ORTHOGONALLY POLARIZED MIMO ANTENNA FOR WIRELESS APPLICATIONS

Anil Kumar Patnik[1], R.Sai Bhargavi[2], Y. Raviteja[3], M. Satish[4], K. Goutham Varma[5]

[1]*Assistant Professor, Raghu institute of Technology, Vishakapatnam*
[2,3,4,5]*UG Student, Raghu institute of Technology, Vishakapatnam*

Abstract:In this paper, a design of 4 element MIMO antenna with minimized ground structure to diminish mutual coupling between F-antenna, which are placed in orthogonal polarization position. Here the square shaped ground plane structure is minimized by dividing it with square shaped concentric rings along the horizontal and vertical axis of the ground plane. At first, a design of single antenna which is alike F-antenna which operates at a Frequency range of 6.94GHZ to 9.46GHZ. This designed parasitic elements are placed along a ground plane in 4 different orthogonal polarized position. The frequency bands we considered is around 6GHZ to 10GHZ. The substrate material used is Rogers RT/Duroid 5880.

***Keywords*:** F-Antenna, minimised ground plane (MGP), MIMO antenna, parasitic elements.

I. INTRODUCTION

An antenna is an electric device which converts electrical power to radio waves and vice versa. Now a day, MIMO antenna technology is used for wireless communication since it supports the utilization of multiple antennas at both transmitter and receiver ends. The antennas present at the either end of the communication circuit is combined to reduce errors and enhance data speed. In MIMO systems a transmitter sends continuousflow of signals with the help of multiple transmitting antennas. Using these MIMO antennas, it is possible to double the number of antennas present at the transmitter as well as at the receiver ends, because of which receiver power increases.

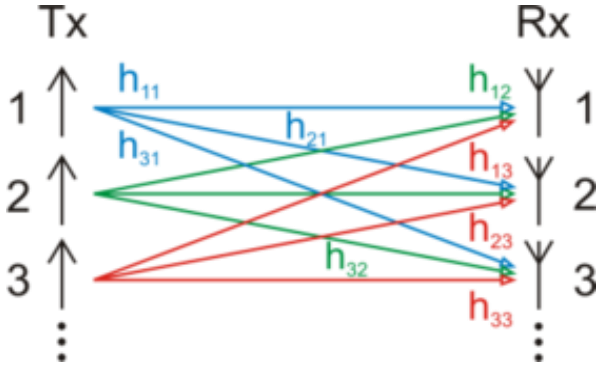

Fig: MIMO ANTENNA

F-antenna are used in wireless communication, and generally derived from quarter wavelength patch antenna. The dielectric substrate is placed between tow sheets. As it is derived from quarter wavelength patch antenna the size of the antenna is small and compact, impedance matching can be controlled without more matching components. These antennas are widely used in mobile phones, tablet computers, and for GPS. More over it provides transmission capabilities like GSM, Bluetooth, and wifi. This F-antenna is most commonly used antenna in matching devices. The main reason behind designing new antennas is to reduce its size without affecting its performance factor. To reduce mutual coupling different antenna designs have been proposed now a days, low mutual coupling can be attained with the help of different techniques like slot technique etc. Defective ground plain structures are used in alternate to the metamaterial structure while reducing the overall size of antenna. As the traffic in the communication system is increasing, multiple input and output system is required for transmitting multiple Gbps data to large number of users. As the demand for 5G technology increases day by day, but they are only few frequency bands which supports 5G applications. It is necessary to have a higher band which allows high data rate in Gbps. Higher bandwidth are easily achieved

when working with very higher frequency band which is above 6GHZ. In order to satisfy the needs of 5G both in transmission as well as reception, a proper antenna is required. So here we suggest antennas which are capable of working at a frequency 6 GHz and above.

II. METHODS

A. Proposed F antenna

As considering the above advantages with F antenna, we used F antenna as an antenna element in our MIMO design. We consider it for easy to design purpose on 4.5cm X 4.5 cm ground plane dimensions and a 4.5cm X 4.5cm X 62mil RogersRT/Duroid 5880^{TM} as a dielectric substrate. The strip line of F shape has a width 0.1cm and length 1.5cm along with 1X0.5cm short arm and 1.5X0.4cm long arm and the connection between them is 0.3cm X 0.3cm.

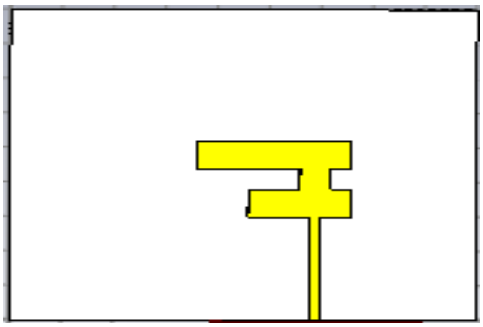

Figure [1]

The loss curve of above F antenna is shown in fig2.

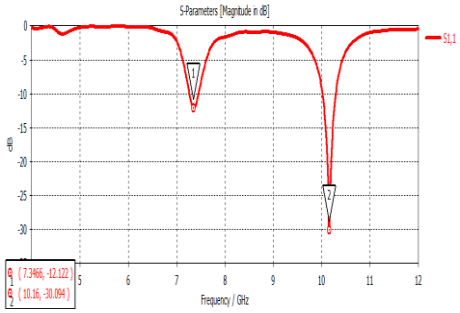

Figure [2]

The above defined F antenna having dual band operating at 7.3466 GHz and 10.16 GHz with a loss of -12.122 dB and -30.094 dB respectively.

B. *Proposed MIMO antenna setup*

The above designed F antenna is arranged in an orthogonal polarization placed in a MIMO design.

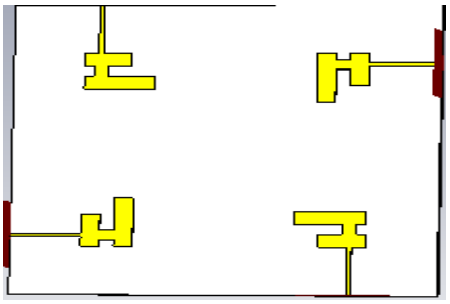

Figure [3]

By etching the square shaped rings from the bottom of ground plane like a split ring resonator model with metamaterial-based rings are 1cm length and having a square patch of 0.4cmX0.4cm along with a ring width of 0.4cm as shown in figure [4].

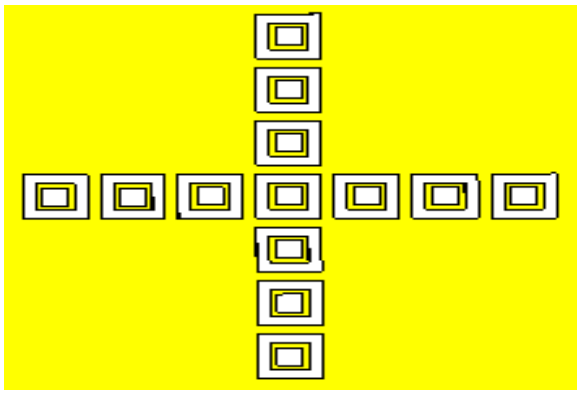

Figure [4] Bottom view of MIMO antenna

III. SIMULATED RESULTS AND ANALYSIS

The loss curve for above designed MIMO model results in having dual band operating at 7.3893 and 10.178 GHz with return loss -12.141 dB and -25.351 dB respectively shown in figure [5].

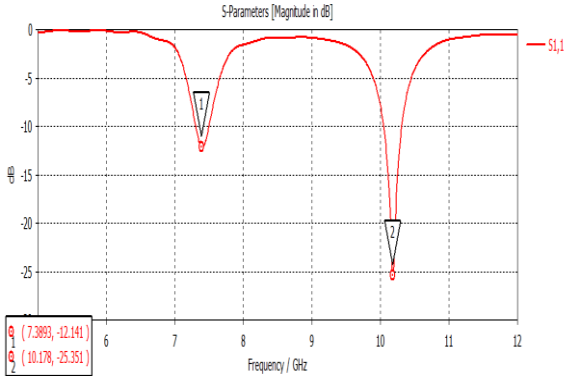

Figure [5]

For previously generated F antenna, the Voltage Standing Wave ratio curve was shown in figure [7] which is operating at 7.3542 GHz and 10.158 GHz with a return loss of 1.6562 dB and 1.0657 dB respectively.

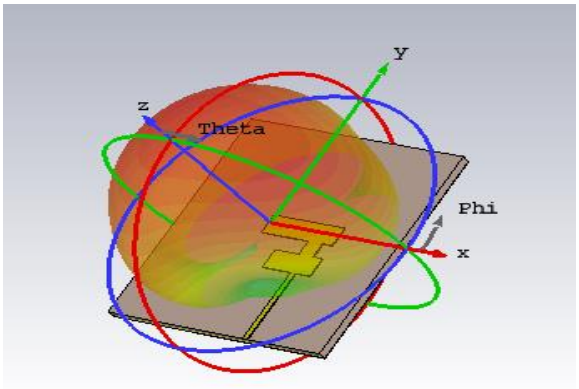

Figure [6]

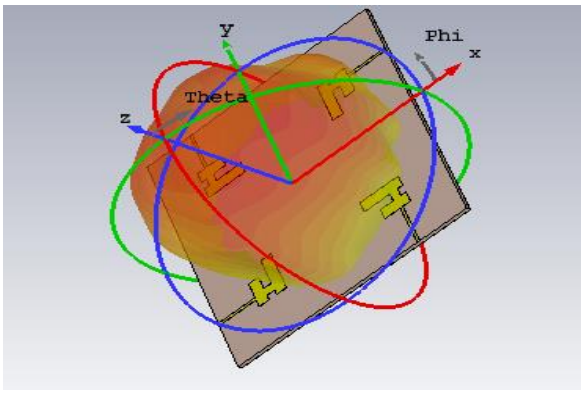

Figure [7]

The designed MIMO antenna exhibits its VSWR characteristics with a dual band operating at 7.3852 GHz and 10.174 GHz with a return loss of 1.6597 dB and 1.1202 dB as shown in figure [9].

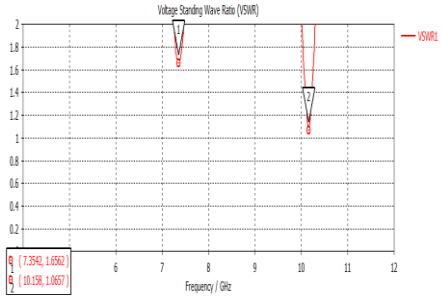

Figure [8]

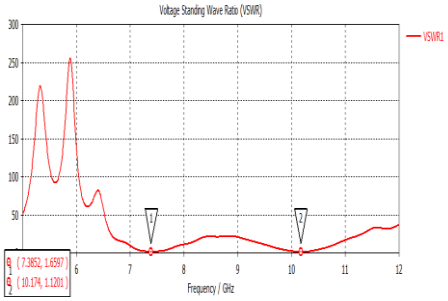

Figure [9]

The far field directivity of our MIMO designed model is with a frequency of 8.5GHz with a Main lobe magnitude 7.56 dB in 2.0deg. direction with an Angular width of 65.6 deg. and a side lobe level of -12.4 dB as shown in figure [10].

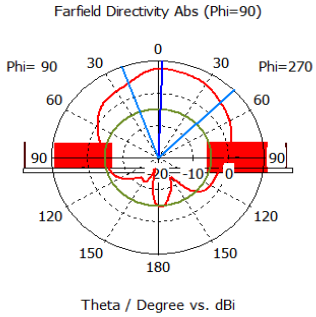

Figure [10]

IV. CONCLUSION

The performance of proposed 4 element MIMO antenna with and without RGP is analysed and as we can see there is slight improvement in reducing the mutual coupling by etching the ground in MIMO antenna here the proposed model without and with RGP mostly worked in frequency bands approximately around 7.38GHz and 10.17GHz with good return loss. This higher frequency band belongs to c and x bands are also being in consideration for future 5G wireless applications.

V. REFERENCES

[1]. Ali, M.; Guangli Yang; Huan-Sheng Hwang; Sittironnarit, T., "Design and analysis of an R-shaped dual-band planar inverted-F antenna for vehicular applications", IEEE Transactions on Vehicular Technology, vol. 53, issue 1, pp. 29–37, January

[2]. F.N.M. Redzwan; M.T. Ali; M.N.Md Tan; N. F. Miswadi, "Design of Planar Inverted F antenna for LTE Mobile Phone Applications"; Region 10, Symposium, 2014 IEEE.

[3]. Waleed Ahmed, Asad Ali; Wasif Tanveer Khan; "Small form Factor PIFA antenna design at 28GHz for 5G applications", Antennas and Propagation (APSURSI), 2016 IEEE International Symposium.

[4]. Raj Kumar, J. P. Shinde and M. D. Uplane" Effect of Slots in Ground Plane and Patch on Micro strip Antenna Performance", International Journal of Recent Trends in Engineering, Vol 2, No. 6, November 2009.

[5]. Chakravarthy VVSSS, P.S.R. Chowdary, Ganapati Panda, Babita Mhaji, Jaume Anguera and Aurora Andujar, "On the linear antenna array synthesis techniques for sum and difference patterns using flower pollination algorithm," Arab Journal of Science and Engineering, Springer Nature, Volume 43, Issue 8, pp 3965–3977.

[6]. Sara Mahmoud, W. Swelam, Mohamed Hassan, "Parametric Study of Slotted Ground Microstrip Patch Antenna" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 11, Issue 1, Ver. III (Jan. - Feb .2016), PP 01-08.

[7]. Sudheer Kumar Terlapu, P. S. R. Chowdary, Ch Jaya, V. V. S. S. Sameer Chakravarthy and Suresh Chandra Satapathy, " On the Design of Fractal UWB Wide-Slot Antenna with Notch Band Characteristics", International Conference on Microelectronics, Electromagnetics and Telecommunications 2017, Springer Lecture Notes in Electrical Engineering - 471, 907-912, (2018).

[8]. Nora Mohamed, Mohamed-Hicho; Eva Antonino Daviu; Marta CabedoFabres; Miguel FerrandoBataller; "Characteristic Modes in Slot Antennas Etched in A Finite Ground Plane", Antennas and Propagation (APSURSI), 2016 IEEE International Symposium.

[9]. Straightpath Communication Inc. "A straight Path Towards 5G (white paper)" September 16, 2015.

Mr Anil Kumar Patnaik has completed M.Tech from Andhra University College of Engineering(A), Visakhapatnam and B.Tech from Pydah engineering College. Currently Working as Assistant Professor, Department of Electronics and Communication Engineering in Raghu Institute of Technology, Visakhapatnam. His Areas of Interest is Antennas.

Ms. R.Sai Bhargavi is Pursuing Her Bachelors of degree in Electronics and Communication Department, in, Raghu Institute of Technology, Dakkamarri, Visakhapatnam, and Andhra Pradesh.

Mr. Y Raviteja **is Pursuing His Bachelors of degree in Electronics and Communication Department, in, Raghu Institute of Technology, Dakkamarri, Visakhapatnam, and Andhra Pradesh.**

Mr. M. Satish **is Pursuing His Bachelors of degree in Electronics and Communication Department, in, Raghu Institute of Technology, Dakkamarri, Visakhapatnam, and Andhra Pradesh.**

Mr. K Goutham Varma **is Pursuing His Bachelors of degree in Electronics and Communication Department, in, Raghu Institute of Technology, Dakkamarri, Visakhapatnam, and Andhra Pradesh.**