International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 14
November 2017

Fractal Slot Loop Eleven Band Antenna Designing For Wideband Applications

G. CHANDRA SHEKAR, Department of Electronics and Communications,

University College of Engineering, Osmania University,

Hyderabad, Telangana, India.

ABSTRACT:

The fractal dielectric Resonator Antenna is projected Material used is FR4 epoxy having material four constant . 1st iteration provides metric of 2 hundredth and second iteration offers metric of 27th at 7GHz. Constant gain of five decibel is present over entire vary of frequency. Cross polar level is 20 db below copolar level. Structure is worked up by coaxial feed at an offset. This study provides entirely new structure for metric improvement. A multiband pattern CPW-fed slot antenna loaded with a material resonator orthodox to over one Wi-Fi desires is provided throughout this text. The minkowski geometry[1] is employed to induce over one frequency bands furthermore on provide a miniaturized vogue compared to its geometer counterpart. The thought behind setting the nonconductor load is to serve a twin motive of rising the ohmic resistance metric of the antenna on the highest frequency band besides to up the ultimate smart issue concerning the antenna. The slot loop acts as a hybrid antenna showing the venture of every an antenna what's additional as a feed mechanism for the nonconductor block to radiate. Layout hints relating to closed type formulae and equal version which has lumped resonators, distributed resonators and ohmic resistance transformers of the fabric loaded kind slot antenna is supplied to present an perception into the functioning of the antenna. The reflection constant parameters of the antenna yield an in depth match among the circuit model and folks obtained from complete wave machine.

I.INTRODUCTION:

Wi-Fi communications have full-grown at a awfully rapid tempo the globe over over the previous couple of years, which give a high notch flexibility within the communication infrastructure of environments that embrace massive geographical point buildings, hospitals, factories. wi-fi generation has

gone through special stages of improvement ever seeing that its origination. through the years there had been distinctive necessities of this generation that advanced out of the stress. Presently, in strategic additionally to property right the wireless devices and systems need to cater to completely different frequencies, have to be little in size, broadband and need to be of low value [1]. To reap the important packages a excessive performance large band antenna with nice radiation characteristics square measure needed. over the past few years, the dielectric resonator antenna (DRA) has received big attention as a result of its many blessings along with delicate weight, type flexibility, low profile, low dissipation loss, excessive material power and better electricity handling capability, special to be had feeding mechanism. DRA may be during a few geometries like cylindrical, square, spherical, half split cylindrical, disk, hemispherical and triangular shaped [2]. then again, form formed antennas boast many fascinating functions that stem from their inherent geometrical homes. The self-similarity of positive form systems leads to a multiband behavior of self-comparable form antennas and frequency-selective surfaces. From the other issue of read, excessive convoluted type and area-filling residences of bound fractals allow to minimize extent occupied by a resonant detail. though difficult gadgets with similar homes of the fractals are outlined, using form geometries has the gain that irregular difficult object could also be described during a well-described geometrical framework. the most motivation of this task is currently a days, cellular communication structures are becoming additional} more notable. Antennas for software-defined and / or reconfigurable radio structures ought to have extremely-huge band or multi-band traits on the thanks to be versatile enough to cowl any viable destiny cell communication frequency bands. One approach to supply such flexibility is to assemble multi-band antenna that operates over precise narrowband frequencies. however, it might be very powerful to befittingly gain the frequency requirements of all destiny news report system. rather, a tiny low band associate antenna that covers a large vary of frequencies could also be an impressive candidate not best for contemporary multi-band applications but to boot for destiny news report systems running on new frequency bands. these days, it has been incontestable that a band monopole antenna is promising to be used for mobile wireless devices that embrace laptop computer

systems, mobile phones, and organizer (personal virtual help) telephones. With bandwidths as low as some %, vast band programs the usage of ancient Microstrippatch designs and DRA styles square measure restricted. Completely different drawbacks of patch antennas embrace low performance, forced strength potential, spurious feed radiation, poor polarization purity, slim bandwidth, and production tolerance problems.

II.LITERATURE SURVEY:

CPW-FED KOCH FRACTAL SLOT ANTENNA FOR WLAN/WiMAX APPLICATIONS:

This paper was enforced within the year 2008 that deals with a twin wide-band CPW-fed modified koch fractal written slot antenna, acceptable for wireless native space network and WiMAX operations. The operative frequency is down by the koch iteration technique resulting in compact antenna. The antenna has an resistance information measure from 2.38-3.95 gig cycle and 4.95-6.05 gigacycle covering WiFi and WiMAX frequency bands. The simulated results showed that the introduction of Koch pattern slot instead of the triangular slot geometry lowers the frequency of operation along with wide-band matching. the disadvantage of this system is, only 2.0dBi of gain is achieved. The antenna Koch iteration technique does not provide lots of bands.

MULTIBAND PRINTED MONOPOLE ANTENNAS LOADED WITH OCSRRs FOR PANs AND WLANs:

This paper was enforced within the year 2011 during which multiband written monopole antennas loaded with Open Complementary Split-Ring Resonators (OCSRRs) square measure bestowed. The OCSRRs, sculptured as parallel resonant tanks, act as high-impedance components at their resonance ,and completely different effective sections will be achieved within the monopole by putting them at correct locations. 2 prototypes square measure designed, factory-made and measured: 1) a single-loaded OCSRR dual-band written monopole antenna covering the Bluetooth and IEEE 802.11a/b/g/n bands (2.40–2.48 and5.15–5.80 GHz, respectively) and 2) a tri band model supported an equivalent style, however with an extra OCSRR designed to additionally cowl the IEEE 802.11y waveband (3.65–3.70 GHz). each antennas are written on a single-layer of a affordable substrate, leading to terribly compact style. he disadvantage of this system was would really like of sophisticated bias networks to

achieve multiple band utilization. Slots inscribed are like sort of bands

SIMPLE PRINTED MULTIBAND ANTENNA WITH NOVEL PARASITIC-ELEMENT DESIGN FOR MULTISTANDARD PORTABLE APPLICATIONS:

This paper was enforced among the year 2013 in uses s simple written multiband antenna with parasitic-element design for multi-standard hand-held terminals in mobile communications is given. The projected antenna performs 3 resonance modes covering six bands of wireless standards, equally as GSM, GPS, DCS, PCS, UMTS, and LTE 2300/2500. In geometry, the antenna merely consists of 2 metal stubs. One is an formed driven stub operational as a feeder and an embedded conductor. the choice are often a fashioned parasitic stub operational as a radiator. constant studies and therefore the style rule area unit closed. The antenna occupies a district of 18×37 millimetre on prime of a system board.The drawback of this system is that the antenna space occupies solely somewhat physical space(18×37×0.6mm)with a simple written PCB structure, that produces the antenna fabrication very price effective.

III.EXISTING APPROACH:

Fractal dielectric resonator antennas are investigated for wide impedance information measure by reducing the overall Q issue of the antenna [13]. However, until now most researchers have focused on the slot antenna and also the DRA as separate elements. many papers with the slot antenna as feed components are investigated [14-15]. However, to our greatest data this is the first paper to debate integration of a DRA with fractal slot loop to boost antenna practicality. A mathematician island formed CPW fed slot loop antenna has been designed to cover 5 different wireless standards among others. However, it's tough to maintain the gain of the antenna at a close to constant price over totally different frequencies. to beat this downside, the slot antenna is loaded with virtually sq. formed dielectric resonator (DR) to get almost constant gain in any respect separate frequencies. it's seen that the image antenna conforms to GSM 900 (890-960 MHz), PCS 1900 (1850-1990 MHz), IEEE 802.11b/g/n (2.4 – 2.485 GHz), WiMAX 3.5 (3.4 – 3.6 GHz), IEEE 802.11a/h/j/n (5.15-5.85 GHz) among others.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue 14
November 2017

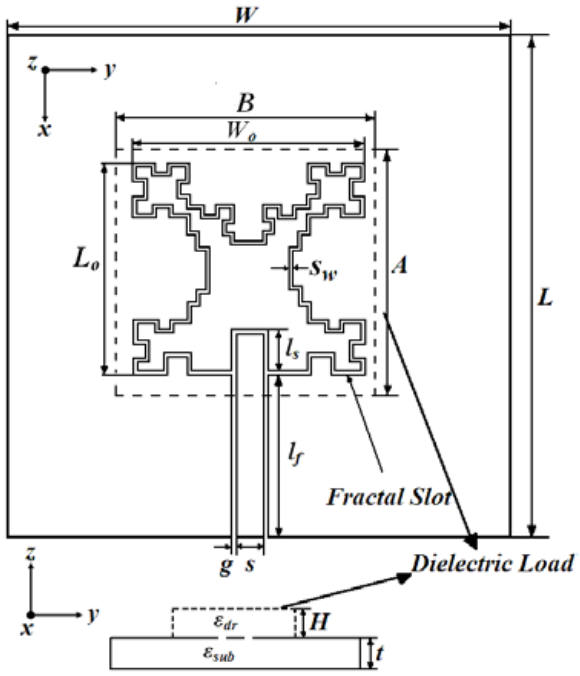


FIG 4.1: SAMPLE DESIGN

In the existing system antenna |is intended for operating in7 bands of frequency supported the dual dielectric placed with fractal designed supported minkowski design structure. it's tough to keep up the gain of the antenna at a close to constant worth over different frequencies.

ANTENNA DESIGN:

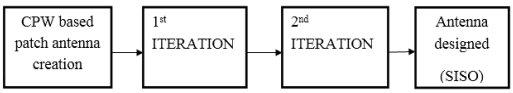


Fig 4.2: Existing antenna design

DISADVANTAGES:

1.Need of Complex Bias Networks to reach multiple band utilization.

2.The gain of this existing system is 3.1dBi.

3.Using HFSS system the time required for the simulation process for is higher.

4.Only 7 bands are obtained using the SISO (Single Input Single Output) method.

IV.PROPOSED SYSTEM:

To overcome this drawback, the slot antenna is loaded with an {almost|a virtually} sq. shaped dielectric Resonator (DR) to get almost constant gain at all distinct frequencies, so there's a rise in bandwidth and gain. using MIMO (Multiple Input Multiple Output) method, the quantity of bands are exaggerated to eleven. Also the simulation time is reduced by using CST tool. during this project, a multiband fractal CPW-fed slot antenna loaded with a dielectric resonator orthodox to multiple wireless standards is conferred during this project. The fractal design is used for variable frequency range. the concept behind inserting the material load is to serve a twin purpose of enhancing the ohmic resistance bandwidth of the antenna at the higher waveband also as improving the gain of the antenna.

Table 1. Range of frequency

TECHNOLOGY	FREQUENCY RANGE
WCDMA	824-894 MHz
GSM	880-960MHz
FDD-LTE/GSM	1.7-1.8GHz
WCDMA/GSM	1.8-1.9GHz
TD-LTE/TD-SCDMA	1.9-2.1GHz
TD-SCDMA	2.0-2.02GHz
TD-LTE	2.3-2.4 GHz
FDD-LTE	2.5-2.6 GHz
WLAN(Wi-Fi,Bluetooth)	3.4-3.6 GHz
WiMAX(Overall MW frequency)	4.6-5.9GHz
WiMAX(mobile equipment)	6.1-7GHz

NEED OF MULTIBAND ANTENNA:

To reach the requirements of CRN concepts the antenna should be compatible of operating multiple obtainable frequency bands inside the availed spectrum of usage (0-6GHz).If an user need to exploit a another band as a secondary user the user equipment should be compatible of operating to use the another band as secondary user.

DESIGN FLOW:

The Fig shows the block diagram of the proposed system. The main block deals with the overall designing of an multiband minkowski fractal design antenna.The designing process involves the CST(Computer Simulator Technology) where a certain design steps are followed. Design is done over the patch with base of dielectric substrate.A dielectric substrate again placed over the antenna patch which leads to multiband system.

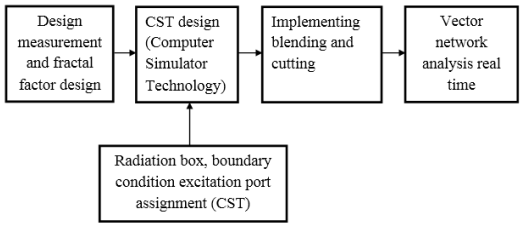


Fig 4.3 Proposed Block Diagram

In this block the designing of antenna is done using the CST (Computer Simulator Technology),then the designed antenna is transferred to CADD design for the fabrication process. The antenna is fabricated using copper which is made of FR-4 substrate. Finally the bands generated from the antenna are analyzed using vector network analyzer.

ANTENNA DESIGN:

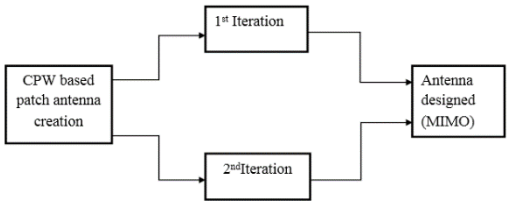


Fig 4.4 Proposed antenna design

FRACTAL ANTENNA:

Fractal antennas designed during a manner fraction of a design that means a design increased to succeed in the total design if the antenna design is zoomed in also the antenna seems to be within the same design in its inner design additionally. The starting geometry of the fractal, known as the instigator, could be a geometer

square: every of the four straight segments of the beginning structure is replaced with the generator, which is shown at all-time low figure.

This iterative generating procedure continues for an infinite variety of times. It is used to reduce the scale of antenna by increasing the economical with that stock up occupied volume with electrical length. Many iterations are compared with the sq. loop antenna. minkowski isn't only broadband but they additionally demonstrate multiband impact.

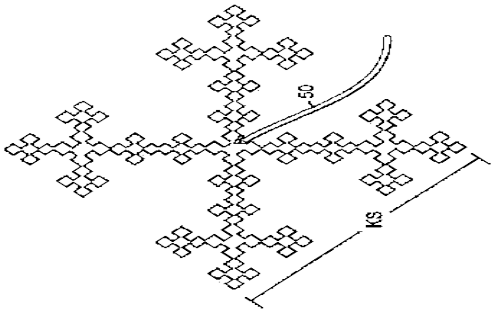


Fig4.5 General Fractal Design

The final result's a curve with an infinitely involved underlying structure that's not differentiable at any purpose. The repetitive generation method creates a geometry that has involved details on an ever-shrinking sc

ale

V.DESIGN MEASUREMENT AND FRACTAL FACTOR DESIGN:

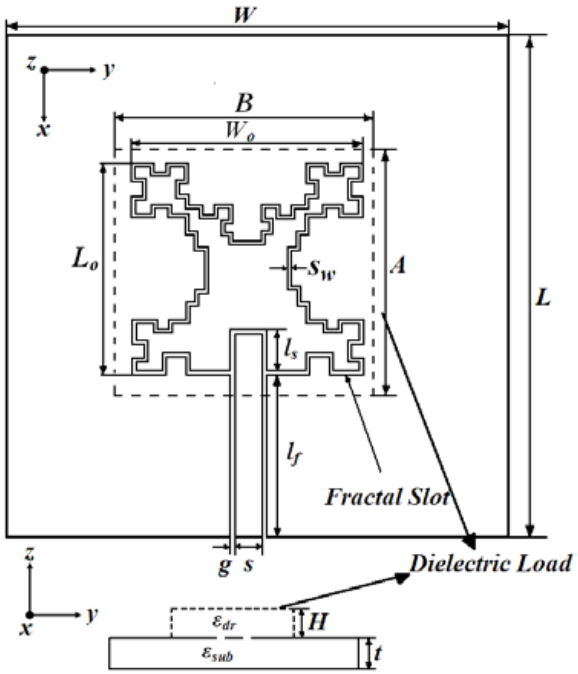


Fig 6.0 Layout of the fractal slot antenna with dielectric loading

The shape design is used for varying frequency vary. the thought behind putting the insulator load is to serve a twin purpose of enhancing the electric resistance information measure of the antenna at the higher waveband in addition as rising the gain of the antenna. shape may be a thought that is being enforced in microstrip antenna to possess higher characteristics than microstrip antenna. The word shape springs from the Latin word “fractus” that means broken, uneven, any of assorted very irregular curves or form that repeat themselves at any scale on that they're examined. The finalized style pattern of the minkowski shape design primarily based antenna

MATERIAL USED:

Substrate: FR4, Thickness: 1.6mm, Permittivity: 2.4, Loss tangent: 0.24 The FR4 substrate is employed as the material as substrate due to its property inflammability and the application mobile device antenna. as a result of in mobile devices it's enabled with FR4 as the PCB board substrate. Ground plane/ diverging component is copper plate which is due to its property of abundant conductivity, copper plate is used as diverging and conducting arm more used for grounding properties**.**

SLOT ANTENNA:

A Slot Antenna consists of a metal surface typically a flat plate with a hole or slot cut out. plate is driven once as an antenna by a driving frequency the slot radiates magnetism waves throughout a really means that moderately like device. the form and size of the notice time for addition as a results of the driving frequency verify theradiation distribution pattern. Generally the radio waves ar provided by the wave guide and thus the antenna consists of slots inside the wave guide. Slot antenna square measure usually used at radio frequency and microwave frequency, instead of line antenna once larger management of illustration is required. Slot antenna are wide utilized in measuring system antenna for the sector antenna used for the telephone base station and are usually found in normal desktop microwave offer used for analysis functions.

DIELECTRIC RESONATOR ANTENNA:

Dielectric Resonator Antenna (DRA) avoids some limitations of the patch antenna moreover because the high conductor losses at mm wave frequencies, sensitivity to tolerance and slender bandwidth. the oblong type is way easier to fabricate and one or further dimensional parameters are accessible

Table2 Design parameters and corresponding values

PARAMETER	VALUES
Ground plane size (L*W)	100mm*100mm
Loop Slot Dimension (L_0*W_0)	25mm*25mm
Stub length (L_s)	3mm
Slot width (S_w)	0.4mm
2nd indentation factor (i_2)	0.5
Dielectric Slab Dimensions (A*B*H)	33mm*30mm*5mm

VI.DESIGNING PROCESS:

INITIATE:

The input material utilized in this project is copper plate that may be a conducting material and this

copper metal is chosen attributable to its inflammability property and the capability of retentive the impact resistance and also for its outstanding resistance to corrosion. at first the bottom plane is of size 100*100mm from that the loop slot dimension is calculated by (lambda/4) wherever the patch antenna is made. Here 2 copper plates are taken for two inputs so that first iteration and 2nd iteration are done separately by using MIMO pattern.

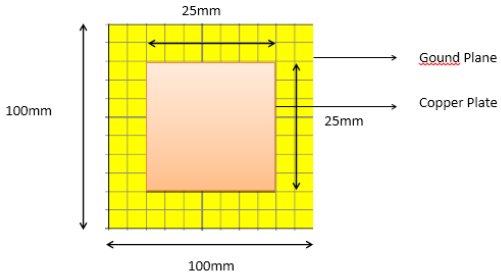


Fig 4.11 Initial copper plate

Fig 4.7 Initial copper plate

FIRST INDENTATION ANALYSIS:

Before the shape analysis feed is given to the copper plate. during this method the patch antenna with 25*25mm of size is taken then all the edges area unit divided into a magnitude relation of 1/3 which provides three 8.33 all the perimeters. The indentation issue for 1st iteration is zero.9 and so,

Indentation dimension = 0.9= 7.497

The etching of those antenna is completed in a sq. shape and any additional iterations are in done in different scales

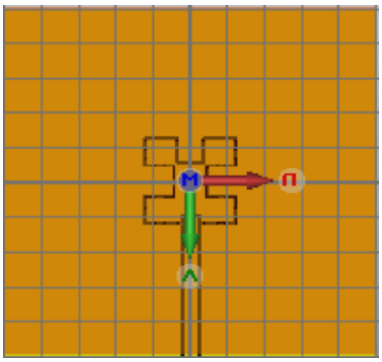


Fig 4.8 First Indentation factor analysis of antenna

SECOND INDENTATION ANALYSIS:

In this method the patch antenna with 25*25mm of size is taken then all the perimeters area unit divided into a ratio of 1/3 which supplies three 8.33 all the perimeters. The indentation issue for 1st iteration is 0.9 and so within the stage once more every of the sq. engraved sides under go another iteration using the indentation issue of 0.5.So the calculation of second indentation issue is given by,

Indentation dimension = 0.5*2.499= 1.2495.

Similarly the iteration process continues using this fractal design.

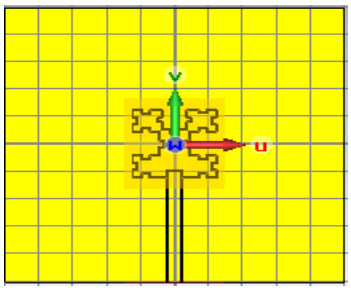


Fig 4.9 Second Indentation factor analysis of antenna

FINAL PROCESS:

Finally the fractal designed antenna is loaded with a dielectric resonator in order to increase the gain and bandwidth ofthe antenna. The slot antenna is loaded with a nearly square shaped Dielectric Resonator(DR) to obtain almost constant gain at all discrete frequencies

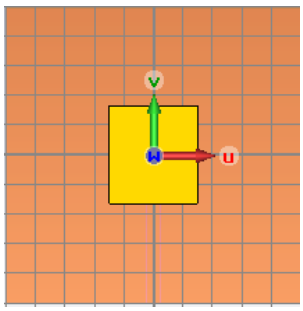


Fig 4.9 Antenna after loading Dielectric Resonator(DR)

The antenna design that is ready for the fabrication process isshown in the Fig The designing process is done in the CST tool and then simulated in the software to obtain the required output and frequency plots.

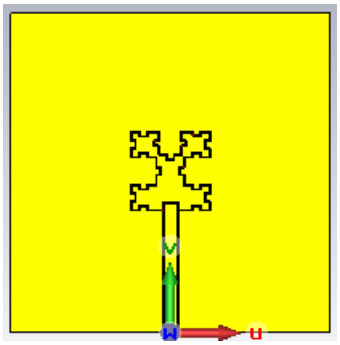


Fig 4.10 Final Minkowski antenna design

STAGES OF ITERATION:

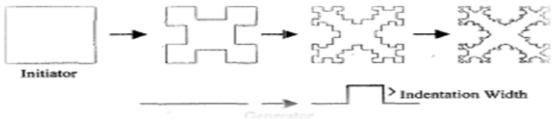


Fig 4.16 Generation of Minkowski Fractal

DESIGN EQUATION:

$$f_0 = \frac{c}{2\pi\sqrt{\varepsilon_r}}\sqrt{k_x^2 + k_y^2 + k_z^2}$$

$$k_x = \frac{m\pi}{a}, k_y = \frac{n\pi}{b}, k_z = \frac{l\pi}{2d}$$

$$k_x^2 + k_y^2 + k_z^2 = \varepsilon_r k_0^2$$

CALCULATION OF RESONANT FREQUENCY:

Equation for resonant frequency in particular band is,

$$f_0 \cong \frac{c}{q \times \delta \times \{2(L_0 + W_0)\}}$$

The values attained from the indentation factor is,

$$\delta = 1 + \sum_{k=1}^{n} \left\{ \left(\frac{2}{3}\right)^{k} \prod_{j=1}^{k} i_j \right\}$$

Ratio between the basic frequency and the n^{th} iteration frequency is,

$$\frac{f_n}{f_0} = 0.6(n)^{1.2} + 1.2$$

RESULT AND EXPERIMENTS:

We have produced 11 bands in this project using Minkowski fractal design based antenna and MIMO pattern for cognitive radio applications. The gain obtained in this project is 5dBi.

The design of antenna in the first iteration and the corresponding output is shown in the Fig 5.1 and 5.2

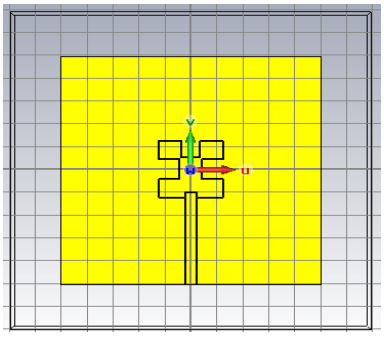


Fig 5.1 1st Iteration

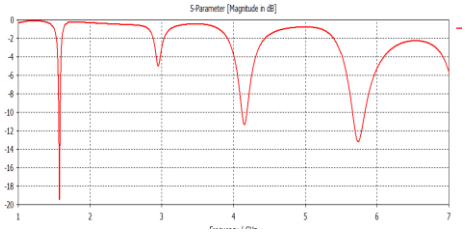


Fig 5.2 Frequency plot of 1st Iteration

Fig represents the frequency plot of first iteration that is obtained.

The design of antenna in the second iteration and the corresponding output is shown in the Fig

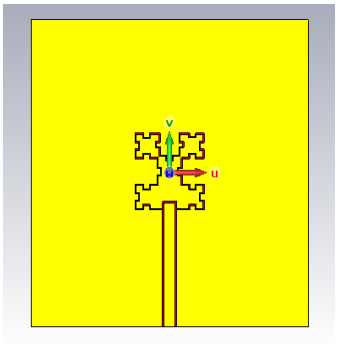


Fig 5.3 2nd Iteration

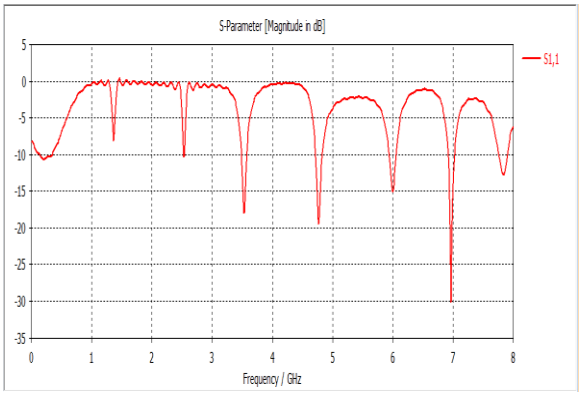


Fig 5.4 Frequency plot of 2nd Iteration

Fig 5.4 represents the frequency plot of second iteration that is obtained.

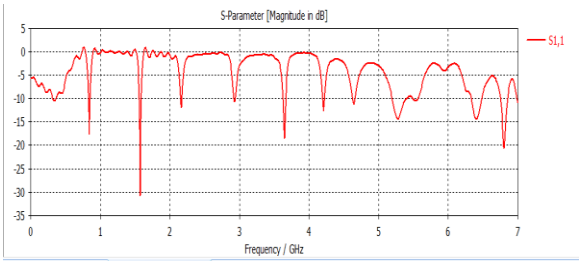


Fig 5.5 minkowski fractal antenna dielectric loaded

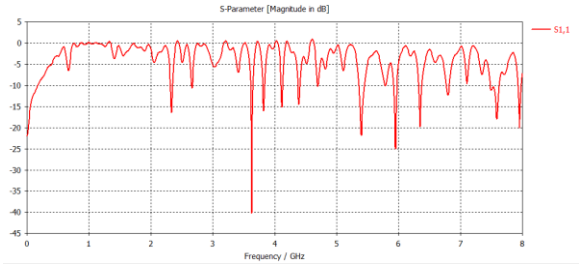
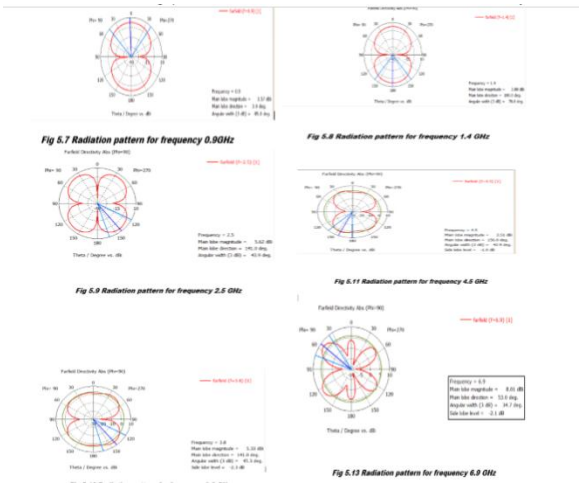


Fig 5.6 Final minkowski fractal antenna MIMO frequency plot output S11

Fig 5.6 represents the Final Minkowski fractal antenna frequency Plot and this shows that 7 bands are obtained.

RADIATION PATTERN:



CONCLUSION:

This project proposed a multiband frequency range using Minkowski fractal designed antenna which provides 7 bands using MIMO pattern and dielectric resonator loading. The projected antenna exhibits a multiband performance with most gain of 3.5 dBi .An investigation on the utilization of material loaded fractal slot loop antenna for multi-band performance is performed during this work. minkowski boundary slot carved on associate FR4 substrate fed by CPW is proposed and characterised. constant quantity studies are administered to optimize the antenna design parameters. constant circuit model is shown to supply associate understanding into the functioning of the antenna. the whole circuit consists of lumped resonators for the DRA, distributed resonator components for the slot line and ohmic resistance transformers to point the coupling between separate circuit components. The fictitious paradigm yields a heptaband performance for a -10 sound unit reflection co-efficient. Much compact in nature. Multiband variation is achieved simply as a result of the fractal design. Ease in design methodology.

6.2 FUTURE ENCHANCEMENT:

The size of the antenna is the main disadvantage of this project so, in future the size may be reduced below 100mm *100mm which will be portable and can be used in mobile sectors and other mini mobile application.

REFERENCES:

[1] C. C. Chen, C. Y. D. Sim and F. S. Chen, "A Novel Compact Quad-Band Narrow Strip-Loaded Printed Monopole Antenna," *IEEE Antennas Wireless Prop. Letters,* vol. 8, pp. 974 – 976, Aug. 2009.

2] R. A. Bhatti, Y. T. Im and S. O. Park, "Compact PIFA for Mobile Terminals Supporting Multiple Cellular and Non-Cellular Standards," *IEEE Trans. Antennas Prop,* vol. 57, no. 9, pp. 2534 – 2540, Sep. 2009.

Prop, vol. 60, no. 10, pp. 4479 – 4484, Oct. 2012.

[7] F. J. H. Martinez, G. Zamora, F. Paredes, F. Martin and J. Bonache, "Multiband Printed Monopole Antennas Loaded With OCSRRs for PANs and WLANs," *IEEE Antennas Wireless Prop. Letters*, vol. 10, pp. 1528 – 1531, Dec. 2011.

[8] M. R. Booket, A. Jafargholi, M. Kamyab, H. Eskandari, M. Veysi and S. M. Mousavi, "Compact multi-band printed

[3] Y. Cao, B. Yuan, G. Wang," A Compact Multiband Open-Ended Slot Antenna for Mobile Handsets," *IEEE Antennas Wireless Prop. Letters,* vol. 10, pp. 911 – 914, Sep. 2011.

[4] S. I. Latif and L. Shafai, "Investigation on the EM-Coupled Stacked Square Ring Antennas With Ultra-Thin Spacing," *IEEE Trans. Antennas Prop,* vol. 59, no. 11, pp. 3978 – 3990, Nov. 2011.

[5] K. Huang and T. Chiu, "Triband Inverted-F Antenna With Stacked Branched Monopoles and a Parasitic Strip," *IEEE Antennas Wireless Prop. Letters,* vol. 10, pp. 1208 – 1211, Nov. 2011.

[6] O. P. Falade, M. U. Rehman, Y. Guo, X. Chen and C. G. Parini, "Single Feed Stacked Patch Circular Polarized Antenna for Triple Band GPS Receivers," *IEEE Trans. Antennas*

dipole antenna loaded with single-cell metamaterial," *IET Micro. Antennas and Prop*., vol. 6, no. 1, pp. 17 – 23, Mar. 2012.

[9] K. C. Lin, C. H. Lin and Y. C. Lin, "Simple Printed Multiband Antenna With Novel Parasitic-Element Design for Multistandard Mobile Phone Applications," *IEEE Trans. Antennas Prop,* vol. 61, no. 1, pp. 488 – 491, Jan. 2013.

[10] C. T. P. Song, P. S. Hall and H. G. Shiraz, "Shorted Fractal Sierpinski

Monopole Antenna," *IEEE Trans.Antennas Prop*., vol. 52, no. 10, pp. 2564 – 2570, Oct. 2004.

[11] D. D. Krishna, M. Gopikrishna, C. K. Anandan, P. Mohanan and K. Vasudevan, "CPW-Fed Koch Fractal Slot Antenna for WLAN/WiMAX Applications," IEEE Antennas Wireless Prop. Letters, vol. 7, pp. 389 – 392, Nov. 2008.

[12] C. Varadhan, J. K. Pakkathillam, M. Kanagasabai, R. Sivasamy, R, Natarajan and S. K. Palaniswamy "Triband Antenna Structures for RFID Systems Deploying Fractal Geometry," *IEEE Antennas Wireless Prop. Letters*, vol. 12, pp. 437 – 440, Mar. 2013.

[13] S. Dhar, R. Ghatak, B. Gupta and D.R. Poddar, "A Wideband Minkowski Fractal Dielectric Resonator Antenna," *IEEE Trans. Antennas Prop*., vol. 61, no. 6, pp. 2895 – 2903, Jun. 2013.

[14] Y. Gao, B. L. Ooi, A. P. Popov, "Dual-band hybrid dielectric resonator antenna with CPW-fed slot", *Microwave and Optical Technology Letters*, vol. 44, No. 1, pp. 170-172, Jan. 2006.

[15] Y. F. Lin, H. M. Chen and C. H. Lin, "Compact Dual-Band Hybrid Dielectric Resonator Antenna With Radiating Slot", IEEE Antennas and Wireless Propagation Letters, vol. 8, pp.6-9, 2009.

Author Profile:

G. CHANDRA SHEKAR.. COMPLETED MASTER OF ENGINEERING AT UNIVERSITY COLLEGE OF ENGINEERING OSMANIA UNIVERSITY..
Email id: **chandu.vnr2007@gmail.com**.