IJDACR
ISSN: 2319-4863

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 12, July 2017)

Designing and Analysis of 2×1 Triangle Shaped Slotted MIMO Antenna for Wireless Application

Apurva Choudhary[1]
M.Tech Scholar[1]

SIRT, INDORE

Ms. Shivangini Morya[2]
Assistant professor[2]

SIRT INDORE

***Abstract*— The Antenna is a device which radiates or receives electromagnetic wave. The single input single output antenna has very low capacity and poor data rate which is overcome by Multiple input multiple output technology. The MIMO technology enables the higher data rate with great enhancement in capacity of the system. In this report the design process that covers the simulation of calculation process and analysis part using the development of microprint antenna with the computer simulation technology. Designed two element triangular shaped MIMO antenna for single band produced better isolation characteristics. The research in this thesis provides achievement of high isolation using triangular shaped slotted structure in MIMO system. This antenna is constructed using FR4 substrate. After simulation with CST software the performance of the proposed antenna is investigated. The proposed antenna result produces -22 dB of return loss at 5.9 GHz resonant frequency. The isolation is more than 15 dB found in the entire frequency band (5.8 to 6.0 GHz). The ECC is found 0.0006 and gain 1.23 dBi at resonant frequency.**

***Keywords*— *Isolation, ECC, VSWR, AR, CST, WLAN*.**

I. INTRODUCTION

Antenna is a basic element, which is used to link transmitter and receiver by using the free space. It is used to transmit and receive the electromagnetic waves. It is a system of elevated conductors which couples the transmitter or receiver to the free space. Transmitting antenna is connected to the transmitter with the help of transmission line, by which electromagnetic waves enter into the free space and after travelling from free space it is received by the receiving antenna, which then transfer the electromagnetic wave to the receiver. In this way, the transmission of Electromagnetic wave completes. Antenna is a transducer which converts electrical power into radio power. An antenna is an essential element for all the equipment which uses the radio waves for the transmission.

Through the years of inventions, microstrip antennas are the most common option used to realize monolithic integrated circuits for microwave circuits, radar and other wireless communication purposes. The different shapes and operating mode of the microstrip patch are used, so the designs become very versatile and useful in terms of operating frequencies, polarization, radiation patterns and impedance matching.

II. RELATED WORK

In this paper, the antenna elements have semi-printed structure, which has fractal shape and it operate in ISM (2.4-2.489 GHz) band as well as between 5 and 6 GHz. By using this structure, we can get satisfactory value of mean effective gain (MEG) and low correlation between the signal channels. In the design of antenna, Hilbert curve is adopted, because printed Hilbert antenna meets both the requirements of multi-frequency and of small size [1].

This paper presents an extensive survey of work done in the field of triangular patch micro strip antenna. The author has been described isolation enhancement mechanisms of printed MIMO antenna systems. There are six isolation techniques have been described using decoupling networks, meta-material structures, parasitic elements, neutralization lines and defected ground. Improved isolation is observed from the measured s-parameter curves over a band of 14 MHz a compact wideband indoor base station antenna, loaded with artificial magnetic conductor (AMC) is proposed for MIMO antenna system covering 5.2/5.8 GHz WLAN and 5.5 GHz WiMAX band. Two/Sixteen-element MIMO antenna array

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 12, July 2017)

is proposed in the paper. Periodical AMC surfaces are introduced under the dipole elements to achieve unidirectional radiation and low profile. A coupling E-shape micro strip feed line utilized in the element to provide good matching [2].

A compact high-isolation ultra-wideband (UWB) multi-input-multi-output (MIMO) antenna loaded with L-shaped branches is proposed. This design provides high isolation at 2.4 GHz WLAN and 3.1-10.6 GHz UWB bands. The proposed antenna is based on meandering monopoles in which a high isolation can be obtained by etching a slot at the centre of the ground and an ultra-wide bandwidth can be obtained by involving two inverted L-shape parasitic strips and two smaller L-shape stubs, and a high isolation is obtained by etching a slot at the centre of the ground. The achieved reflection coefficient value is lower than -10 dB [3].

In this study, a design of circularly polarized antenna based on Koch fractal geometry is presented. The circular polarization is achieved by placing two asymmetric Koch fractal geometries on x- and y-planes of the single-probe-feed square radiator. For the purpose of tuning resonant frequency around 911 MHz, four arrow shaped slots are inserted in diagonal axes of the square radiator. The antenna is fabricated on FR4 substrate. The presented geometry was fabricated with the MITS-Eleven Lab PCB machine. The antenna parameters measured by an Agilent N52330A vector network, to validate the simulation result. The 3-dB AR (Axial Ratio) bandwidth and impedance bandwidth of the proposed of the antenna design are found to be 8MHz (907-915 MHz) and 37 MHz (891-928 MHz) [5].

For an indoor MIMO wireless communication system, the dual polarized antenna with wide impedance bandwidth and high isolation is presented by the author. In this paper, the antenna consists of cavity-backed bowtie antennas with parasitic elements. It can cover different type of frequency bands like DCS/PCS/UMTS/LTE. The presented MIMO antenna has a sufficiently wide impedance bandwidth (VSWR<2) to cover the entire operating frequency band (1710-2690 MHz) and that the measured isolation (S12) between MIMO antennas elements is higher than 31 dB. The proposed MIMO antenna has a low ECC (<0.00425), which means that MIMO antennas 1 and 2 operated independently [6].

.

III. Proposed Antenna Design

Antenna Specifications:

Design Parameters: The layout of design problem is given below-
Microstrip Patch Antenna Design is having a triangular slotted patch with inset feed line style power supply. The triangular patch structure is simple and easy to design. Antenna is designed for frequency range 5.81- 6.0 GHz, Wi-Fi used in this frequency. Antennas are placed on the dielectric layer and base ground structure made up of copper.

The parameters will be clear from the table shown below.

TABLE I

Operating Frequency	5.9 GHz
Dielectric constant of the dielectric layer (εr)	4.3 (FR4 substrate)
Dielectric layer thickness (h)	1.523mm
Thickness of patch and ground plane	0.07 mm

I) Design of Ground-
For the design of the ground, copper (pure) material is used, having dimensions as follows-
Ground length (gl) = 30.84 mm
Ground width (gw) = 32 mm
Ground height (gh) = 0.07 mm

II) Design of Substrate-
For the design of the substrate, FR-4(lossy) substrate is used, having dimensions as follows-
Substrate length (sl) = 33 mm
Substrate width (sw) = 32.19 mm
Substrate height (sh) = 1.524 mm

III) Design of Feed-
For the design of the feed, PEC material is used, having dimensions as follows-Feed length (fl) = 8.9 mm
Feed width (fw) = 2.52 mm
Feed height (fh) = 0.07 mm

IJDACR
ISSN: 2319-4863

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 12, July 2017)

IV) Design Of Patch-

For the design of the patch, PEC material is used, having dimensions as follows-

Patch length (pl) = 20.8 mm

Patch width (pw) = 14.51 mm

Patch height (ph) = 0.07mm

MIMO antenna system–

Design Specification: The Figure 1 shows the design of triangular shaped slotted microstrip patch antenna. In this figure there are two patches having width W_P = 14.51 mm and length L_P =20.0 mm are mounted on a single substrate of width W_1= 64 mm and length L_1 =33 m. The Triangular shaped structure provide the optimum isolation below -15 dB for the entire frequency range.

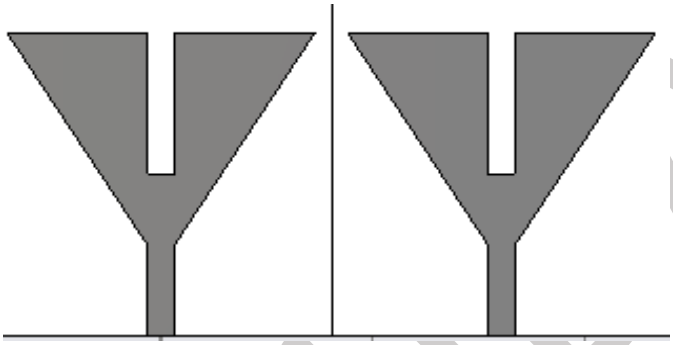

Figure 1 Design of microstrip patch antenna: Front view

Figure 2 Back side of antenna

The figure 2 shown the back view or ground plane of proposed antenna which has width of 32 mm and length of 30.84 mm.

.

MIMO antenna system - Simulation results:

The simulated results of S-parameters and bandwidth are obtained at the resonant frequency 5.9 GHz and analyzed for isolation and bandwidth

Isolation Characteristic-

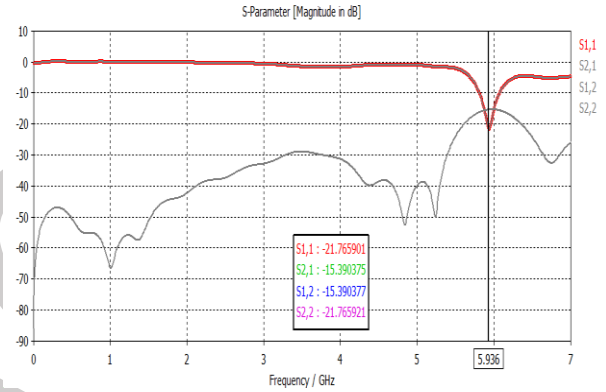

Figure 3 S parameters graph at frequency 5.9 GHz

S-parameters are the most important factor to decide the isolation and reflection coefficient, which is shown in figure 3 S12 and S21 are found to be less than -15 dB at frequency 5.9 GHz. S_{11} and S_{22} is found to be less than -21 dB at frequency 5.9 GHz. Both S11 and S22 are found to be same due to symmetry of the antennas.

Bandwidth characteristic-

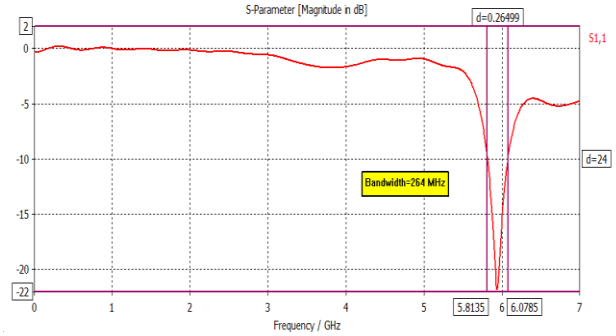

Figure 4: Bandwidth of 2×1 MIMO antenna at 5.9 GHz.

IJDACR
ISSN: 2319-4863

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 12, July 2017)

According to S-parameter results, upper frequency and lower frequency are calculated at -10 dB of S11 or S22. According to the simulated results, the bandwidth found to be 264 MHz.

ECC (Envelop Correlation Coefficient)

In an MIMO antenna system correlation "ρ" shows the influence of different propagation paths of the radio frequency signals that reach to the antenna elements.

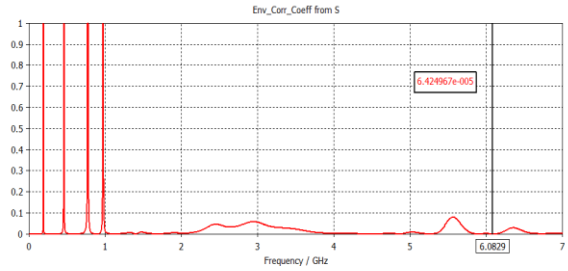

Figure 5 ECC for antenna

The envelope correlation coefficient (ECC) is a measure of the correlation between the radiations Patterns of MIMO receiving antenna pairs. Its value ranges from 0 to 1, where 0 represents No correlation and 1 is complete correlation of the radiation patterns. From the plots it is clear that structures have good ECC values is 0.00064.

VSWR:

VSWR is a measure of the value of the reflection from the load (antenna) and how much power radiated from the antenna into surrounding.

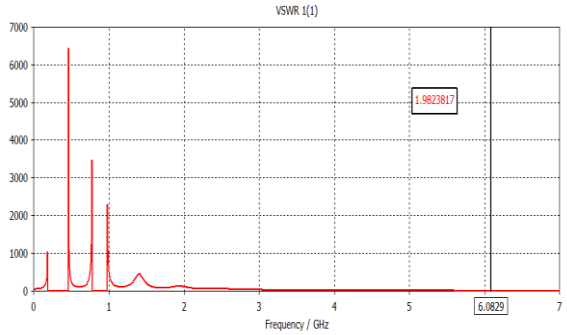

Figure 6 VSWR graph

VSWR parameter defines the reflections coming at the ports and its ideal value is 1 and its range is from 1 to ∞. Its value should be close to 1.From the above graphs it is shown that the value of VSWR is 1.98 at resonant frequency.

Radiation Pattern

Radiation pattern or antenna pattern of an antenna is defined as "a graphical representation or a mathematical function of the radiation properties (power flux density, radiation intensity, field strength, directivity, phase or polarization) of the antenna as a function of positions (spherical coordinates). The E-field radiation pattern at frequency 5.9 GHz is presented in figure 7.

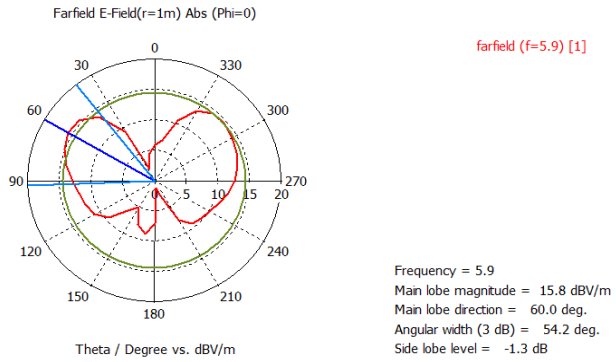

Figure 7 Designed Antenna E-Fields at 5.9 GHZ

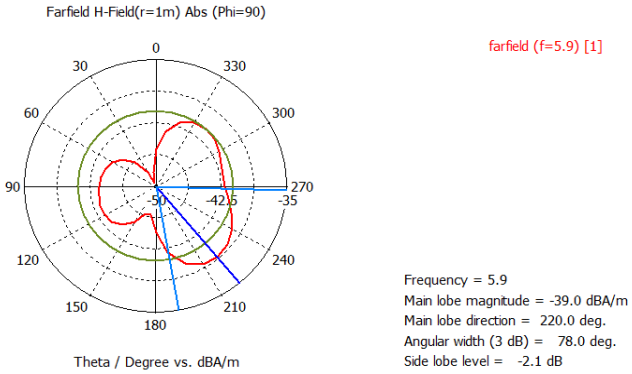

Figure 8 Designed Antenna H-Fields at 5.9 GHZ

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 12, July 2017)

The H-field pattern of triangular shaped MIMO antenna at frequency 5.9 GHz is presented in figure 8. The main lobe direction of pattern is 220^0 has magnitude -39.0dBA/m.

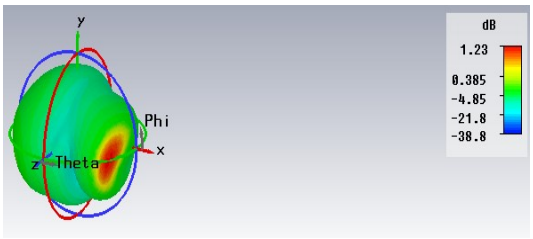

Figure 9 Gain of the designed Antenna (3D View) at 5.9 GHZ

The gain plot (figure 9) gives the **Gain = 1.23 dB**. The gain of the in a particular which is very useful for WLAN Application. From polar plot view of the gain, it can be seen that at a frequency of **5.9 GHz Gain** is **3.423 dB.** Radiation pattern obtained is quasi-omnidirectional with main lobe direction (E-Field) at an angle of **60 degree,** having angular beam width of **54.2 degree.**

IV. CONCLUSIONS

A triangle-shaped slotted micro strip MIMO antenna is designed with isolation element is introduced using the full ground and is simulated by using CST Microwave tools. The antenna is designed for frequency 5.9 GHz frequency (5.8-6.0 GHZ) with FR4 substrate (ε_r=4.3), h=1.523 mm, tanδ=0.02. The designed antenna produced very low value of ECC is 0.0006 with gain of 1.2 dBi. The antenna produces the below -15 dB isolation in the proposed frequency band. The 2X1 MIMO antenna has VSWR of 1.98 and peak radiated power at the resonant frequency. The main advantage of proposed design is the shape of design which produces low correlation without using any isolation structure between antennas.

REFERENCES

[1] Mohammad S. Sharawi "Printed Multi-band MIMO Antenna Systems: Techniques and Isolation Mechanisms' The 8th European Conference on Antennas and Propagation (EuCAP 2014).

[2] Guihong Li, Huiqing Zhai, Long Li, Changhong Liang, Rongdao Yu, and Sheng Liu "AMC-Loaded Wideband Base Station Antenna for Indoor Access Point in MIMO System" IEEE transaction on antenna and propagation, vol. 63, NO. 2, February 2015.

[3] Jing-Ya Deng, Li-Xin Guo, and Xiang-Long Liu "An Ultrawideband MIMO Antenna With a High Isolation" IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 15, 2016.

[4] Andreas Peristerianos, Argiris Theopoulos, Anastasios. G. Koutinos, Theodoros Kaifas and Katherine Siakavara "Dual-Band Fractal Semi-Printed Element Antenna Arrays for MIMO Applications" IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 15, 2016.

[5] Akanksha Farswan, Anil Kumar Gautam, Binod Kumar Kanaujia,and Karumudi Rambabu "Design of Koch Fractal Circularly Polarized Antenna for Handheld UHF RFID Reader Applications" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 64, NO. 2, FEBRUARY 2016.

[6] Hyunwoo Lee and Byungje Lee "Compact Broadband Dual-Polarized Antenna for Indoor MIMO Wireless Communication Systems" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 64, NO. 2, FEBRUARY 2016.

[7] Yen-Sheng Chen , Cheng-Pang Chang "Design of a four-element multiple-input–multiple-output antenna for compact longterm evolution small-cell base stations" IET Microwaves, Antennas & Propagation, ISSN 1751-8725, 12th November 2015.

[8] Mohammad Alibakhshi-Kenari1 , Mohammad Naser-Moghadasi, Ramazan Ali Sadeghzadeh, Bal S. Virdee, Ernesto Limiti "Dual-band RFID tag antenna based on the Hilbert-curve fractal for HF and UHF applications" IET Circuits, Devices & Systems, ISSN 1751-858X, 23rd August 2015.

[9] Chung-Yi Hsu, Lih-Tyng Hwang, Fa-Shian Chang, Shun-Min Wang, Chih-Feng Liu "Investigation of a single-plate π-shaped multiple-input–multiple-output antenna with enhanced port isolation for 5 GHz band applications" IET Microwaves, Antennas & Propagation, ISSN 1751-8725, 18th December 2015.

[10] ongyue Qu, Rui Zhang, Hyeongdong Kim "Decoupling between ground radiation antennas with ground-coupled loop-type isolator for WLAN applications" IET Microwaves, Antennas & Propagation, ISSN 1751-8725, 18th December 2015.

[11] Mohammad S. Sharawi, Sheikh S. Iqbal, and Yanal S. Faouri "An 800 MHz 2×1 Compact MIMO Antenna System for LTE Handsets" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 59, NO. 8, AUGUST 2011.

[12] Haiming Wang, Dongya Shen, Teng Guo , Xiupu Zhang "A High Isolation MIMO Antenna Used a Fractal EBG Structure"

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 12, July 2017)

[13] Jing-Ya Deng, Li-Xin Guo and Xiang-Long Liu "An Ultra-wideband MIMO Antenna with a High Isolation" IEEE Antennas and Wireless Propagation Letters.

[14] H. Wang, D. G. Fang, and X. L. Wang "Mutual Coupling Reduction Between Two Microstrip Patch Antennas by Using the Parasitic Elements" .

[15] AtifJamill, Mohd Zuki YUSOffl, Noorhana Yahya2 "Current Issues and Challenges ofMIMO Antenna Designs"

[16] Hyunho Wi, Byeongkwan Kim, Woojae Jung, and Byungje Lee "MULTIBAND HANDSET ANTENNA ANALYSIS IN- CLUDING LTE BAND MIMO SERVICE" *Progress In Electromagnetics Research, Vol. 138, 661{673, 2013.*

[17] Rafik Addaci, Aliou Diallo, Cyril Luxey "Dual-Band WLAN Diversity Antenna System With High Port-to-Port Isolation" IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 11, 2012.

[18] *Shrivishal Tripathi, Akhilesh Mohan and Sandeep Yadav "*A Compact Octagonal shaped Fractal UWB MIMO Antenna With 5.5 GHz Band-notch Characteristics*"* 2014 IEEE International Microwave and RF Conference (IMaRC).

[19] Istvan Szini, Alexandru Tatomirescu "On Small Terminal MIMO Antennas, Harmonizing Characteristic Modes With Ground Plane Geometry" IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 63, NO. 4, APRIL 2015.

[20] S. Cui, Y. Liu, W. Jiang and S.X. Gong "Compact dual-band monopole antennas with high port isolation" ELECTRONICS LETTERS 12th May 2011 Vol. 47 No. 10.