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CIRCULARLY POLARIZED PATCH ANTENNA

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Abstract:

This work proposes the design of Circularly polarized antenna for wireless system communication such as Mobile Communication and more. The Circular patch has radius of 12.5mm placed on the FR4 substrate. To increase the performance, the slots are introduced in this work. In order to get the Lossless communication and Low interference we are using Low VSWR Value. The proposed antenna resonates at 2.4 GHz, 3.4 GHz, 3.8 GHz, 5.6 GHz and 6 GHz. Hence its applications fall on ISM (2.4 - 2.483 GHz) band, fixed mobile Wi-MAX (2 - 6 GHz) applications. Since the antenna is designed with miniaturized size it can also be preferred for Bio-Telemetry applications. To design and simulate the antenna HFSS software tool has been used.

Keywords — **Antenna, Circularly polarized, HFSS communication, Wireless**

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I. INTRODUCTION

5G innovation will enable an era of connectivity like never before. Anticipated experiences from autonomous driving, tactile internet, Ultra HD video and VR based immersive technologies, all capacity hungry communications, will see demands for higher through-put, better spectral efficiency, ultra-low latency and over 100 times the current number of connections.

In order to support increased traffic capacity, over 10 times existing throughput, and to enable the transmission bandwidths needed to support very high data rates, 5G will extend the range of frequencies used for mobile communication in legacy LTE/4G systems as well as leverage the new Radio Access Technology for 5G called 'NX'. 'NX will focus on new frequencies including new spectrum at sub 6GHz, as well as spectrum in higher frequency bands at mmW. The new standards will be addressed in 3GGP release 14.

5G antenna technology offerings will leverage both the sub 6GHz and mmW frequency space to give ubiquitous coverage and capacity for networks of the future. To get a good communication result C Band is better while compared with other Massive beam forming Antenna Technology. This is demonstrated in our product offering of the 5-6 GHz Massive MIMO Base Station Antennas, namely the MCM 100 with 64 elements 19dBi effective gain. Digital beamforming can be incorporated in the base band processor of the radios connected to each of the individual antennas. "5G" antennas are expected to be smaller, more numerous and part of more high-gain systems than those that have served 3G and 4G systems, and they will need more advanced steering and scanning techniques in order to function well at millimetre wave frequencies.

In 1997Mike Schuster and Kuldip K. Paliwal explained about the types of ANN and said that Bidirectional RNN performs well than other types [11].

In 2004 Hossein Mosallaei and Kamal Sarabandi discussed about a Reactive impedance Substrate (RIS) can be tuned anywhere between perfectly electric (PEC) and magnetic conducting (PMC) surfaces offering a property to achieve the optimal bandwidth and miniaturization factor [13].

In 2005 Dimitrios Peroulis, Kamal Saraband, P.D. Linda and Katehi described about the design of compact and efficient tunable antenna which is applicable for 540-890 MHz [15].

In 2006 Filiberto Biloti, Andrea Alu, Nader

Engheta, and Lucio Vegni explained about the antenna using Inhomogeneous substrate [11].
In 2006 M.A. Saed discussed about the antenna which exhibits very broad bandwidth by using different stubs such as 40%impedence bandwidth (F-stub) and 44% impedance bandwidth (V-shaped stub) [17].
In 2006 Nurhan Turker, Filiz Gunes and Tulay Yildirim expressed about the antenna which is designed using ANN [02].
In 2007 Tamotsu Houzen, Masaharu Takahashi and Koichi Ito discussed about the antenna identifying maximum frequency shifts caused by variations in the electrical properties of body tissues and different anatomical distribution [4].
In 2007 S. Sadat, M. Fardis, F. Geran, and G.Dadashzadeh explained about the antenna which is applicable for impedance bandwidth that can be achieved over the UWB (Ultra Wide Band) frequency range (3.1-10.6 GHz) [16].
In 2008 T.F Lai, Wan Nor Liza Mahadi and Norhayati Soin discussed about the circular patch Micro strip array antenna which is used for KU-band [9].
In 2008 Y.C. Lee and J.C. Sun described about the printed slot antenna using the printed structure in order to improve its dual-band and compact size performances [13].
In 2010 S. Shyam, J. Pattnaik, G. Joshi, S. Devi, and M.R.Lohokare discussed about electrically small rectangular Microstrip antenna which is loaded with MSRR (Multiple Split Ring Resonator) metamaterial working at Ka- band frequency range [14].
In 2010 Jagadish M.Rathod discussed about variety of feeding technique applicable to Microstrip patch antenna [06].
In 2011 Jagtar Singh, A. P. Singh and T. S. Kamal discussed about the technology of FFBP-ANN (Feed-Forward Back propagation-ANN) with one hidden layer which is trained using Levenberg-Marquardt Algorithm [02].
In 2011 Praveen Kumar Malik, Vineet Vishnoi and Shekhar Pundir described that, in Bio-medical applications and wireless communication systems, the Microstrip Antennas are extensively used because of their low-profile features and ease of fabrication [09].
In 2011 K. Siakavara discussed about the methods for the design of patch antenna for Modern Applications [10].
In 2012 N. Vidal, S. Curto, J. M. Lopez Villegas, J. Sieiro, and F.M Ramos discussed about the modified helical shaped 3D spiral antenna covering MICS (Medical, Industrial, Commercial and Scientific) band [1].
In 2012 S. Suganthi, S. Raghavan, D Kumar and S. Hosimin Thilagar explained about the efficiency of the antenna can be improved using some methodologies like inclusion of metamaterial [6].
In 2013 Manish kumar Rajput, Divyanshu Prabhav and Chitransh Karade explained about the use of wide slots to enhance the Bandwidth of the antenna [15].

II. DESIGN OF CIRCULAR POLARIZED PATCH ANTENNA

We started our project with conventional circular patch. With the above dimensions obtained we designed a semi-circular patch antenna. To improve the performance of the antenna slots are introduced in the patch.
Initially, a semi-circular patch radius 12.5mm is designed. Then at second stage a slot of 1.6 mm thickness is introduced in the patch. At third stage three slots of same thickness (1.6 mm) are introduced. The final structure consists of four slots of thickness 1.6mm, the distance between the first set of three slots and second set of slots is kept as 2mm.

Antenna Without Slot:

Initially we started with semi-circular patch. The radius of the patch is 10mm. The size of the ground

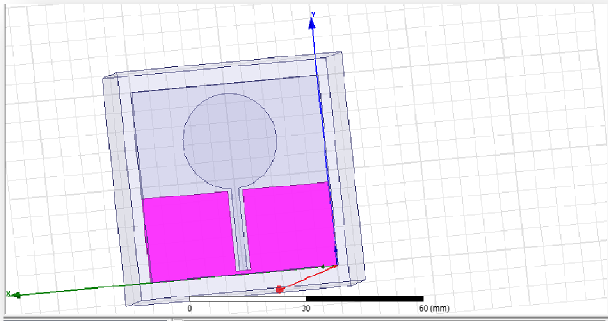

Figure 1: Antenna Without Slot

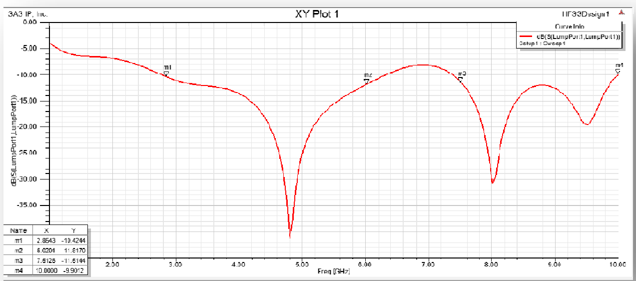

Figure 2. Output Graph

III. DESIGN AND SIMULATION RESULTS OF THE CIRCULARLY POLARIZED ANTENNA

In this stage Four slots are introduced with the thickness of 1.6mm as same in the above cases. The other dimensions of the antenna are retained. The distance between the slots is also kept as 1mm as in the previous set of slots. The first set of three slots and the second set of three slots are separated with the distance of 2mm. In this slot gap we are using the Air bounding in between the Run Bounding which is used to increase the performance of the antenna.
The structure of the circular patch antenna with Four slots and its final output are shown in Figure [3] The antenna with Four slots resonates at three frequencies 2.5 GHz, 3 GHz with return loss -10.2847, -10.1647, -10.6267 respectively.
and substrate is 50mm*50mm*1.6mm. The substrate chosen here is FR4, which is readily available in the market. The Figure[4] shows the structure and simulated result of the basic patch antenna with single slot is depicted in Figure, the antenna resonates at 2.8543 GHz with -12.2 dB return loss. As we are aiming to design an antenna with lower frequency we iterated the initial patch.

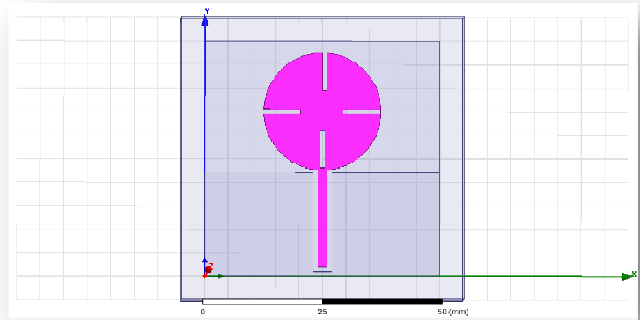

Figure 3 : Antenna with slot

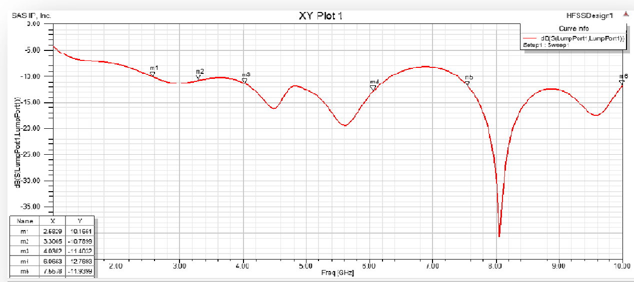

FIGURE 4 : OUTPUT GRAPH

The feed position of the antenna with Four slots is shifted to half of the centre position. So that the resonant frequency of the antenna is shifted to lower part of the microwave spectrum which is our main objective. The Figure[4] shows the structure and output graph of the proposed antenna. It resonates at five frequencies 2.5 GHz, 3.5 GHz, 4.03 GHz, 6.06 GHz and 7.578 GHz with return LOSSES OF -10 DB RESPECTIVELY.

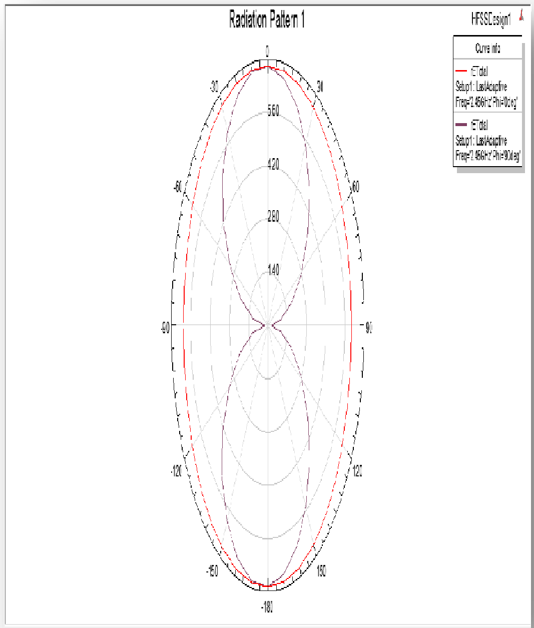

Figure 5 : Smith Chart

IV.CONCLUSIONS

The proposed antenna meets the suitability of application in the lower part of microwave spectrum. The antenna resonates at multiple frequencies and give reduced return loss. However, it provides narrow Bandwidth. The antenna resonates at 2.4 GHz, 3.1 GHz, 3.65 GHz, 5.6 GHz and 7 GHz. Hence this type of antenna can be recommended for applications in the ISM (2.4 - 2.483 GHz) band, fixed mobile Wi-Max (2.4 GHz, 3.2 GHz, 3.65 GHz 5.61 GHz) regions. It can also be made suitable for bio-telemetry and implantable applications by properly simulating and experimenting in the lossy body environments appropriately. The performance of the antenna can be improved using some methodologies like Metamaterials.

REFERENCES

[1] N. Vidal, S. Curto, J. M. Lopez Villegas, J.Sieiro, and F.M Ramos., Detuning Study Of Implantable Antennas Inside The Human Body Progress In Electromagnetics Research,Vol.124, pp.265-283, 2012.

[2] M.Z Zani, M.H. Jusoh, A.A Sulaiman, N.H Baba, R.A.Awang, and M.F Ain., Circular Patch Antenna on Metamaterial, IEEE, 2010.

[3] Javier Abadia et al, 3D-Spiral Small Antenna Design and Realization for Biomedical Telemetry in the MICS band Radio engineering, Vol.18, No.4, 2009.

[4] Tamotsu Houzen, Masaharu Takahashi and Koichi Ito, Implanted Antenna for an Artificial Cardiac Pacemaker System, Progress In Electromagnetics Research Symposium, pp.27-30, 2007.

[5] E.Y Chow, Yuehui Ouyang, Brooke BeierWilliam, J.Chappell, and Pedro P. Irazoqui, Evaluation of Cardiovascular Stents as Antennas for Implantable WirelessApplications, IEEE Transactions on Microwave Theory and Techniques, Vol.57, No.10, 2009.

[6] S. Suganthi, S. Raghavan, D Kumar and S. Hosimin Thilagar, A Compact Hilbert Curve Fractal Antenna on Metamaterial using CSRR, PIERS Proceedings, pp.136-140, 2012.