Industrial Engineering Journal
ISSN: 0970-2555
Volume : 50, Issue 1, No. 1, January 2021

DESIGN OF A MINIATURE PATCH ANTENNA FOR 5G COMMUNICATIONS WITH A WIDE BAND

Pamisetty Chandana[1], N. Naveen Kumar[2], Dr. Y.L. Ajay Kumar[3]
[1]Assistant Professor, [2]Assistant Professor, [3]Associate Professor, ECE Department, Anantha Lakshmi Institute of Technology and Sciences, Ananthapuramu, Andhra Pradesh, India.

Abstract:** This research paper we have developed a new study concerning the miniaturization of micro strip patch antenna by using a wideband slotted star shaped antenna resonating at 42 GHz. The Antenna design plays main role in developing the faster communication technology like 5G. A miniature micro strip patch antenna has been developed, analysed and validated for WI-Max applications. The goal from this work was to improve the bandwidth, change in the dimensions of micro strip patch antenna. In this paper, a wideband slotted star shape antenna for 5G communication is presented. The antenna is developed over ROGERS RT5880tm substrate of 0.762mm height and dielectric permittivity of 2.2 with the dimension of 3mm width and 4.3mm length. A narrowband rectangular patch is changed to gain a wide bandwidth of 41.51GHz with the reference of -10dB return loss. In this thesis, a typical miniature slotted micro strip patch antenna technique has been introduced for the betterment of Gain, Directivity, Radiation pattern and Return Loss. This proposed antenna was design using High Frequency Structural Simulator (HFSS 17.0) software. These parametric studies would be a great interest in the designing of miniature micro strip antennas for wireless communications operating at 42GHz.

Keywords:** Miniaturized antenna, wideband, 5G communications, HFSS 17.0.

1 INTRODUCTION

5th Generation of Communication (5G) has been proposed by the researcher as an answer of numerous issues. The 5G promises to give high speed information rate and move to the expanse of people and developing advances like internet of things (IoT), internet of medical things (IoMT) and internet of vehicles (IoV) [1]. where Antenna is the most fundamental block of the wireless communication. As of late, the developmentof wireless systems prompts a great deal of innovations in the Micro strip antenna designs. Now a day's wireless communication systems have huge demand on various applications.[2] Micro strip Patch Antennas have a considerable amount of advantages over different antennas because of their less weight, low profile, less expense of creation and low volume.[3] Due to this striking highlight, when researchers are having noteworthy consideration towards miniature strip antennas.

Microstrip patch antenna can be utilized in extensive range of uses, for example,in wireless communication and biomedical diagnosis. [4] An antenna is center segment of communication in any of frequency assumes a significant part of 5G also, the small size high gain and wideband antenna is needed to communicate effectively. [5] There aremany feeding techniques used for the Micro strip patch antennas. To keep the structure planar, a micro strip line in the plane of the patch can be etched to feed the antenna. [6]

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 50, Issue 1, No. 1, January 2021

But again, it suffers from the drawbacks that the feed network interferes with the radiating properties of the antenna leading to undesired radiations. For the micro strip feed,[7] As there where an explosive increment in wireless data traffic, MMW communication has gotten one of the most charming strategies In the 5G mobile communications system. [8] the issues engaged with the plan of antenna array architecture for future 5G MMW antenna, in which the antenna components can be conveyed looking like a cross, or hexagon, notwithstanding the customary rectangle [9].

Despite of having numerous advantages, a main drawback of microstrip patchantennas is narrow bandwidth [10]. For real time applications, bandwidth enhancement is usually needed There are various methods for bandwidth enhancement such as using defected ground surface, increasing substrate thickness and slots on radiating patch [11]. For achieving the qualities of wide impedance [12] bandwidth monopole models are regularly utilized, for example, elliptical, pentagon, triangular, rectangular [12], square, hexagonal, annular ring and circular ring antennas. Different strategies had been utilized to the bandwidth improvement in Microstrip patch antenna viz. Multilayer patch,[13] Stacked antenna utilization at impedance match.

The paper contains a profoundly miniaturized antenna for wideband 5G communications. which stable estimation of gain and bandwidth. In this paper is partitioned into following area: segment II presents the theory and structure of antenna. Area III presents designing of the antenna. Area IV contains the outputs of the proposed antenna. Segment V contains the Conclusion While the conversation is deduced in last area joined by references.

II STRUCTURE AND THEORY OF MICROSTRIP PATCH ANTENNA

For designing of substrate ROGERS RT5880tm is used due to easy fabrication and less cost. The width of patch is denoted by “W” and length of patch can be denoted by “L” and height of patch was denoted by “H”. Since there dimensions in the patch are limited along with the width and length, where ground of edges in the patch go through fringing. Since a portion of waves travel on the substrate and some on air, a viable dielectric constant Ɛreff is acquainted with represent fringing where the wave propagation on the line.

$$W = \frac{2cf}{\left(\frac{\varepsilon_r + 1}{2}\right)^{\frac{1}{2}}}, L = \frac{c}{2f\sqrt{\varepsilon_e}} - 2\Delta L$$

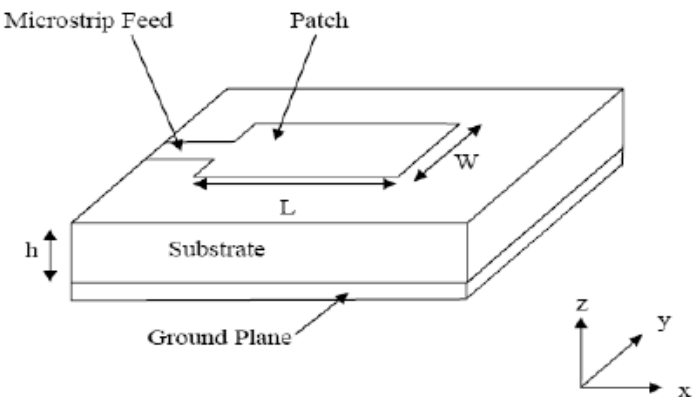

Fig 1: Basic Geometry of Micro strip Patch Antenna

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 50, Issue 1, No. 1, January 2021

III DESIGN OF STAR SHAPED MICROSTRIP PATCH ANTENNA.

An antenna is planned on less cost Rogers RT/duroid 5880 tm substrate took care of 50-ohm micro strip line. an antenna was executed in High frequency structure simulator Software (HFSS). where proposed antenna resonates at 5 distinct bands, that are make possibility for ultra-wideband (UWB) and 5G systems.

The proposed antenna appeared in fig 2, utilizing the essential equations present in the rectangular patch antenna, because of their analysis, simplicity of fabrication and appealing radiation qualities, resonating at 42GHz is planned which is then adjusted by fluctuating their patch mould from three-sided to star shaped.

The total ground length size is degraded it increase the bandwidth of antenna. Finally, here triangular slot was introduced in this patch to remove this match, which results the star shape wideband antenna.

The star shaped antenna having the substrate ROGGERS RT5880tm. Having the copper tape of thickness 0.035mm, the relative permittivity is 2.2 and tangent loss is 0.0009 utilizing High frequency structural simulator (HFSS software). The antenna width is 3mm and length is 4.3mm and the substrate height 0.762mm.

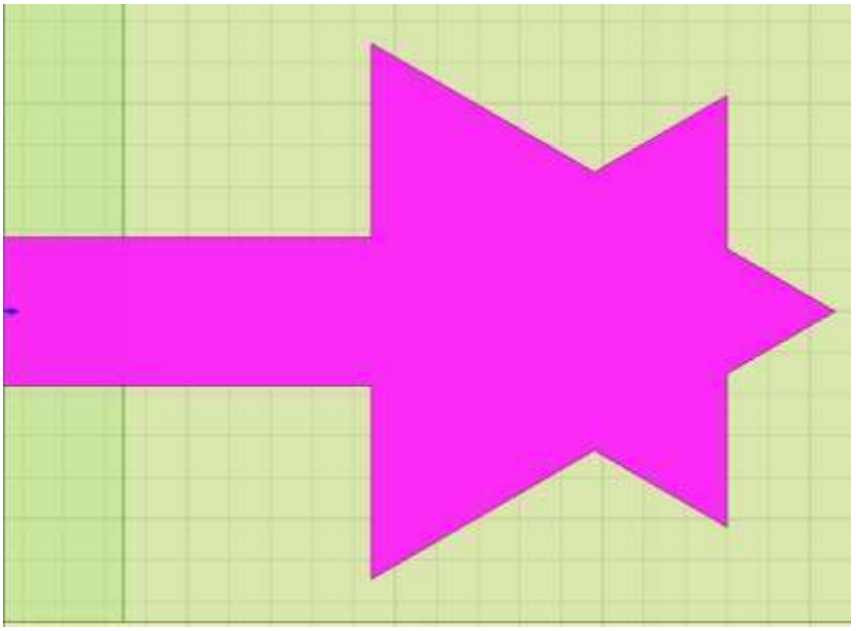

Fig 2: Proposed antenna design

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 50, Issue 1, No. 1, January 2021

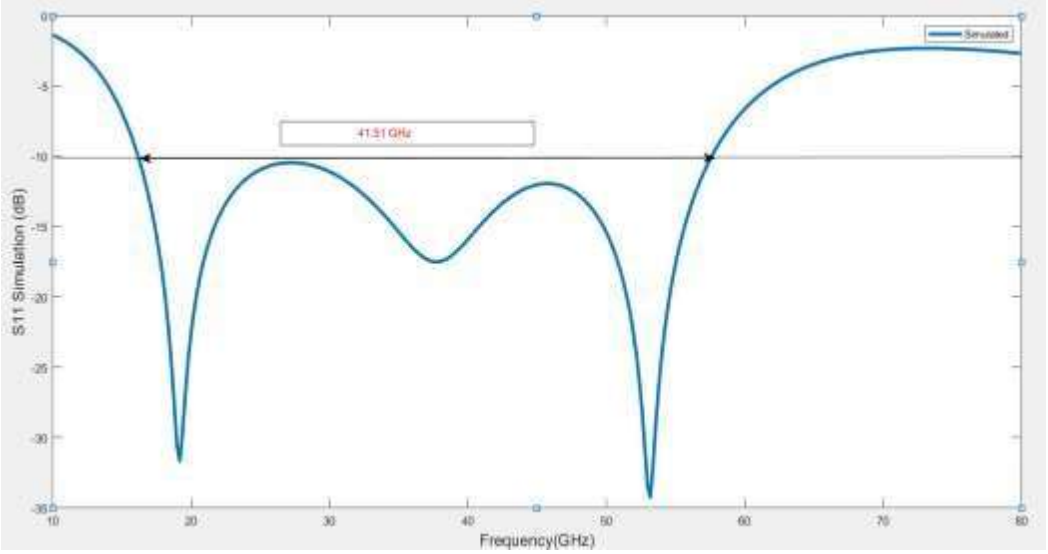

Fig: 3(a) proposed antenna Return Loss and bandwidth

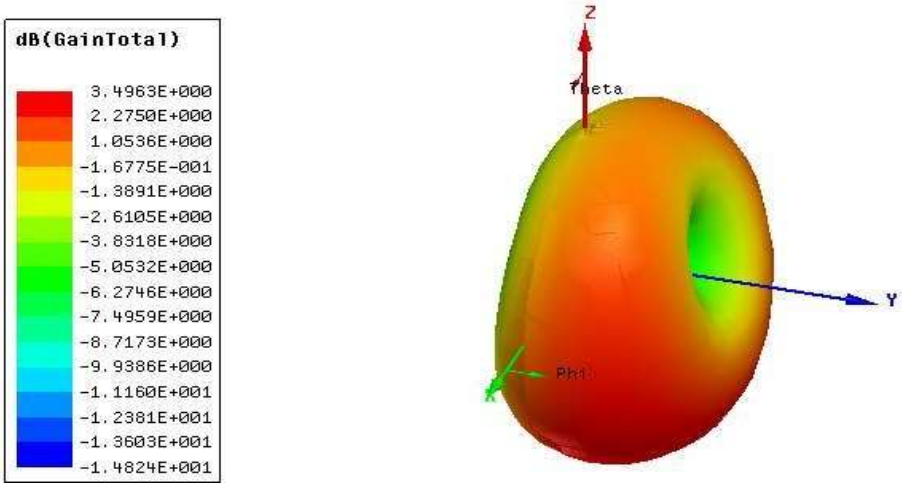

Fig:3(b) Proposed antenna gain

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 50, Issue 1, No. 1, January 2021

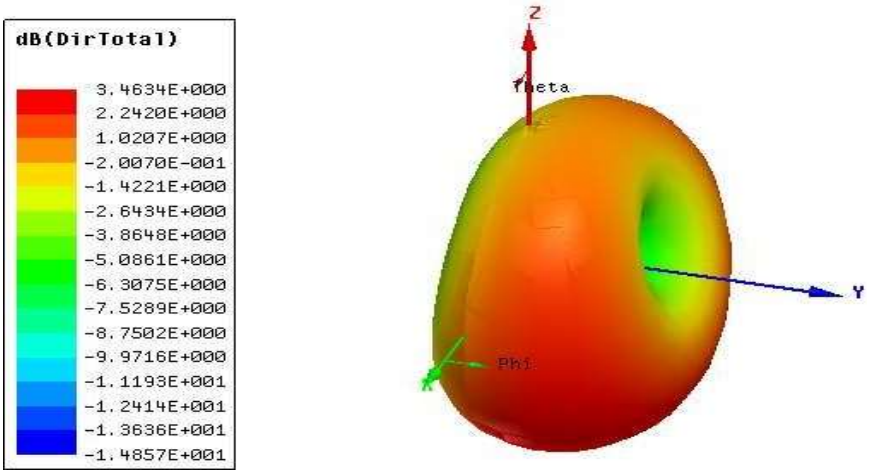

Fig:3(c) proposed antenna directivity

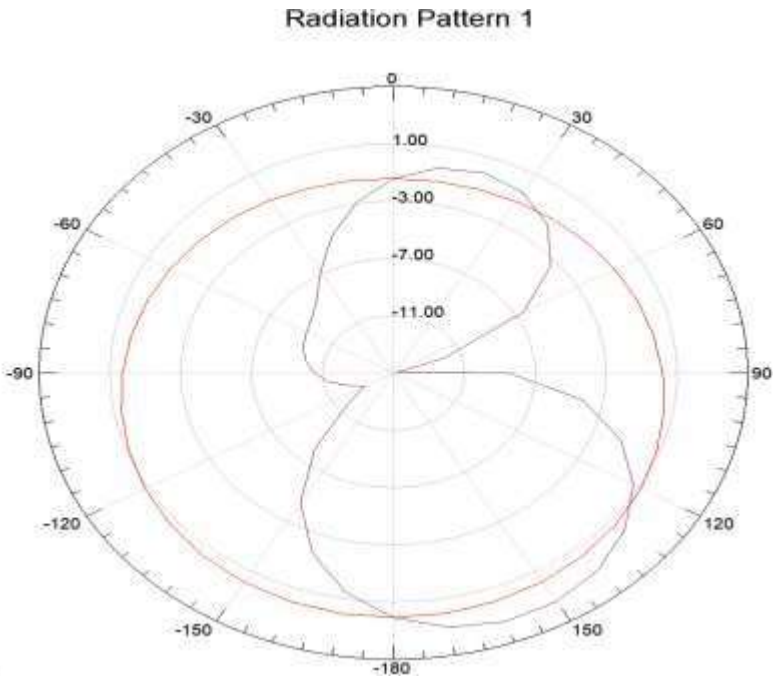

Fig: 3(d) Proposed antenna radiation pattern

.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 50, Issue 1, No. 1, January 2021

IV. RESULTS AND DISCUSSION

The High Frequency Structural Simulation (HFSS software) can be utilized to analyze the proposed antenna results. where return loss graph can be designed antenna at -10 dB bandwidth is shown in figure 3(a) and the Return loss will get as m1 -35.43 and m2 is -29.07. the return loss is very less compared to previous papers. the bandwidthof the proposed antenna, the bandwidth is 41.51 GHZ. Hear the bandwidth is increased.The figure 3(b) shows Gain of proposed antenna, the gain is 3.49dB. The figure 3(c) shows Directivity of proposed antenna, the directivity is 3.46dB. The figure 3(d) show the proposed antenna Radiation pattern, the gain of the Radiation pattern is existing at certain point that point is -1.5290.

In existing antenna having the bandwidth is 30GHz, the proposed antenna showsa wideband impedance bandwidth of 41.51GHz. the resonating frequency is 42GHz.

Table 1 show the correlation of present work with some most recent antennas for wideband applications, the proposed antenna shows wide bandwidth and miniaturized size is looked at [5] and [7] despite the fact that [8] and [1] have a more modest dimension than proposed antenna apparatus.

Table 1: comparison of proposed antenna with recent works

reference	Dimension (mm)	Bandwidth (GHz)
5	2×2×0.78	50.86-82.27
7	12×12×0.8	25.1-37.5
8	12.6×30×0.8	27.9-39.1
1	4×4×0.762	15-45
Proposed antenna	3×4.3×0.762	57.48-16.01

V. CONCLUSION

The Miniaturized slotted star shaped patch antenna for wideband 5G application is present in this letter. In these works, we have developed a new study concerning reducing the size of micro strip patch antenna by utilizing the triangular star shaped antenna resonating at 42GHz. The main goal from this work is to improve the bandwidth and good value of gain anddirectivity. In the Paper, a miniature micro strip patch antenna having slotted star shaped design has been introduced for the betterment of Bandwidth, Gain and Directivity. Here in this paper we have used ROGGERS RT5880tm Substrate and Insert feed technique to improve the antennaperformance. verify the simulated results in HFSS software. Compared the most recent antennasfor wideband applications, where proposed antenna shows better results compared to recent works and it is strong candidate for 5G communication.

REFERENCES

[1] Wahaj Abas Awan, Abir Zaidi, A. Baghdad. “Super Wide band miniaturized patch antenna design for 5G communications.” 2019 IEEE

[2] T.Shanmuganatham and Deepansu Kaushal “Dual Band Microstrip Caution Patch Antenna for Space Applications”, IEEE International Conference on Computer, Communication, and Signal Processing (ICCCSP-2017)

[3] Naqvi AH, Lim S. Review of Recent Phased Arrays for Millimeter-Wave Wireless Communication. Sensors. 2018: 18(10):3194

[4] Zhang, J.; Ge, X. Li, Q.; Guizani, M.; Zgang, Y. 5G Millimeter-Wave Antenna Array: Design and challenges. IEEE Wirel. Commun. 2017,24, 106-112.

[5] W. A. Awan, Halima. A. Zaidi, N. Hussain, S. Khalid and A. Baghdad, “characterization of dual band MIMO antenna for 25GHz and 50GHz applications.”2018 International conference on computing, electronic andelectrical engineering (ICE cube),Quetta, 2018, pp. 1-4.

[6] Chandra Bhan, Ajay Kumar Dwivedi, Brijesh Mishra, Anil Kumar, “Quad Bands U-shaped Slot Loaded Probe Fed Microstrip Patch Antenna”, IEEE, 2015 Second International Conference on Advances in Computing and Communication Engineering.

[7] Jilani, S. F., Alomainy, A., et al.: Millimeter-wave T-shaped MIMO antenna with defected ground structures for 5G cellular networks’,IET microw. Antennas propag., 2018, 12, (5), pp.672-677.

[8] Jilani SF, Abbasi QH, Khan ZU, Loh TOH, Alomainy A, A K Band antenna basedon an enhanced Franklin model for 5G cellular networks. Microw opt technol Lett. 2018:60:1562-1566.

[9] Vinita Mathur, “Comparison of Performance Characteristics of Rectangular, Square and Hexagonal Microstrip Patch Antennas”, IEEE 978-1-4799-6896-1/14/2014.

[10] Praveen Kumar, Palak Tripathi, Saurabh Raj, V.S Tripathi, “ ANN Based Novel Inverted L shape Slotted Patch Antenna For Wide Band Apllications” IEEE, 2019 International Conference on Computing, Power and Communication Technologies (GUCON)

[11] Ranjan Mishra, Raj Gaurav Mishra, Piyush Kuchhal, R.K. Chaurasia “Optimization of the dimension of circular slotted rectangular Microstrip Antenna for wide band wireless applications” IEEE, 2016 International Conference on Recent Advances and Innovations in Engineering (ICRAIE).

[12] Raj Gaurav Mishra, Ranjan Mishra, Piyush Kuchhal, N. Prasanthi Kumari “Design and analysis of CPW-fed microstrip patch antennas for wide band applications” IEEE, 2017 International conference on inventive computing and informatics (ICICI).

[13] R.Bargavi, K. sankar and S.Arivumani Samson, “Compact Triple band H-shaped slotted circular patch Antenna”, International conference on communication and signal processing IEEE,April 3-5, 2014, India.