http://www.jctjournals.com

ISSN(ONLINE):2278 - 3814

Volume-11, Issue-7, July, 2022

JOURNAL OF COMPUTING TECHNOLOGIES (JCT)

International Journal

Page Number: 01-07

# A Literature Review MIMO Patch Antenna

*Prashant Choukikar[1], Dr. Arvind Kourav[2],*

*[1]M.Tech Scholar, [2]Professor,*

*[1,2]Department of Electronics and Communication*

*[1,2]Bhopal Institute of Technology (BIT), Bhopal (M.P), INDIA,*

*[1]prashantchoukikar90@gmail.com, registrarbitsbhopal@gmail.com,*

***Abstract*— In this survey paper researcher discuss that, when several antennas are utilized at both the source (transmitter) and destination (receiver), it is known as MIMO (multiple input, multiple output) (receiver). By combining the antennas at either end of the communication circuit, data may flow along many signal routes at once, reducing mistakes, increasing data speed, and enhancing radio transmission capacity. Creating numerous copies of the same signal boosts the signal-to-noise ratio and error rate by allowing the data to reach the receiving antenna without being influenced by fading. MIMO improves the reliability of wireless connections by increasing the capacity of radio frequency (RF) systems.**

***Keywords*—Envelope Correlation Coefficient (ECC), Multiple-Input Multiple-Output (MIMO), Ultra Wideband (UWB), Defective Ground Structure (DGS), Voltage Standing Wave Ratio (VSWR), Wireless Local Area Network (WLAN)etc.**

## I. INTRODUCTION

Three-way MIMO was introduced to the Mobile Broadband Standard by the 3GPP in Release 8. Law enforcement, broadcast TV production, and government employ MIMO technology for Wi-Fi and cellular 4G and 5G Long-Term Evolution (LTE) and 5G technologies. All 802.11n-capable wireless devices may utilise it in wireless local area networks (WLANs).

Microwave and RF systems may interfere with high-bandwidth communications when using MIMO. When a crisis or power outage occurs, or when a cell network is overcrowded, first responders commonly turn to Wi-Fi.

New innovations introduced by Wi-Fi 6, also known as 802.11ax, have upped the standard for wireless communication and have helped remove the limits associated with adding additional Wi-Fi devices to a network. Currently in development, Wi-Fi 7 should be available in 2024 at the earliest.

Before MIMO, there were several forms of sophisticated antenna technology with varied configurations, most frequently MISO and SIMO (SIMO). These technologies form the foundation of MIMO.

MIMO is a popular wireless technology that was instrumental in the rollout of 4G LTE and the Worldwide Interoperability for Microwave Access (WiMAX) wireless broadband standard. At example, LTE employs MIMO and orthogonal frequency-division multiplexing (OFDM) for speeds of more than 100 megabits per second (mbps). The old 802.11a Wi-Fi rate was half of this. When it comes to transmit diversity, spatial multiplexing, and single- and multi-user systems, LTE relies on MIMO.

LTE's MIMO technology improves data transmission reliability while significantly boosting data speeds. In order to transmit the data, it divides it into many streams. To aid in channel estimation, the data and reference signals are sent across the air to a receiver that is already acquainted with them.As the wireless industry strives to accommodate more antennas, networks, and devices, MIMO technology continues to improve and expand thanks to its employment in several new applications of enormous scope. The introduction of 5G technology is an excellent illustration of this.It's a large 5G MIMO system that uses a lot of tiny antennas to increase bandwidth to the customers, not only transmission speeds like 3G or 4G cellular technology, and support more users per antenna. Time division duplex (TDD) is used in 5G massive MIMO instead of the frequency division duplex (FDD) technique used in 4G MIMO (TDD). Compared to FDD, this has various benefits.

## II.LITERATURE SURVEY

***Chakraborty, P., et. al. (2022),***This research article describes the design steps of a dual-port Dielectric Resonator-based circularly polarized MIMO antenna for wideband applications such as Radar applications and Ku

 

band. The proposed antenna covers the bandwidth of 7.1–22 GHz (106%) with good isolation below −15 dB within the entire frequency band. The antenna also achieves circular polarization characteristics which covers the frequency range of 7.1–7.9 GHz (10.6%). The ECC and diversity gain performances of the proposed MIMO antenna is within the acceptable threshold limit, which is required for enhancing the data rate through spatial multiplexing in wireless communication channels. Moreover, after observing all the results, it can be concluded that the dual-port MIMO antenna can be a good candidate for different wideband applications [01].

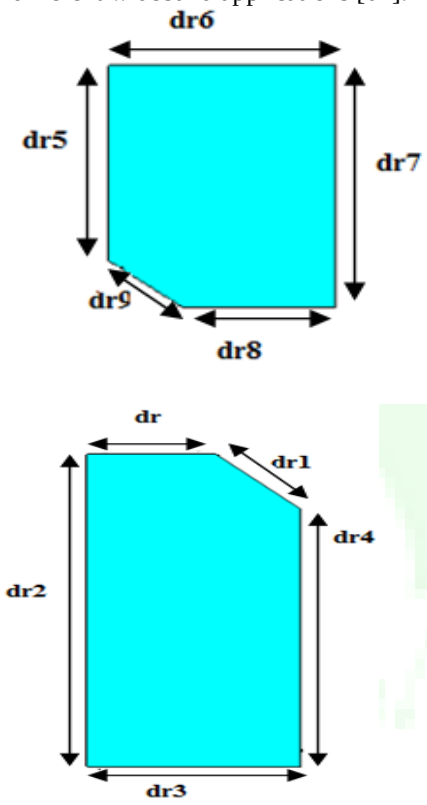


**Fig. 1 The proposed antenna Dual Port Circularly Polarized MIMO Antenna**

***Khan, A., et. al. (2021),*** This research work describes s a compact size (26mm × 31mm) MIMO antenna for the UWB band with a very low mutual coupling (S21/12 < −25dB) within the whole operating band. The proposed technique uses a stub in the ground plane and a single column EBG structure between two rectangular patches. A peak gain of 5.67dB and 85.5% average radiation efficiency within UWB-band was obtained. After fabrication, the designed MIMO antenna was verified for S-parameters and radiation performance in an anechoic chamber. The measured results were in close agreement with simulated results, and the antenna has shown very decent MIMO diversity performance. A high diversity-gain (DG > 9.995), very low ECC < 0.001, and low channel capacity loss (CCL< 0.1bits/s/Hz) makes the designed MIMO antenna a suitable candidate for MIMO applications in the UWB band [02].

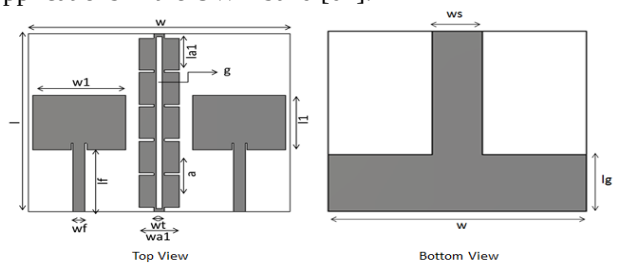


**Fig. 2 Proposed MIMO antenna**

***Kumar, N., et.al. (2020),***This research article describes A compact UWB meander-line electromagnetic band gap structure is designed for mutual coupling reduction in E-plane of UWB MIMO antennas with frequency range 3.1–10.6 GHz. Unit cell is analyzed for band gap using reflection phase method and this gives good bandwidth. The effective band gap of EBG structure is simulated using transmission line model and is increased by using 1-D array of four unit cell. The Ecoupled UWB MIMO antenna is designed using two UWB antennas on same plane facing each other at radiating edges. 1-D array of four EBG unit cell is inserted between the antennas to reduce the mutual coupling. The mutual coupling is further decreased by using EBG in both top and ground planes. Combination of two unit cell in top plane is connected to combination of two unit cells in ground plane through vias and inserted between the antennas. MIMO antenna parameters are simulated and verified by measured results. UWB property of antenna is not affected by the presence of EBG. Mutual coupling is significantly reduced for the whole UWB frequency range. Gain is improved for most of the frequency of proposed UWB MIMO antenna. The obtained values of mutual coupling reduction is also verified by the illustration of surface current density distribution in overall MIMO antenna [03].

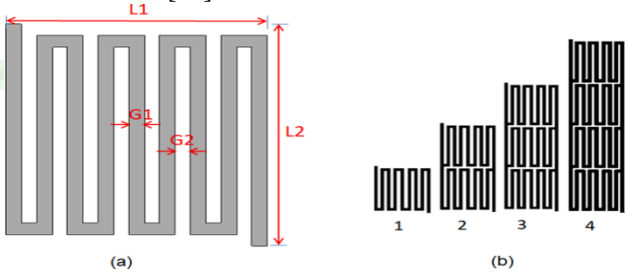


**Fig. 3.Design of unit cell of proposed EBG structure**

***Iqbal, J., et.al. (2019),***In this research work presented, Wideband circularly polarized DRA-MIMO antenna has been studied in this article, isolation between the radiators are enhanced by introducing the parasitic patch and further by incorporating the diagonally position of DRAs. CP achieved due to the parasitic patch which in result not only wide the impedance matching BW but also responsible for the degeneration of two orthogonal modes (TEx δ13 and

 

TEy 1δ3). An important diversity performance parameter for MIMO antenna like diversity and DG results are found to be in an acceptable limit. moreover, the proposed antenna is fabricated and tested, simulated scattering parameters agree well with the measured scattering parameter. The antenna may find its use in WiMAX application [05].

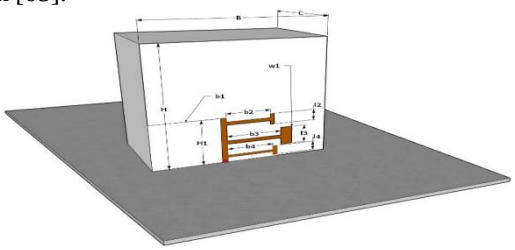

**Fig. 4 Geometry of the linearly polarized single element.**

***Li, W.,et.al.. (2018),***In this paper, a compact inkjet-printed flexible two-element UWB MIMO antenna has been proposed. The proposed antenna owns an overall size of only 22 31 0.125 mm3 . Half-cutting method is utilized to minimize the antenna size and a modified T-shaped ground stub is employed to improve the impedance performance and enhance the isolation. To further reduce the mutual coupling below - 15dB, a slot has been etched at the center of the modified T-shaped stub. In addition, parallel coupled line with stepped impedance transformation and DGS structure is designed as the UWB band-pass filter, to achieve sharp edges of the UWB to prevent generating interference to other communications. The measured results show that the ECC is below 0.3 and the CCL is below 0.4 bit/s/Hz throughout the UWB band, which indicates the good MIMO characteristic of the proposed inkjet-printed antenna [07].

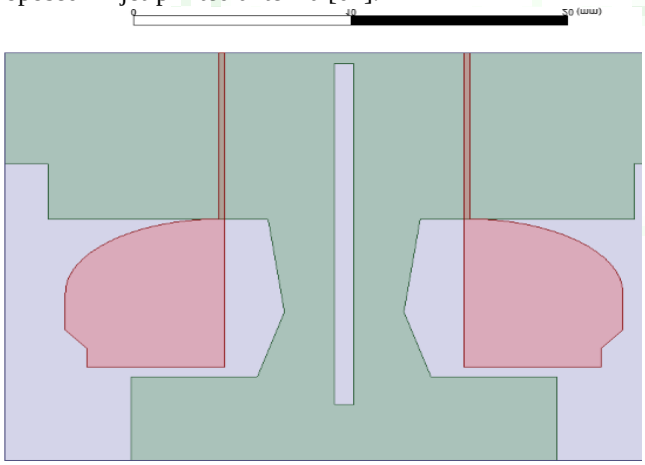

**Fig. 5 Geometry of the proposed flexible UWB-MIMO**

***Bahmani, M., et. Al.(2017),***In this paper, a new compact small planar monopole ultra wide band antenna with tow band notched characteristics has been proposed and its frequency response and fundamental radiation properties have been investigated. The antenna comprises a modified radiating patch and partial ground plane and has an overall dimension of 12 9 18 mm2 . The antenna operates from 2.89 to 12.43 GHz and has two rejection bands around of 3.3–4.3 and 5–6 GHz. The characteristics of small-size with symmetric and omni-directional radiation patterns make the proposed monopole antenna suitable for various UWB wireless communication applications [08].

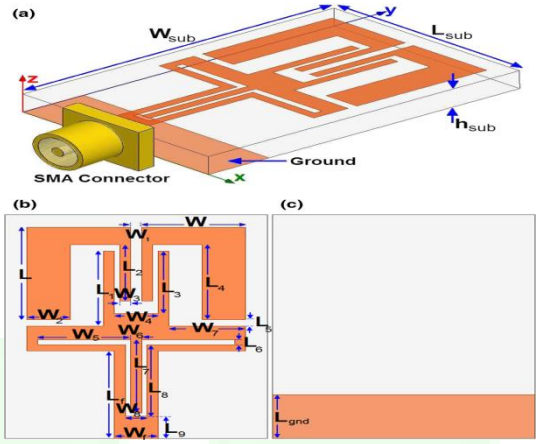


**Fig. 6 Geometry of the proposed antenna, a side view, b top layer, and c bottom layer**

***Ji, J. K. (2016).*** In this study, It was hypothesised and tested that a dual-band antenna might be reconfigured. In the 5.8 GHz band, the antenna has three operating modes and nine different radiation beam patterns. In the 2.4 GHz range, an omnidirectional beam pattern may be formed. In addition, the antenna is quite small. The results of our investigation demonstrate that radiation performance is excellent. This means that a lot of wireless MIMO applications could benefit from the suggested antenna. [10].

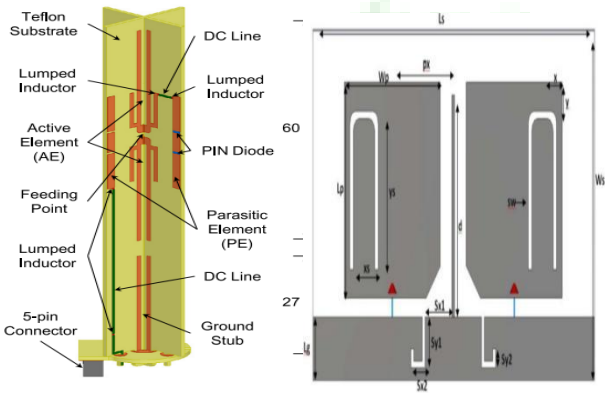


**Fig.7 Geometry of the proposed compact dual-band pattern reconfigurable antenna**

***Purwar, Aditi, et.al. 2015,***throughout this paper, an easy rectangular MIMO antenna is bestowed whose novelty lies in its sensible isolation performance for 3 frequencies at an analogous time (l.7 GHz, 2.7 Gc and 3.7 GHz). The insertion of L-shaped wring rock bottom plane is analyzed by adjusting its length and position. along it's

 

going to be seen whereas simulation that the chamfered edges of the patches effects the isolation of the antenna. a 2 0.5 written MIMO antenna is bestowed that is covering frequencies of 2 bands, LTE (1.7 GHz and a few of.7 GHz) and IEEE 802.11y- 2008(3.7 GHz) showing sensible isolation of vary -15 dB to -30 dB. The dimension of the antenna is 100*55*1.524 mm3 [11].

**Table 2.1 Comparison of MIMO Antenna**

| S.no | Ref/ Year | Geometry | S -11 | Frequency |
|---|---|---|---|---|
| 1 | [01]/2022 | Dual Port Circularly | −10 dB | 7.1 to 7.9 GHz. |
| 2 | [02]/2021 | MIMO antenna geometry | −10dB | 7.25GHz, |
| 3 | [03]/2020 | EBG | 5.4 dB to − 13.6 dB | 3.1–10.6 GHz. |
| 4 | [05]/2019 | Single Element of MIMO Antenna | -28 dB | 3.5-4.95 GHz. |
| 5 | [07]/2018 | Flexible UWBMIMO antenna | -15dB | 3.1–5.0 GHz, |
| 6 | [08]/2017 | Ultra Wide Band (UWB) | - | 3.8 and 5.5 GHz |
| 7 | [10]/2016 | compact dual-band pattern Reconfigurableantenna. | -20 dB | 2.4 and5.8 GHz |

## III ELEMENT ANTENNA SYSTEM

**A. Probe fed antenna element**

The design principle of the SICBS antenna element fed by aco-planar waveguide (CPW) has been studied in detail.

**B. Isolation between two antenna elements**

Exhibits the six configurations of the antenna pair with two identical antenna elements for inter-element mutual coupling study, where the center-to-center spacing between the antenna elements, g, is kept unchanged. The first three configurations are defined as below,

**Case 1** parallel directed antenna element pair (sideto-side)

**Case 2** parallel directed antenna element pair (end-toend)

**Case 3**, orthogonally directed antenna element pair (side-to-end)

Removing the substrate and metallic layer between the antenna elements, three more configurations are defined as follows,

Case 1.2, parallel directed antenna element pair (sideto-side)

- Case 2.2, parallel directed antenna element pair (end-toend)

C. **Isolation of element antenna system** where the adjacent antenna elements are orthogonally positioned (side-to-end) and the antenna elements along the diagonal line are parallel directed (side-to-side).

## IV. CONCLUSION

In this survey paper, we compare different methodology for finding a good method for Reduce Mutual Coupling for LTE and Wi-Max with Modified G-Shape MIMO Antenna for Wide Band Range all survey says that the presented method show the better result, compare to the other a patch antenna with a G-shape MIMO is recommended. This intended frequency range includes a variety of bands with a width ranging from 3.9 GHz to 6.5 GHz between Wi-Fi and Wi-Max. MIMO antennas with G-shaped MIMO patches are becoming increasingly prevalent in WLAN and WiFi systems. The results of the simulation include information on the S11 Return Loss, VSWR, and radiation pattern. Antenna modelling and design results are discussed in length in this chapter. The goal of this study is to develop new, higher-gain microstrip antennas. In addition, electrostatic capacitance conversion (ECC) is discussed.

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