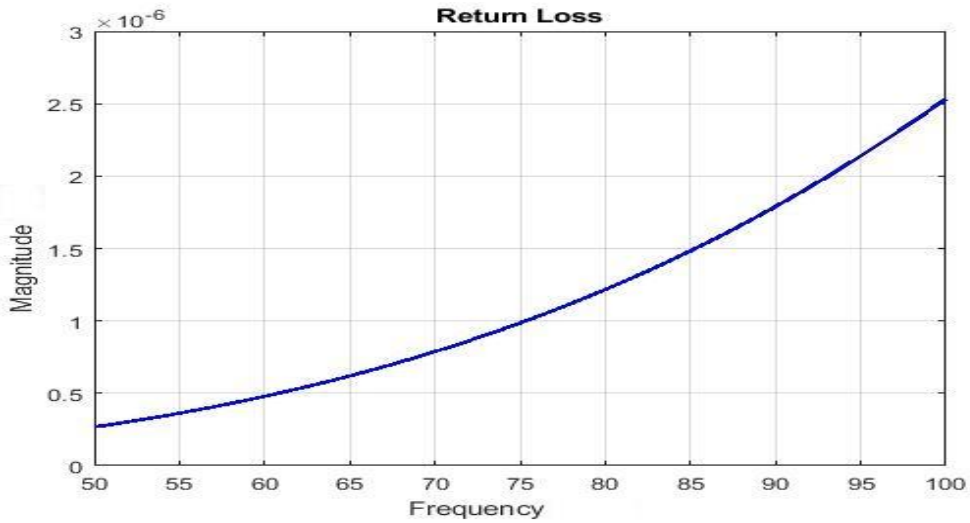

Fig.10:Return Loss

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TABLE **1**

PARAMETERS	PATCH ANTENNA	PIFA
3D Radiation Plot	MAX:6.19 MIN: -23.7	MAX:1.53 MIN: -1.27
Impedance	Parallel resonance	Series resonance
Gain	5.613	1.529
Return Loss	0.0415	0.25

The array response pattern shows distinct data streams represented by the stronger lobes.These lobes indicate the spread or separability of the spectrum.

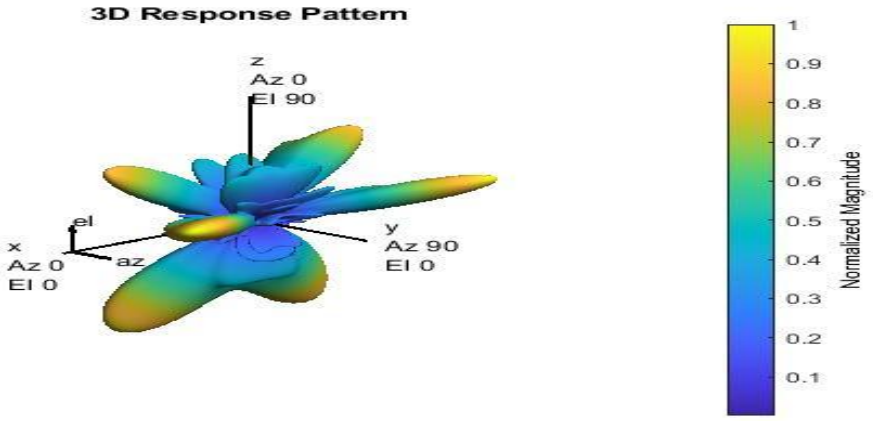

Fig.11:3D Radiation Pattern of MIMO System

For the MIMO system modeled, the displayed receive constellation of the equalized symbols offers a qualitative assessment of the reception. The actual bit error rate offers the quantitative figure by comparing the actual transmitted bits with the received decoded bits per user.

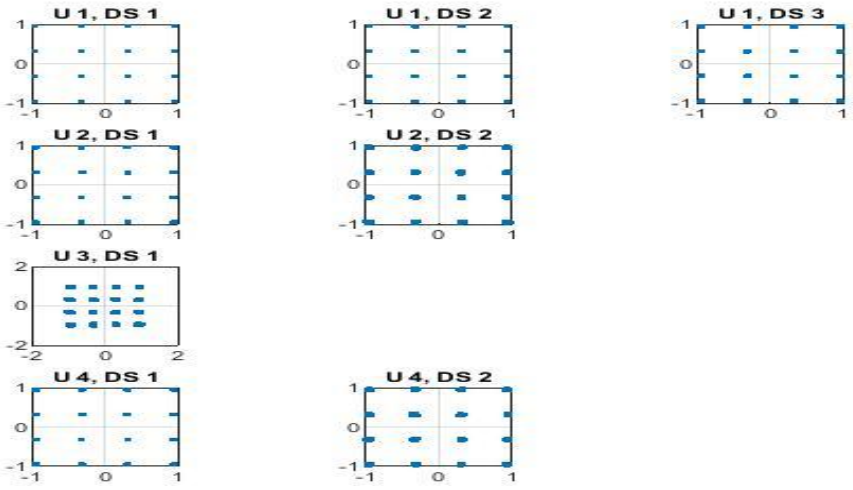

Fig.12:Constellation Of Equalized Symbols

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V.CONCLUSION

The design of proposed Patch antenna and planar Inverted F antenna(PIFA) has been evaluated in the MATLAB R2019b.The simulated result shows the antenna's 3D radiation pattern, impedence plot, return loss.The evaluated results has been applied for the application of MU-MIMO technology.The proposed design constrain will be utilized to develope an array model and the above mentioned parameters can be simulated according to their applications in near future.

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