Design of Meandered Line MIMO Antenna at a Frequency of 3.5 Ghz for 5G Application

G.Naga Jyothi Sree, Suman Nelaturi

Abstract– ***The meandered line structure MIMO formation with a dimension of 40 x 23 mm² demonstrated here. This formation structure maintained the transmission as well as reflection coefficients ≤ -10 dB & -20 dB. In distinction to this formation structure is described by variation distance between the patches is 2 mm to reducing the interference. Meanwhile placing of the patches vertical and horizontal one co inside with each other isolation at the multi-band frequencies identified that a better improvement in isolation. This formation of system developed stable patterns of radiation, gain, diversity gain and group delay. The antenna simulations are taken by using computer simulation technology (CST).***

Keywords: ECC, group delay, meandered line MIMO , radiation efficiency

I. INTRODUCTION

In the current wireless systems there is a contemporary issue in the intention of MIMO communication part for the increasing of antenna parameters. In the present all the fields of wireless systems in distinction to growth of technology in ITS and, navy systems, satellite band of contempory systems requires larger data rates. A UWB MIMO aerial with band-notched parameters is listed in [1]. The offset microstrip-fed slits functional to feed effective antenna beside wider-band impedance matching. A simple decoupling structure is used to improve Port isolation. Further , low mutual coupling about greater than -15 dB along with the low envelope correlation coefficient which is below 0.02. With the characteristics mentioned above including a compressed size used promising candidate being MIMO/diversity systems. In [2] a closely-packed type diversity slot antennas resonating in the UWB proposed. Reduced mutual coupling (S21 < −20 dB) resolved by considered improvement about the directional radiation exclusively about slot antenna with quarter-wavelength slot resonator. Meanwhile, the diversity characteristics about diversity gain (DG), correlation coefficient and mean effective gains (MEGs) studied, which explained that current diversity antenna used for short range UWB communication. A compact [3] two element MIMO radiator along improved isolation abide physically realized. In the improved MIMO system, the mutual coupling analyzed with including without patch element middle of the antennas. In this MIMO antenna array [4]obtained at 6.8 GHz among an impedance bandwidth like 25% distributed the frequency range from 6.10 GHz–7.80 GHz with a decreased mutual coupling of −33 dB at the desired resonated at frequency.

Manuscript published on 30 December 2019.
***** Correspondence Author (s)
G.Naga Jyothi Sree, Research scholar, ECE department VFSTR,vadlamudi Guntur, A.P, India nagajyo53@gmail.com
Dr. Suman Nelaturi ,Asst.professor , ECE department VFSTR,vadlamudi Guntur, A.P, India **nelaturi.suman4@gmail.com**

In [5] a compact dimension of 48 x 48 mm² operated in the range 5.1 – 5.8 GHz frequency range band- notched properties for slotted UWB diversity aerial isolation les than – 20 dB obtained a peak gain of 2.5 dBi. A printed MIMO radiator with [6] a size of 32 mm x 32 mm operated in the range 3.1 GHz- 10.6 GHz whose isolation obtained as ≤ abide – 20 dB. A single layered structure [7] differential CPW antenna a compact area occupied 30 mm x 35 mm x 0.8 mm resonated in the frequency range of 5.2 GHz – 6.0 GHz whose coupling maintained -20 dB along with peak gain about 1.3 dBi for tapered UWB antenna. In [8] a compact analysis for portable device application considered a 26 mm x 40 mm ranged from frequency about 2.1 GHz – 10.6 GHz obtained peak gain around 2.9 dBi. A compact MIMO antenna hexagonal monopole antenna [9] represented a dimension of 45 x 25 mm² ranged from 3.0 - 12.0 GHz maintained isolation -15 dB including the peak gain about 3.5 dBi. A compact two [10] element MIMO aerial among compact area of 55 mm x 20 mm x 1.6 mm resonated with a range from 4.6- 6.1 GHz produced better antenna parameters including the peak gain about 4.0 dBi for wireless applications. The advantage of the proposed design produced characteristics about 3.5 GHz for the 5G applications.

II. ANTENNA CONSTRUCTION & ITS GEOMETRY

The current design a compact size about 40 x 23 mm² occupied area using FR4 substrate with a height of 1.6 mm. A rectangular slits are cutting in a patch to improving the better antenna parameters like radiation efficiency, reflection coefficient and peal gain of the design. In distinction to reduce the mutual coupling between the patches the structure of the same element embedded in to a vertical arrangement to the substrate identified that better improvement in the proposed designed structure. Fig. 1 describes the meandering line formation of MIMO structure whose patch length along with width are 40.0 mm and 23.0 mm occupied in a FR4 substrate maintained a loss tangent 0.002. First considered a rectangular slot and then cut end of the patches are rectangular slots and middle of the patch taken square slot. In this approach we designed a single monopole aerial and placing the identical at a spacing out about 2.0 mm arranged in vertical direction directed toward right side of the substrate. In distinction to this arrangement process by varying various approaches of distances obtained at a particular value d = 2.0 mm obtained the better mutual coupling.

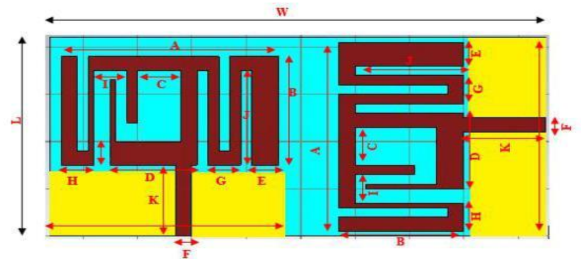


Fig. 1: Design formation MIMO structure

III. RESULTS ANALYSIS &DISCUSSION

Fig.1 represents the dissimilarity of the meander line design comparison about S-parameters which is resonated at a frequency of 3.5 GHz obtained reflection coefficient is -28.5 Db. This result obtained from effective designing meander lines in a patch with values of 2.0 mm, 2.5 mm and 3.5 mm. At this frequency obtained effective reflection with wider bandwidth ranging 3.40 GHz- 3.60 GHz generated 200 MHz. In arranging this type of MIMO structure there should be a great decrease in the mutual coupling nearly -25.0 dB. Here, we observed that throughout the range of frequencies from 3.4 GHz to 3. 55 GHz constant isolation. Fig.2 indicates the VSWR representation throughout the frequency 3.40-3.70 GHz maintained a VSWR ≤ 2. This designed structure holds that incident as well as reflected waves produced from transmitter part to receiver part maintained better standing wave ratio. Fig. 3 reflects the signal of group delay at operating frequency of 3.50 GHz obtained -7.34 ± 1 nsec which identifies that how much of time is delays travelling from port $ 1 to port $ 2 of the corresponding design structure. This criterion identified that throughout the operating band side frequencies generating for different delay times of the aerial analysis systems maintain the delay representation values ≤ ±1nsec.

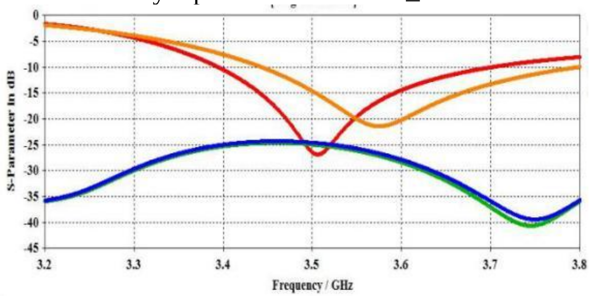


Fig.1 Comparison of S-Parameters

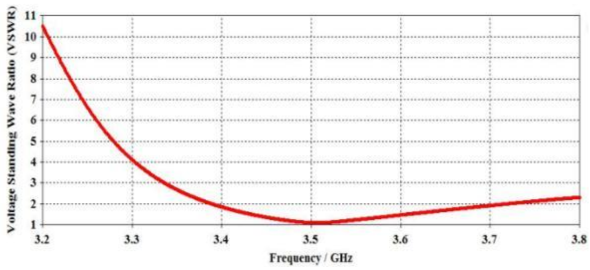


Fig. 2 VSWR of the meander line MIMO design

Table 1: Design parameters of the structure

Param eters	W	L	A	B	C	D	E	F	G	H	I	J	K
Value (mm)	40	23	18	13	8	10	2	3	4	4	3	20	10

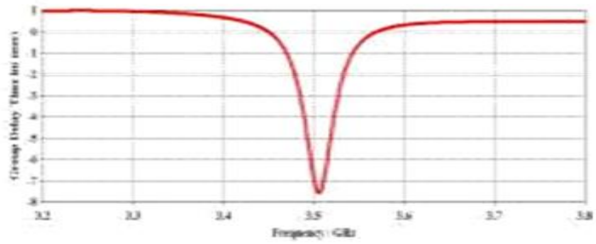


Fig. 3 Group Delay of the system

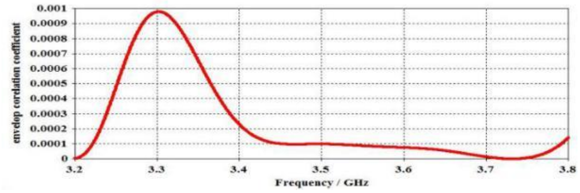


Fig. 4 ECC of the system

Fig. 4 identifies that envelope correlation coefficient at the operated region about 3.5 GHz its value is less than 0.2 for any MIMO design analysis is a great contribution of the analyzed system. This will be evaluated either using far-field pattern or S-parameter pattern. Here we measured with S-parameter pattern. Using this evaluation system another major factor remain a diversity gain is evaluated with the help of ECC. At the resonant band occupies place its value approximately 9.9995 dBi. The peak gain of the that particular design approximately equal to 3.72 dBi at the resonant band of frequency of 3.5 GHz which better to compared the literature review systems which is noted in Fig. 6. The aerial operated at resonant frequencies radiation pattern of that systems have co as well as cross polarization which is implemented in Fig. 7. It shows that the co-pol always greater than the cross-polarization which produces around -44.5 dB. Fig. 8 shows its radiation efficiencies which is equal to 88.89% at the resonant band of frequency.

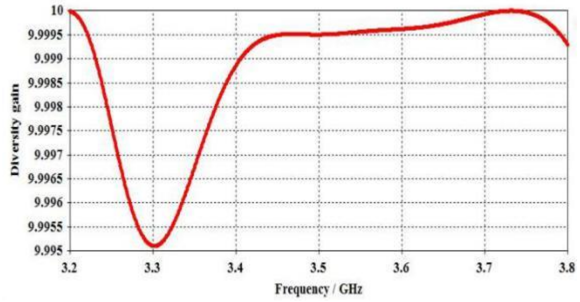


Fig. 5 Diversity of the system

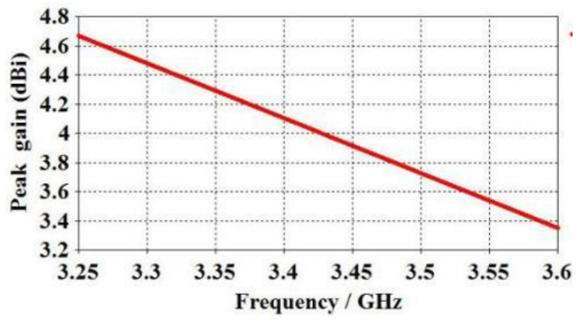
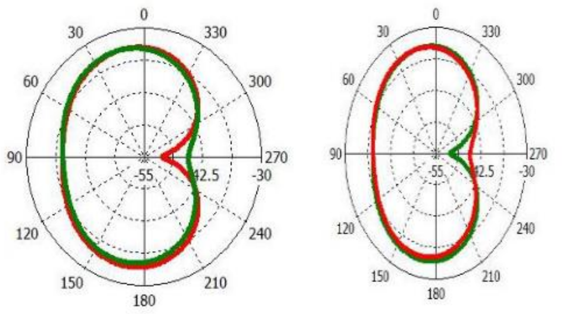


Fig. 6 Peak gain of the system

Retrieval Number: A10041291S52019/2019©BEIESP
DOI:10.35940/ijeat.A1004.1291S519
Journal Website: www.ijeat.org

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)



(a) 3.5 GHz
Fig. 7 Radiation Patterns

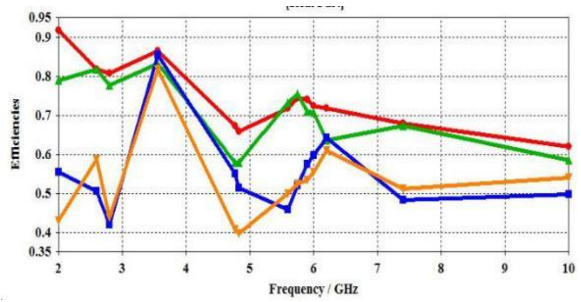


Fig.8 efficiency

IV. CONCLUSION

The study of a two element MIMO formation is presented in this paper. In order directed toward integrate MIMO type technology, another similar radiator element is embedded vertically considering minimum amount insertion loss. The alternative radiator is inserted in various desirable orientations together with less insertion loss remain identified at afar distance of 2.0 mm. The MIMO radiator system has ECC value≤ 0.0001 over the single band operations including an average peak gain more than
3.72 dBi. Diversity gain of the current designed structure is around more than 9.9995 dBi over the operating systems suitable for 5G applications.

REFERENCES

1. L. Kang, H. Li, X. Wang and X. Shi, Compact offset microstrip-fed MIMO antenna for band-notched UWB applications, IEEE Antennas Wireless Propagat. Lett. 14 (2015) 1754.
2. C.-X. Mao, Q.-X. Chu, Y.-T. Wu, and Y.-H. Qian, “Design and investigation of closely-packed diversity UWB slot-antenna with high isolation,” Progress in Electromagnetics Research C, vol. 41, pp. 13–25, 2013.
3. K.J. Babu, R.W. Aldhaheri, M.Y. Talha and I.S. Alruhaili, Design of a compact two element MIMO antenna system with improved isolation, Progr. Electromag. Res. Lett. 48 (2014) 27.
4. S. S. Jehangir and M. S. Sharawi, “A miniaturized uwb biplanar yagi-like mimo antenna system,” IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 2320–2323, 2017.
5. P. Gao, S. He, X. Wei, Z. Xu, N. Wang and Y. Zheng, Compact printed UWB diversity slot antenna with 5.5 GHz band-notched characteristics, IEEE Antennas Wireless Propagat. Lett. 13 (2014) 376.
6. J. Ren, W. Hu, Y. Yin, and R. Fan, “Compact printed MIMO antenna for UWBapplications,” IEEE Antennas and Wireless Propagation Letters, vol. 13, pp. 1517–1520, 2014.
7. Z.-H. Tu, W.-A. Li and Q.-X. Chu, Single-layer differential CPW-fed notch-band tapered-slot UWB antenna, IEEE Antennas Wireless Propagat. Lett. 13 (2014) 1296.
8. L. Liu, S. W. Cheung, and T. I. Yuk, “Compact MIMO antenna for portable devices in UWB applications,” IEEE Transactions on Antennas and Propagation, vol. 61, no. 8, pp. 4257–4264, 2013
9. R. Mathur and S. Dwari, “Compact CPW-Fed ultrawideband MIMO antenna using hexagonal ring monopole antenna elements,” AEU - International Journal of Electronics and Commu- ¨ nications, vol. 93, pp. 1–6, 2018
10. Aw, M. S., K. Ashwath, and T. Ali. "A compact two element MIMO antenna with improved isolationfor wireless applications." Journal of Instrumentation 14.06 (2019): P06014