Journal of Information Systems Engineering and Management
2025, 10(10s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

A Comparative Assessment for Examining the Performance of Reconfigurable Multiband MIMO Antennas for Communication Systems

[1*]S. N. V. J. Devi Kosuru, [2]Dr.R.Praveen kumar, [3]Dr. Ravi Kumar, [4]Dr.S.Gokulakrishnan, Dr.Abhisek Sethy[5], Dr. Velagapudi Sreenivas[6]

[1]Assistant Professor, Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India*
jyotsnakosuru@gmail.com
[2]Associate Professor, Department of Electronics and Communication Emgineering, Easwari Engineering College, Chennai, Tamilnadu, India
rpjcspraveen@gmail.com
[3]Associate Professor, Department of Electronics and Communication Emgineering, Jaypee University of Engineering and Technology, A.B.Road, Raghogarh, Guna,
Mathya Pradesh, India.
ravi.kumar6@gmail.com
[4]Assistant Professor, Department of Computer Science and Engineering, Dayananda Sagar University Bengaluru India.
s.gokulakrishnaan@gmail.com
[5]Department of Computer Science and Engineering , Sikha O Anusandhan (SoA) deemed to be University Odisha,INDIA
abhiseksethy@soa.ac.in
Professor
[6]Department of Computer Science and Engineering , SRK Institute of Technology, Vijaywada-A.P, India
velagapudisreenivas@gmail.com

ARTICLE INFO

Received: 14 Nov 2024

Revised: 26 Dec 2024

Accepted: 10 Jan 2025

ABSTRACT

This overview discusses various MIMO Antennas used in wireless communications. MIMO Antennas play an important role in day-to-day communications in the current age scenario. Many research activities in the field of MIMO antennas have already been proposed within the last decade. The reconfigurability of reconfigurable antennas is used to meet the ever-changing scenarios and operating requirements. Reconfigurability in terms of polarization is critical in MIMO systems because they require multiple inputs to reduce fading. In this survey, we explain distinct MIMO Antennas and about their parameters. This research article will also cover the various MIMO antennas with specifically artificial components and their influence on reducing The majority of MIMO antennas suffer from the unfortunate results of Mutual Coupling (MC), low radiation gain, and insufficient information taking care of limit because of restricted range. We will examine mutual coupling and cross polarisation between antenna parts as well as address surface currents. ECC and MIMo antenna competence are also important in dissecting the presentation of an antenna.

Keywords: Error Correcting Codes, Effectiveness, SCA, impedance match, Coupling matrix, Reconfigurable antenna

I. INTRODUCTION

Communications systems requiring high data transmission rates of up to 1Gb/s have attracted a lot of innovators. The MIMO-UWB applications that integrate both UWB and MIMO technology that reach goal. Frequency band with high working allotment of (3.1)-(10.7) GHz, it utilized to have a high information data transfer rate. It remarks the ability to deal with multiple fading along these lines, which fuses UWB and MIMO advancements, and then multiple path issues successfully addressed while likewise expanding the channel's capacity, frameworks, and radio wire. Its qualities straightforwardly affect the productivity of UWB-MIMO frameworks. Subsequently, the radio wire plan for a UWB-MIMO framework has gotten wide contemplations and examinations from a local area of analysts [2–7].

The essential target of this exploration article is to foster a radio wire component for a MIMO framework. Various answers for significant concerns like helpless increase, low data transfer capacity and shared coupling were additionally investigated. This conversation gives a short outline of different procedures to work on the presentation of the MIMO radio wire framework to further develop information transmission inside the restricted range accessible, strategies to decrease the coupling between the MIMO receiving wire components, and MIMO receiving wires with low radiation gain.

II. LITERATURE SURVEY

S. Rajkumar presented a MIMO receiving wire with four parts coordinated in a 2*2 lattice form that possesses UWB properties in [1], as illustrated. In Fig.1

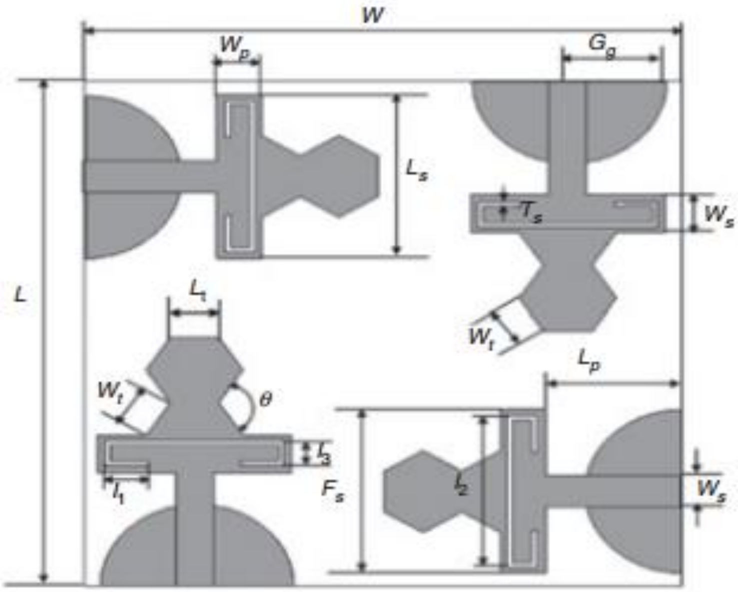


Fig.1 Geometrical Antenna

A crossbreed made out of a hexagon, a trapezoid, and an opened square shape. These three are associated in series and took care of through a microstrip line. Every one of the four pieces is symmetrically arranged to one another, subsequent in incredible segregation, for need of an extra decoupling structure is killed. Space with rectangular part helps in improvement of a band score trademark in the receiving wire. The receiving wire is 40 1.6 mm3 in size and transmits consistent omni directional radiation. It displays a sensible impedance move speed in the (2.4)–(10.6) GHz range and loss when return under 20 dB as shown in figure 2. Radio wire was extraordinary decision of the MIMO receiving wires.

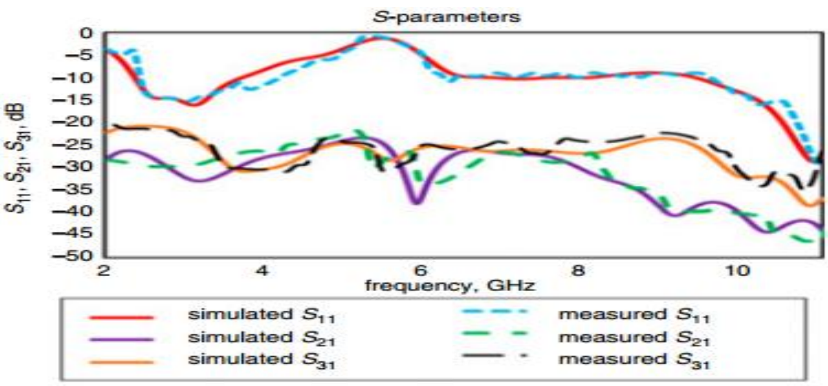


Fig.2 S-parameter

Ahmed S. Eltrass presents a UWB MIMO radio wire with bi score groups and solid segregation in [2]. The double indent groups are intended for the dismissal of recurrence groups utilized for remote applications that exist in the UWB recurrence range. The radio wire has a great separation of >20 dB on a 73 0.79 mm3 recieving wire. This undeniable degree of seclusion is accomplished without the need of the extra decoupling structure showed in fig.3.

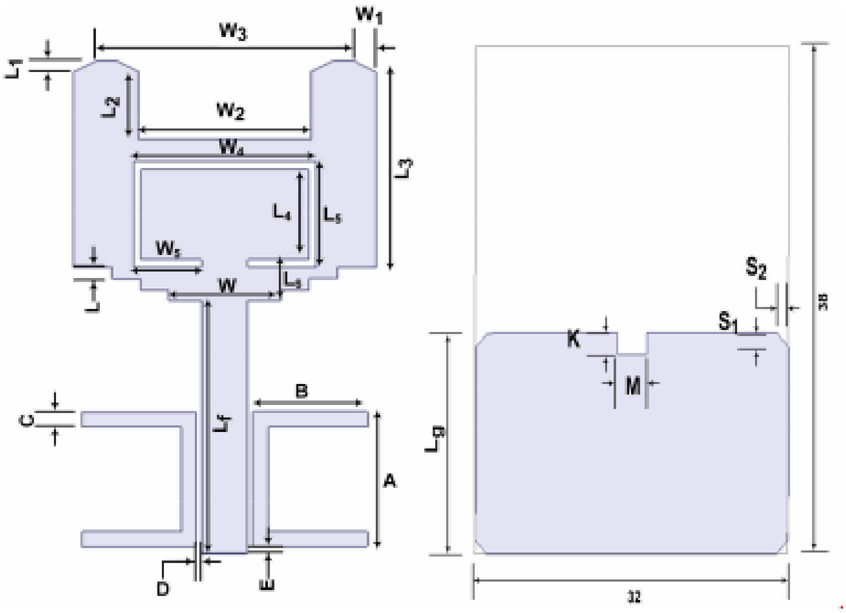


Fig. 3 Geometry of the antenna

A couple of parasitic components were embedded on one or the other side of the micro strip line to make the indent groups at (3.3 – 3.8)GHz and (5.1–5.8) GHz, the rectangular fix is stacked between two stub edges of wandered square shapes at two corners. The receiving wire utilizes the ambutatatory fix of rectangle stops the rectangular space in center to accomplish UWB. The ground plane is just somewhat complete, with a space in the upper community, and it is definitively a similar length as the feed line. The receiving wire additionally has solid MIMO properties, for example, low Error correcting codes upsides of 0.0015 in an extremely down misfortune the channel limit, is outlined in fig.4.

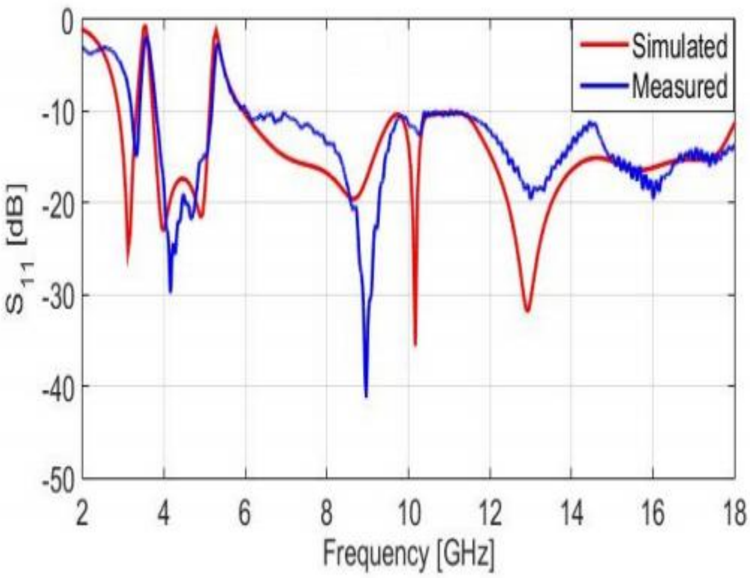
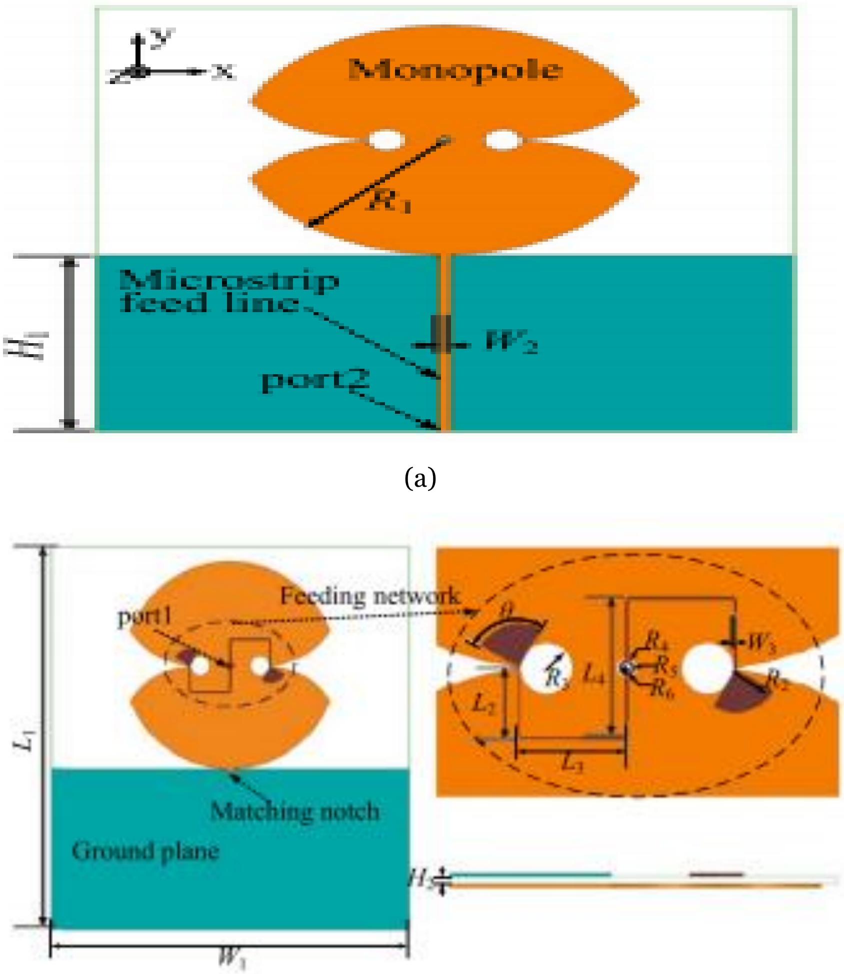


Fig. 4 Reflection coefficients

Li Nie presents a monopole MIMO radio wire with great disconnection for UWB applications in [3]. In inverse groups of a two-component receiving wire, twin tapped openings are ended with a circle in the fix. A feed structure, which capacities as a force divider, is exactly situated at the lower part of the best cuts. The feed structure comprises a rectangular strip line terminated with baluns at the two finishes. These tightened openings and feed structure symmetrically make roundabout modes, coming about in circularly energized and helping with the foundation of seclusion. The base plane have halfway with one cut in the upper community that is the very same length as like feed line delineated in fig. 5, 6.

Zhenya Li presents a Vivaldi MIMO receiving wire with great disconnection and two indent groups for UWB applications in [4]. As shown in fig.7, a two-component radio wire is worked with twin tightened spaces in the fix on rival sides and a T-molded opening in the middle of the two tightened openings.



(a)

(b)

Fig. 5 (a) Anterior view (b) Posterior and side views

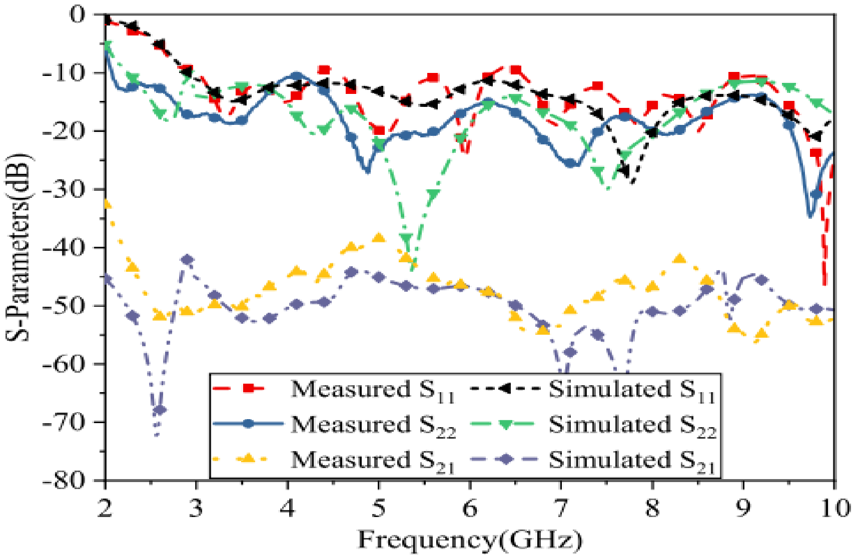


Fig. 6 S-parameters Vs Frequency

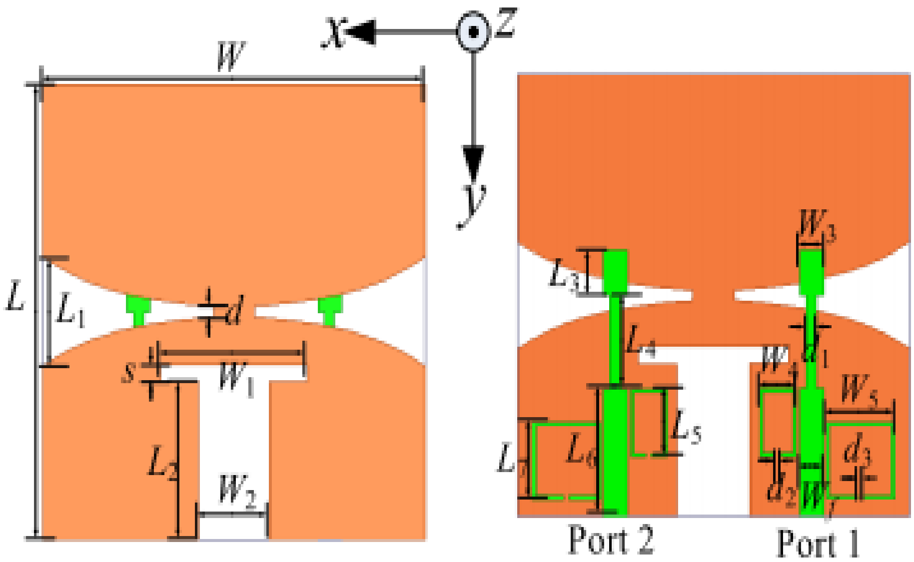


Fig. 7 (a) Topmost view.(b) Ground view.

A feed structure is a hybrid structure with rectangle like segments with different impedances, is put precisely at the lower part of the tightening cuts. SRR gadgets are utilized to change the radio wire's score groups. These tightened spaces and feed structures symmetrically make round modes, coming about in circularly energized and supporting the foundation of separation. The ground plane is just somewhat complete, with a space in the upper place, and it is exactly a similar length to feed line. The two groups were made at frequency range of (5.3-5.8) GHz and (7.85-8.55) GHz, separately. As displayed in fig.8, the receiving wire likewise has solid MIMO elements, for example, low Error corcting codes esteems and an extremely low misfortune in channel limit.

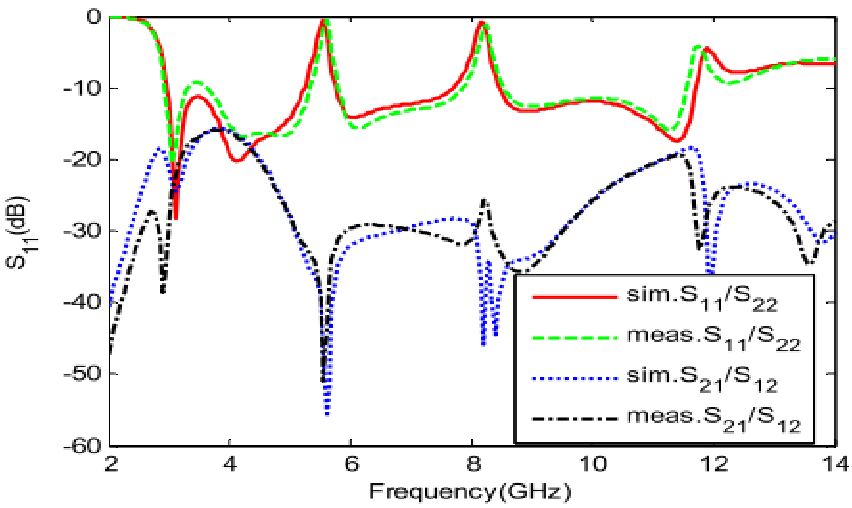


Fig. 8 S_{11} Vs Frequency

Zhijun Tang gave a Multi Input Multi Output radio wire 4 parts coordinated in a 2*2 lattice design with UWB qualities with indent groups in [5]. The radio wire is little and conservative, yet it performs well as far as transfer speed and score groups. The fix is a fundamental square shape with a microstrip line going through it. Every one of the four parts is symmetrically lined up with one another to give the greatest detachment. The prerequisite for an extra decoupling structure is wiped out by making an opening looking like a step case that stretches out from the MIMO center to the furthest limit of the receiving wire parts. The DGS structure in the radio wire component leads in band scores, as found in given in fig. 9 and 10.

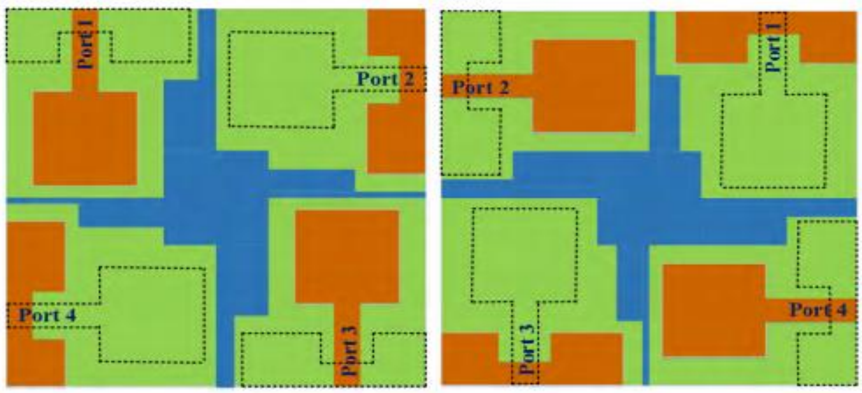


Fig. 9 (a) Topmost view. (b) Backword view.

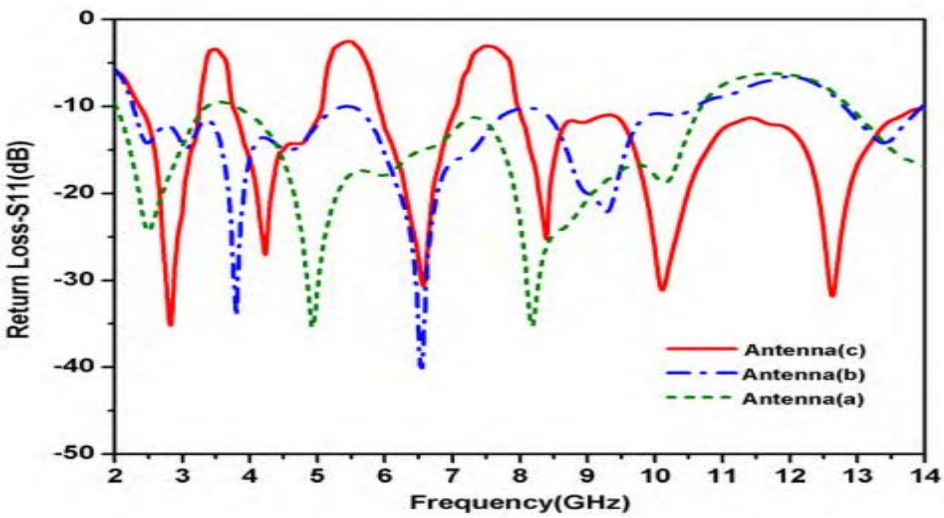


Fig. 10 Return loss

Syed S. Jehangir [6] presents a three-component yagi radio wire. The radio wire's excellence has the capacity to create various types of radiation designs in many ways. It can be refined by animating a few receiving wire parts in the MIMO radio wire. Utilizing the exchanging approach showed in fig.12, we can likewise tune different radio wire boundaries additionally including gain and FBR. The radiator is a circle enclosed by three chiefs pointing in three unique ways, as found in picture 11. These chiefs are significant for boosting the radio wire's benefit. A strip feed is utilized to control the radiator, and then the rectangular end is join the circle for impedance coordinating. The 3 radio wire parts are situated similarly and are coated with1200 degrees separated. The earth is simply somewhat framed and is formed like a minuscule circle. The radiator is animated through taking care of using, and some shorting vias were used in the receiving wire for transfer speed improvement. These shorting vias are introduced in the stub that associates with the radiator.

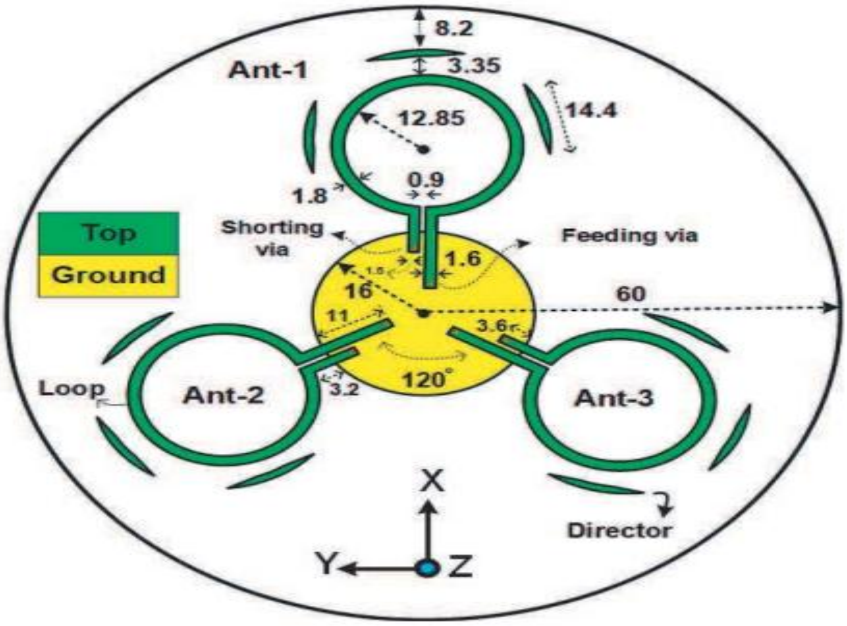


Fig. 11 MIMO antenna

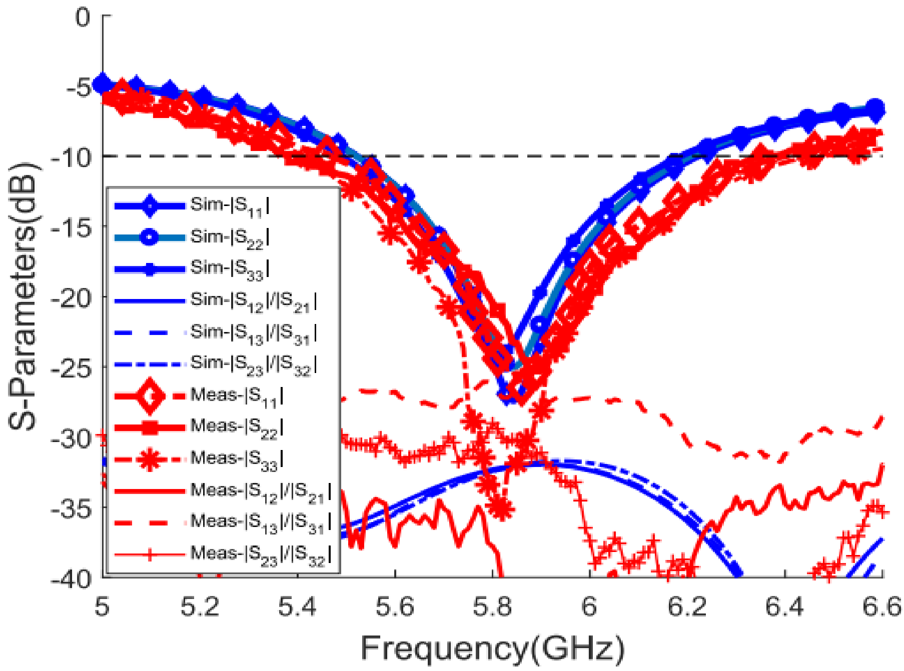


Fig. 12 S-parameter

Libin Sun proposes in [7] a MIMO antenna with a changeable emission pattern and polarizing properties. As illustrated in fig.13, the antenna is suplied by a complicated feeding mechanism, it is critical for signal phase fluctuation and radiator is a simple rectangle that is loaded in all four directions by fork-shaped stubs. Patch cables connect the feed structure to the radiator complex feed is used largely for the generation of half-power signals ,are that are required for developmental changes of radiation patterns. These patterns have opposed properties and may thus be utilized to increase the channel capacity of the antennas depicted in fig14.

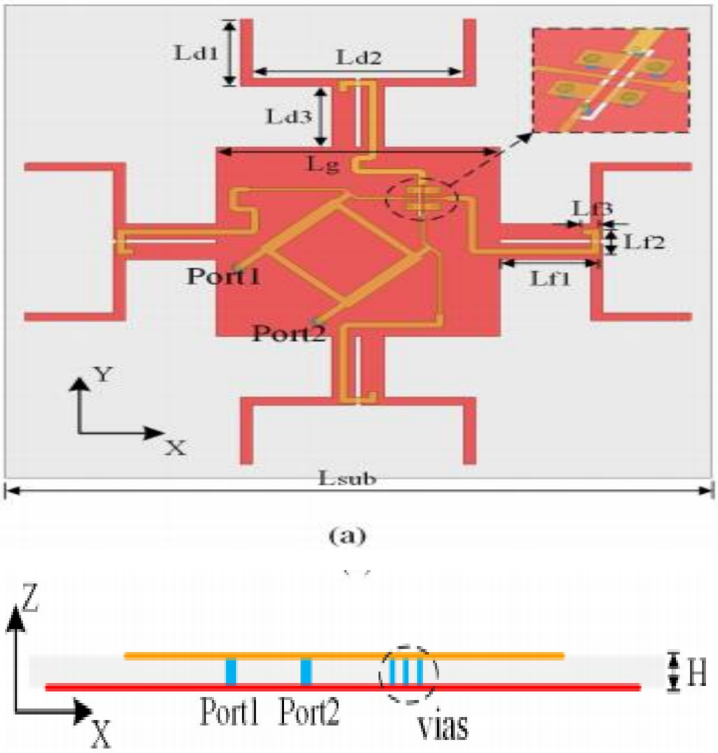


Fig. 13 Antenna structure (a) Top view. (b) Side view

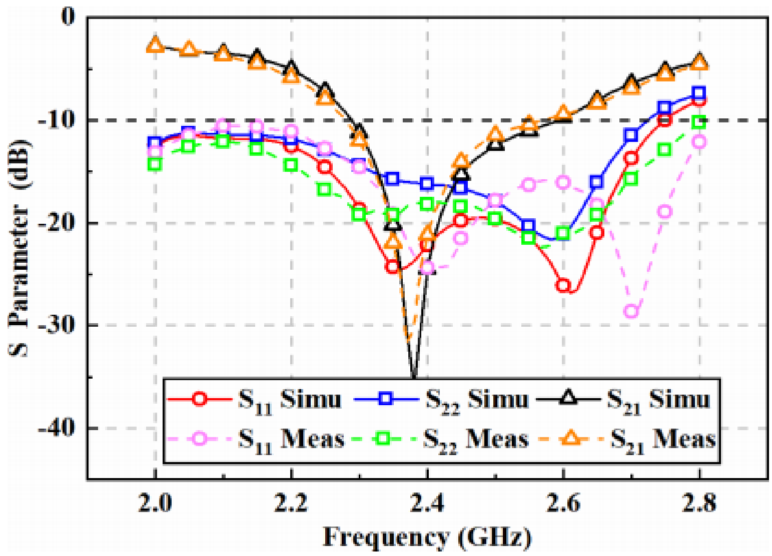


Fig. 14 S-parameters

In [8,] Anping Zhao introduced a Multi Input Multi Output receiving wire for fifth generation portable interchanges. The receiving wire structure is developed so that the radio wire component goes about as a detachment component with practically no requirement for additional decoupling structure. The receiving wire is a rectangular circle with two stubs appended to it. As delineated in fig.15, an extra T-formed component is put inside the rectangular circle. As found in figure 16, the mixed level is exceptionally decreases and is about (– 20) dB. Working recurrence of (3.5)GHz. The radio wire was connected to the base plane at 2 spots, and the feed is shipped off a t-formed component.

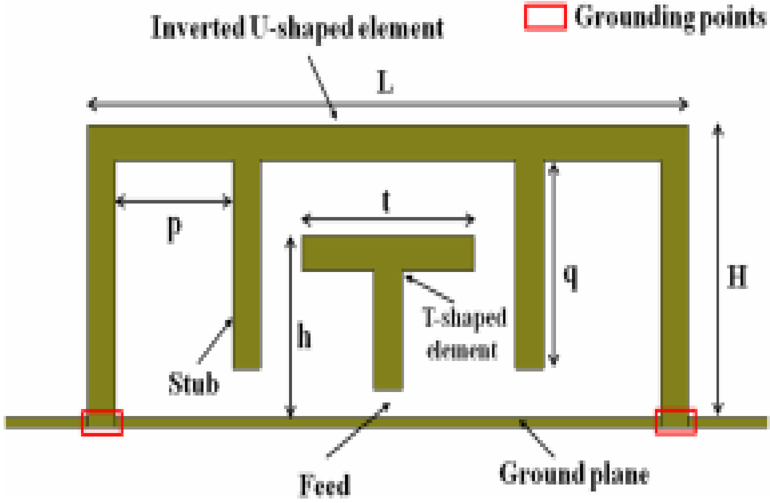


Fig. 15 Antenna element.

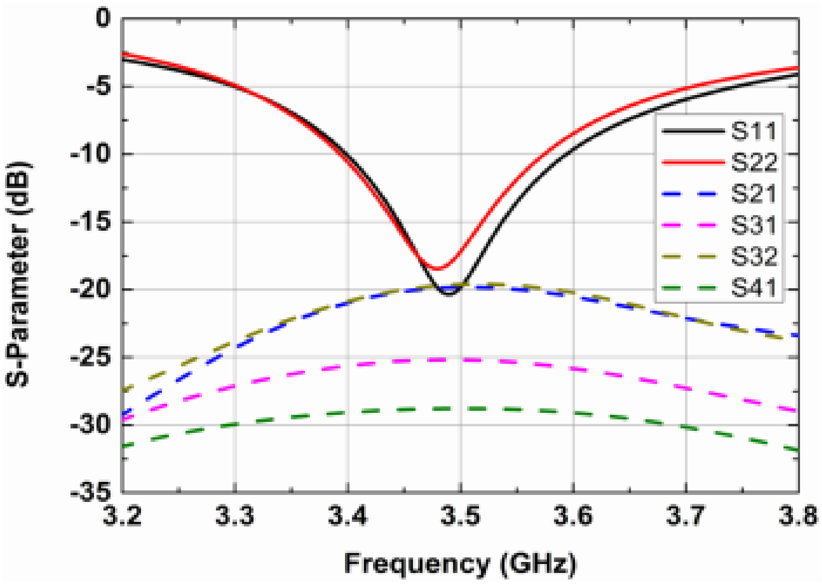


Fig. 16 S-parameter

Bing-Jian Niu gives a MIMO radio wire self-detachment in [9]. To accomplish disconnection, a profound space is cut in the fix that isolates the two emanating ports. The creators utilized the SIW technique to make a little receiving wire for this situation. Notwithstanding the decoupling opening, the creators included two extra spaces on each side of the decoupling opening the foster the flow and store the energy made by SIW's depression. The total impact has been delivered in an exceptionally conservative radio wire with high seclusion, as found in Figure 18.

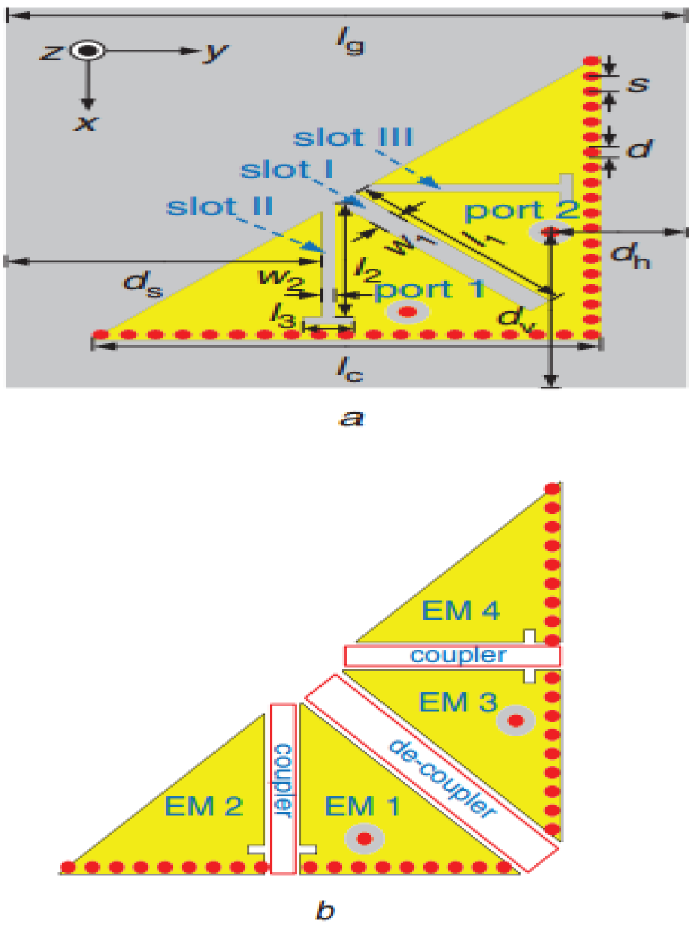


Fig. 17 SIW cavity antenna

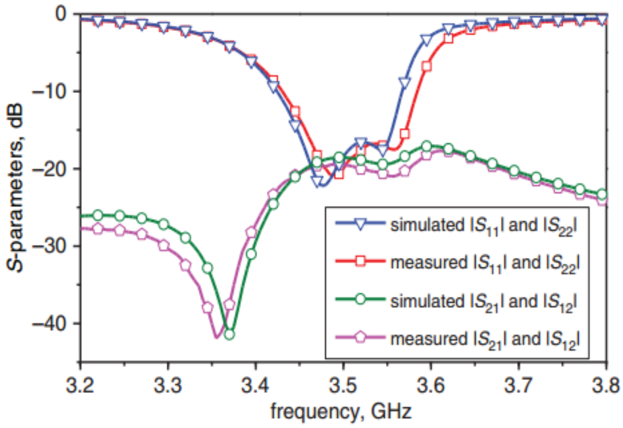


Fig. 18 S-parameters

T Sreenath Reddy presents in [10] a 4-poll Multi input Multi output antenna with reconfigurable isolation and frequency of operation characteristics. Frequency Pin diodes in the patch and isolation should be used to achieve reconfigurability. Pin diodes in the defective base structure shown in fig.19 can be used to achieve reconfigurability. The entire structure is encapsulated within a (38*38) mm2 space. The main disadvantage of this design is its low radiation efficiency and gain values. This is primarily due to the proposed antenna structure. Despite the modest gain, the antenna's emission pattern at both frequency bands is quite good.

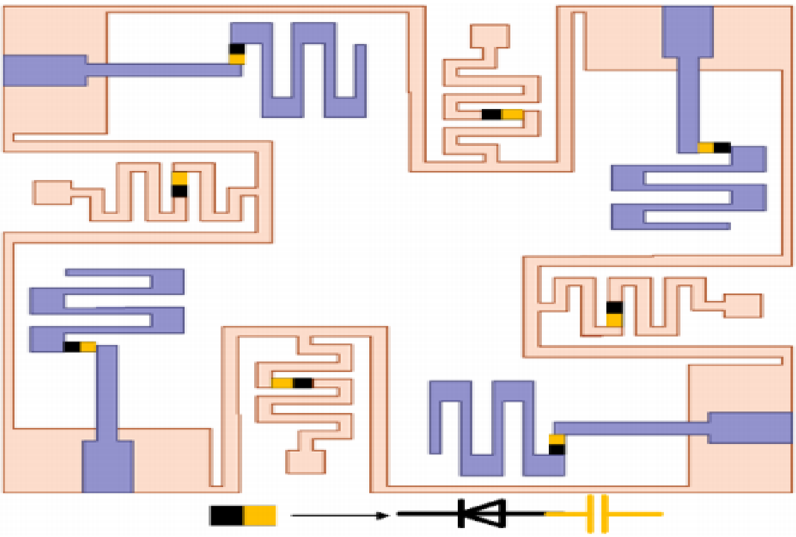


Fig. 19 Antenna of Reconfigurable MIMO

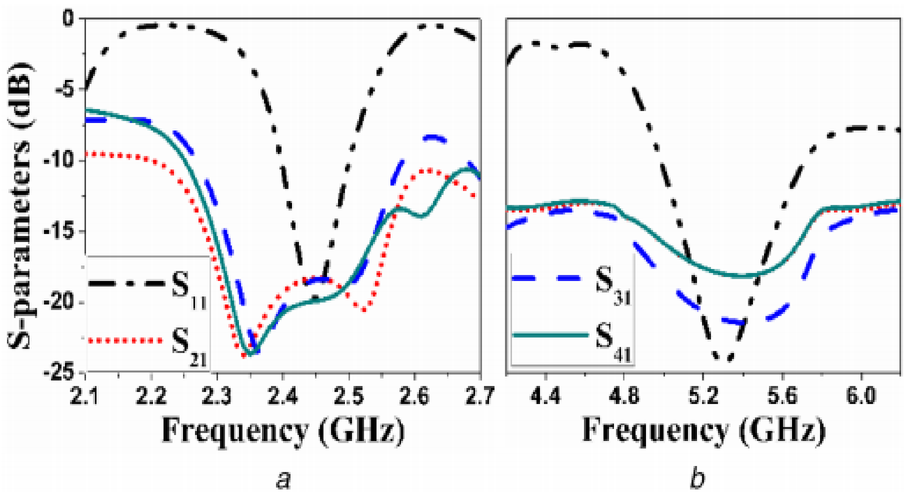


Fig. 20 S-edges (a) PIN diode is ON, (b) PIN diode is OFF

T Kavitha and S Shiyamala propose shorten microchip patch antenna for distant applications which is loaded with Dual U Slot in [11]. In Loaded dual U slot, shorten Microchip Patch Antenna referrers above anticipated far-off applications. A reverberation recurrence is found to be 2.5GHZ. The data transfer capacity accomplished by the receiving wire for the lower and higher full frequencies is 19.2 percent. Over the got recurrence band, the receiving wire has an OK addition of 2.1dB to 5.7dB.

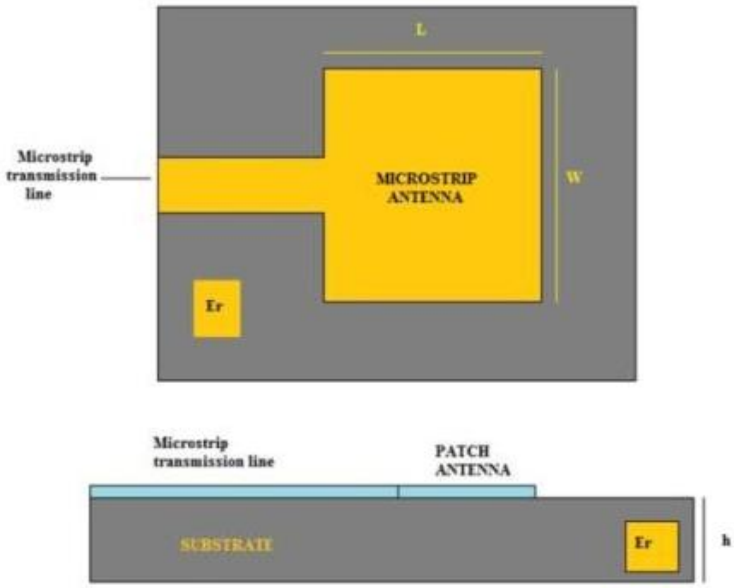


Fig. 21 Geometry Microstripp atchantenna

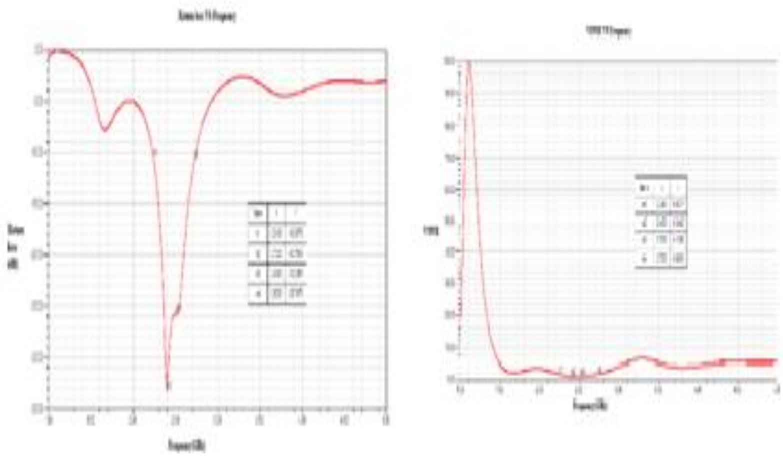


Fig. 22 Simulated return loss Vs frequency

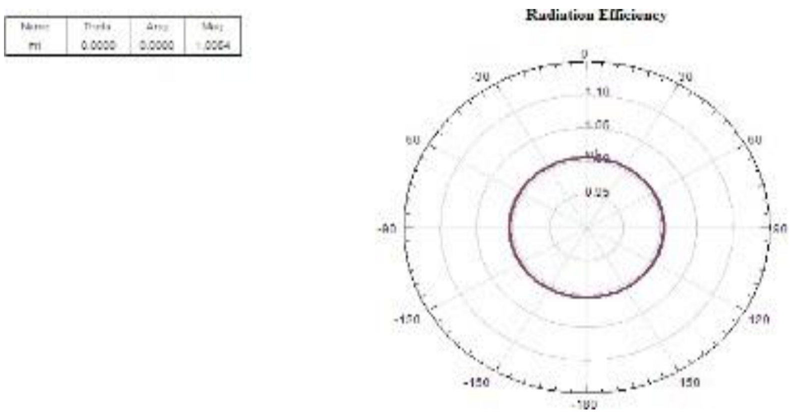


Fig.23: Reproduced radiation effectiveness of the proposed radio wire at 2.5 GHz

IV. CONCLUSION

In this review paper, distinctive MIMO Antenna plans are inspected, and an assortment of approaches presented by the creators is analyzed. In this review article, we track down that shared coupling is a significant issue in various MIMO radio wires. In addition, the majority of the designed antennas have a low gain issue. All of these issues in this communication domain can be addressed in the future by designing an effective MIMO antenna. In the future, attempt to build a more powerful radio wire that can beat as far as Mutual Coupling (MC), gain, return misfortune, and transmission capacity.This author relates MIMO of eight-port which interlace and MIMO of four-port which goes underlie in CR radio wire framework for 5G communications at 6 GHz. An multi functional channel, which can give all-pass filter, customizable bandpass filter, and tunable band reject filter reactions, in initial phase in the planning cycle. A four-port wideband receiving wire is likewise being created and joined with the multifunctional channel.

Compliance with Ethical Standards

Conflict of interest

The authors declare that they have no conflict of interest.

Human and Animal Rights

This article does not contain any studies with human or animal subjects performed by any of the authors.

Informed Consent

Informed consent does not apply as this was a retrospective review with no identifying patient information.

Funding: Not applicable

Conflicts of interest Statement: Not applicable

Consent to participate**:** Not applicable

Consent for publication**:** Not applicable

Availability of data and material:

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Code availability**:** Not applicable

REFERENCES

[1] S. Rajkumar, A. Anto Amala, and K.T. Selvan, "Isolation enhancement of UWB MIMO antenna using molecular fractal structure," ELECTRONICS LETTERS, Vol. 55, No. 10, May 2019, pp. 576–579.

[2] Ahmed S. Eltrass and Nahla A. Elborae, "New Design of UWB-MIMO Antenna with Improved Isolation and Dual-Band Rejection for WiMAX and WLAN Systems," IET Microwaves, Antennas & Propagation, Vol. 13 Iss. 5, pp. 683-691.

[3] Li Ying Nie, Xian Qi Lin, Zi Qiang Yang, Jin Zhang, and Bao Wang, "Structure-Shared Planar UWB MIMO Antenna with High Isolation for Mobile Platform," IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 67, NO. 4, APRIL 2019.

[4] Zhenya Li, Chengyu Yin, and Xiaosong Zhu "Compact UWB MIMO Vivaldi Antenna With Dual Band-Notched Characteristics" IEEE Access, VOLUME 7, 2019.

[5] Zhijun Tang et. al. "Compact UWB-MIMO Antenna With High Isolation and Triple Band-Notched Characteristics" IEEE Access, VOLUME 7, 2019.

[6] Syed S. Jehangir and Mohammad S. Sharawi "A Wideband Sectoral Quasi-Yagi MIMO Antenna System With Multibeam Elements" IEEE Transactions on Antennas and Propagation, VOL. 67, NO. 3, March 2019.

[7] Libin Sun et. al. "A Compact Planar Omnidirectional MIMO Array Antenna With Pattern Phase Diversity Using Folded Dipole Element" IEEE Transactions on Antennas and Propagation, VOL. 67, NO. 3, March 2019.

[8] Anping Zhao and Zhouyou Ren "Size Reduction of Self-Isolated MIMO Antenna System for 5G Mobile Phone Applications" IEEE Antennas and Wireless Propagation Letters, VOL. 18, NO. 1, January 2019.

[9] Bing-Jian Niu and Jie-Hong Tan "Compact SIW cavity MIMO antenna with enhanced bandwidth and high isolation" ELECTRONICS LETTERS 30th May 2019 Vol. 55 No. 11 pp. 631–632.

[10] Sreenath Reddy Thummaluru, Rajkishor Kumar, Raghvendra Kumar Chaudhary "Isolation and frequency reconfigurablecompact MIMO antenna for wireless local areanetwork applications" IET Microwaves, Antennas & Propagation, 2019, Vol. 13 Iss. 4, pp. 519-525

[11] T.Kavitha S.Shiyamala, "Inverted dual U slot-loaded truncated microstrip patch antenna for wireless applications", International Journal of Engineering and Technology, Vol 7 , No 2.21 , 2018.

[12] S. Chen and J. Zhao, “The requirements, challenges, and technologiesfor 5G of terrestrial mobile telecommunication,” *IEEE Commun. Mag.*,vol.52,no.5,pp.36–43,May2014.

[13] L. Geand K. M. Luk, “Band-reconfigurable unidirectional antenna: A simple, efficient magneto-electric antenna for cognitive radio applications,”*IEEEAntennasPropag.Mag.*,vol.58, no.2, pp. 18–27,Apr.2016.

[14] K.R.Jha, B. Bukhari, C. Singh, G. Mishra, and S. K. Sharma, “Compact planar multi standard MIMO antenna for IoT applications,” *IEEE Trans.AntennasPropag.*,vol.66, no.7, pp.3327–3336,Jul.2018.

[15] R. Hussain and M. S. Sharawi, “Integrated reconfigurable multiple- input–multiple-output antenna system with an ultra-wideband sensing antenna for cognitive radio platforms,” *IET Microw., Antennas Propag.*,vol.9,no.9,pp.940–947,Jun.2015.

[16] R. Hussain, M. S. Sharawi, and A. Shamim, “An integrated four- element slot-based MIMO and a UWB sensing antenna system for CR platforms,” *IEEE Trans. Antennas Propag.*, vol. 66, no. 2, pp. 978–983,Feb.2018.

[17] R. Hussain and M. S. Sharawi, “A cognitive radio reconfigurable MIMO and sensing antenna system, ”*IEEE Antennas Wireless Propag.Lett.*,vol.14, pp.257–260, Oct.2015.

[18] Y. Tawk, J. Costantine, and C. G. Christodoulou, “Reconfigurable filters and MIMO in cognitive radio applications, ”*IEEE Trans.AntennasPropag.*,vol.62, no.3, pp.1074–1084,Mar.2014.

[19] T. Alam, S. R. Thummaluru, and R. K. Chaudhary, “Integration of MIMO and cognitive radio for sub-6 GHz 5G applications,” *IEEE Antennas Wireless Propag. Lett.*,vol.18, no.10, pp.2021–2025,Oct.2019.

[20] S. R. Thummaluru, M. Ameen, and R. K. Chaudhary, “Four-port MIMO cognitiveradiosystemformid- band 5G applications, ”*IEEE Trans. Antennas Propag.*, vol.67, no.8, pp.2758–2766, Aug.2019.

[21] Qual comm Technologies, SanDiego, CA, USA. *Spectrum for 4G And 5G.* (Dec.2017). [Online]. Available: https://www.qualcomm.com/media/documents/files/spectrum-for-4g-and-5g.pdf

[22] B. Thomas. *Qorvo:Is Your Hand set RF Readyfor5G?*Accessed: Feb.2018.[Online].Available: https://www.qorvo.com/resources/d/isyour-handset-ready-for-5G-Qorvo-white-paper

[23] A. C. Guyette and E. J. Naglich, “Short-through-line band stop filters using dual-couple dresonators,”*IEEE Trans. Microw. TheoryTechn.*,vol.64, no.2, pp.459–466,Feb.2016.

[24] R. Gomez-Garcia, L. Yang, J.-M. Munoz-Ferreras, and D. Psychogiou, "Single/multi-band coupled-multi-line filtering section and its application to RF diplexers, band pass/band stop filters, and filtering couplers, ”*IEEE Trans. Microw. Theory Techn.*, vol. 67, no. 10, pp. 3959–3972,Oct.2019.

[25] S. Amari, U. Rosenberg, and R. Wu, “In-line band- reject filters with non resonating nodes and/or phase shifts," *IEEE Trans.Microw.TheoryTechn.*,vol.54,no.1,pp.428–436,Jan.2006.

[26] J. D. Baena *et al.*, “Equivalent-circuit models for split-ring resonators and complementary split-ring resonators coupled to planar transmission lines,”*IEEETrans.Microw.TheoryTechn.*,vol.53, no.4,pp.1451–1461,Apr.2005.

[27] V. S. Bhaskar, E. L. Tan, and L. K. H. Holden, “Design of wide- band bow ties lot antenna using sectionally modi fied Giel is curves, ”*IEEE Antennas Wireless Propag. Lett.*, vol. 17, no. 12, pp. 2237–2240,Dec.2018.

[28] V. S. Bhaskar and E. L. Tan, “Design of dual-band omni directional planar microstrip antenna using Giel is curves, ”in *Proc. IEEE Int. Symp. Antennas Propag. North Amer. Radio Sci.Meeting*, Montreal, QC, Canada, Jul.2020, pp.309–310.