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COMPARATIVE STUDY OF FRACTAL ANTENNA WITH RECTANGULAR MICROSTRIP ANTENNA.

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Abstract: In the present work the proposed fractal antenna is compared with L slotted linear microstrip antenna. Fractal antenna is basically used for multiband operations but here a new approach is developed for enhancement of bandwidth by fractal antenna. With the same dimension of ground plane it is found that the fractal antenna which is designed by the repetition of rectangular blocks provide much greater bandwidth than linear L slotted microstrip antenna of same dimension. The fractional bandwidth of fractal antenna is 58% and the fractional bandwidth of linear L slotted antenna is 30%. So it is clear that fractal antenna provides better bandwidth as comparison with linear microstrip antenna. The proposed fractal antenna is used for C band applications and L-slotted antenna is used for WLAN applications. Here we are comparing the bandwidth of fractal antenna with L Slotted antenna. we conclude by the results that the fractal antenna is better then microstrip patch antenna in enhancement of bandwidth. Here a line feed is used to energize the antenna and IE3D Zealand simulation software is used for simulation work.

Keywords: fractal, enhance bandwidth, gain, line feed, C band.

I. INTRODUCTION

The current upsurge in wireless communication systems has forced antenna engineering to face new challenges, which include the need for small-size, high performance, low cost antennas. There are many approaches to reduce the size of the antenna without much affecting the antenna performance. The application of the fractal geometry is one of the techniques. Fractal antenna is the antenna that uses a fractal, self –similar design to maximize the length or increase the parameter on inside sections or the outer structure of material that can receive or transmit electromagnetic radiation within a given total surface area or volume [1]. Fractal antennas have performance parameters that repeat periodically with an arbitrary fitness dependent on the iteration depth. Iteration depth refers to the number of iterations that should be carried out to get higher order structure [2-3].

Fractal antenna is basically used for multiband operations but here a new approach is adopted by which the proposed fractal antenna provide much better bandwidth as compare with linear microstrip antenna. The proposed fractal antenna is design by rectangular blocks with this approach the gasket design is obtained which is energized by a line feed and lenth and width of rectangular blocks varied in gasket design. with this approach proposed fractal antenna (fig 1) provides a fractional bandwidth of 58%..The length and width of the proposed antenna is 40 and 50 respectively with close to same dimension of linear microstrip antenna the L slotted microstrip antenna (fig 2) is designed and analyzed by IE3D simulation software. It is observed that it provides the fractional bandwidth of 30% which is very less than the bandwidth which is obtained by the proposed fractal antenna with this observation it is clear that the fractal antenna and the rectangular microstrip antenna of same dimension the fractal antenna provides much better results as compared to linear L shape slotted antenna. Microstrip antennas are used in high performance aircraft, spacecraft, satellite and missiles, where size, weight, cost, performance, ease of installation, and aerodynamic profile are constraints. Presently there are many other government and commercial applications, such as mobile radio and wireless communications that use microstrip antennas [1]. Microstrip antennas however have limitations in terms of bandwidth and efficiency, all imposed by the very presence of the dielectric substrate.

Here the rectangular block of size 4×2 mm is used for making the given fractal antenna and also its different size is used as shown in figure 2. To energize the given antenna a line feed is used. The length and width of strip line feed is 4 mm and 14 mm respectively. The probe feed position on strip line is shown in figure 1. The ground plane size is 41×50 mm^2. The proposed antenna is operated in C band hence it covers the applications of C band. The gain and directivity of proposed antenna is 2.62 and 3.67 dB. Such type of antenna cover the application of telecommunication, satellite communication, Wi-Fi, Radar, commercial and military. Another we are taking L shape slotted antenna whose length and width are 41 and 51.5 and it resonates at 2 GHZ.

II. ANTENNA DESIGN SPECIFICATIONS

Table1: Antenna design specifications -1

Ref.Block width	Length	Wg	Lg	ε_r
2	4	45	35	4.4

Table: 2 Antenna design specifications -2

Strip line length	Strip line width	Feed coordinate
4	14	X=23.174,y=3.25

The L-Shape Microstrip patch antenna is approximately a one-half wavelength long section of rectangular Microstrip transmission line. When glass epoxy is the antenna substrate, the length of the rectangular Microstrip antenna is approximately one-half of a free-space wavelength. As the Antenna is loaded with a dielectric as its substrate, the length of the antenna decreases as the relative dielectric constant of the substrate increases. The resonant length of the antenna is slightly shorter because of the extended electric "fringing fields" which increase the electrical length of the antenna slightly radiating .The proposed L Shape slotted antenna is designed is by using glass epoxy material with the designing frequency of 2 GHZ and the calculated Length and Width of the L slotted antenna are found to be 41mm and 51.5 respectively. By using IE3D simulation software the L Shape slotted Antenna is analyzed and it is found that it provides a bandwidth of 30%.the Resonating frequency of L shape slotted antenna is 2.1 GHZ and the gain & directivity of L Shape slotted antenna is 2.8 db and 3.2 respectively. The L Shape slotted antenna is energizes by probe feed,

Table3:L slotted Antenna design specifications

Parameters	Values
Dielectric Constant of the substrate	4.4 (glass epoxy)
Operating frequency	2.1 GHz
Height of the substrate	1.6 mm
Feeding method	probe Feed
Polarization	Linear
Gain	3.2 db
VSWR	1-2
Dielectric loss tangent	0.0013

I1I. ANTENNA DESIGN PROCEDURE

The proposed fractal antenna is designed by the repetition of rectangular block of size 4×2 mm^2 for making the proposed antenna material of glass epoxy material is used $\epsilon_{r=}$4.4 [4] and substrate height is 1.6 and loss tangent ratio is 0.0013.The block size is varied during the designing of antenna for the enhancement of the bandwidth.A modified line feed is used to enhance the bandwidth of proposed fractal antenna. The probe feed is placed at point (X = 23.175, Y = 3.25). During the designing of proposed antenna on IE3D ground plane is starting from (0, 0) at lower left corner. The geometry of proposed antenna is shown in fig

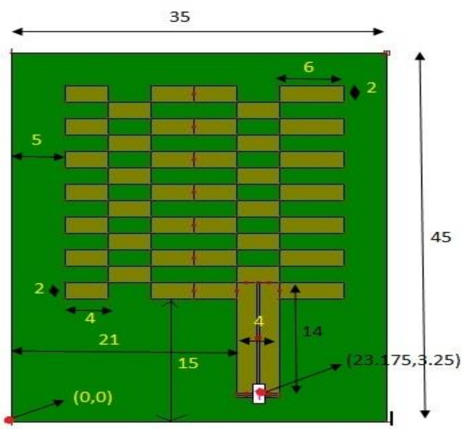

Fig.1. Geometry of proposed fractal antenna

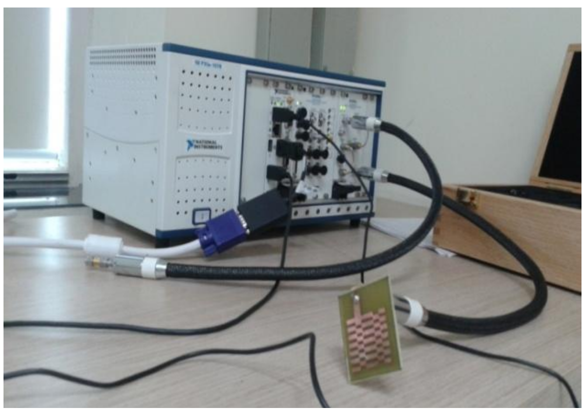

Fig.2. Experimental setup of proposed antenna

The most important parameters needed for the design of this antenna are the width and length of the patch antenna.

An accurate value of the width and length affects the results very much. For designing a rectangular Microstrip patch antenna, the length and width are calculated as below [1]

$$w = \frac{c}{2fr}\sqrt{\frac{2}{\varepsilon r+1}}$$

Where c is the velocity of light ($3x10^8$ m/s), ε_r is the dielectric constant of substrate (4.4), f_r is the antenna design frequency (2.0GHz), W is the patch width, and the effective dielectric constant εreff is given as

$$\varepsilon reff = \frac{\varepsilon_r + 1}{2} \text{ w } = \frac{c}{2fr}\sqrt{\frac{2}{\varepsilon r + 1}} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$$

By using the above mentioned equation we can find the value of actual length of the patch as

$$L = \frac{c}{2fr\sqrt{\varepsilon reff}} - 2\Delta L$$

The extension length ΔL is calculated as

$$\frac{\Delta L}{h} = 0.412\frac{(\varepsilon_{reff} + 0.3)(\frac{W}{h} + .264)}{(\varepsilon_{reff} - .258)(\frac{W}{h} + 0.8)}$$

The length and the width of the ground plane can be calculated as [1]

$$L_g = 6h + L$$
$$W_g = 6h + W$$

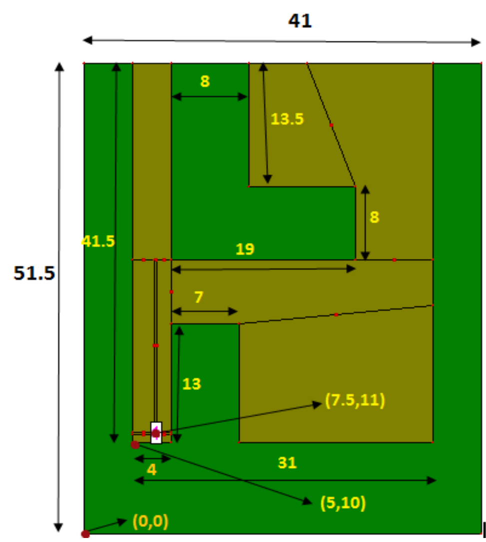

Fig.3. Geometry of L slotted antenna

IV. Comparitive study of fractal antenna and L slotted microstrip patch antenna.

Here we have performed the comparative study of Fractal antenna with Linear L Slotted microstrip patch antenna. It is concluded that the fractional bandwidth of fractal antenna is much better then the Linear slotted L shape antenna. Different parametrers are also

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compared as shown in the table. Fractal antenna covers all the applications of C band and Linear slotted L shape antenna covers the application of WLAN.

Table 4: Comparison of two antennas

Parameter	Fractal antenna	L slotted antenna
Fractional bandwidth	58.1%	30%
Gain	2.62	2.8
Directivity	3.67	3.2
Return loss	-19	-20
VSWR	1-2	1-2

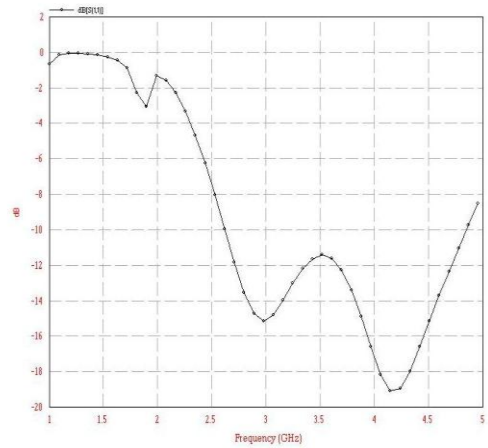

Fig5. Return loss v/s frequency graph.

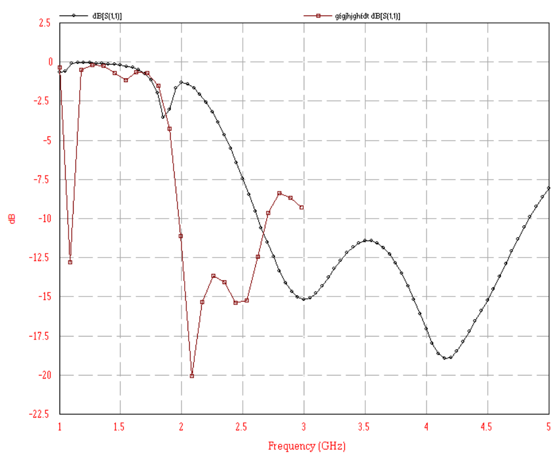

Fig 4: comparision of fractal and L shaped antenna

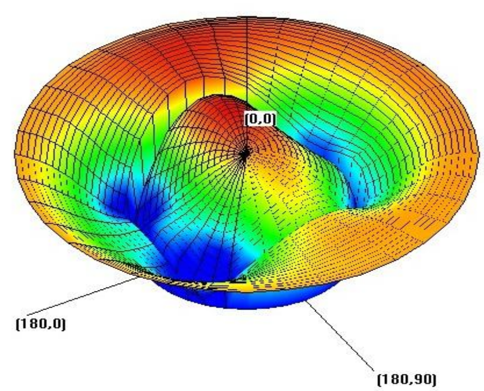

Fig.6. 3D Radiation pattern of proposed antenna.

V. Results and discussion

The frequency band of proposed antenna is from 2.65 GHz to 4.82 GHz. The fractional bandwidth is around 58.1%.The return loss is -19 db .The resonant frequency is 4.2GHZ. The proposed antenna covers the application of C band. This is the best and convenient method to calculate the input and output of the signal source. It can be said that when the load is mismatched the whole power is not delivered to the load there is a return of the power and that is called loss, and this loss that is returned is called the „Return loss". This Return loss determined in dB

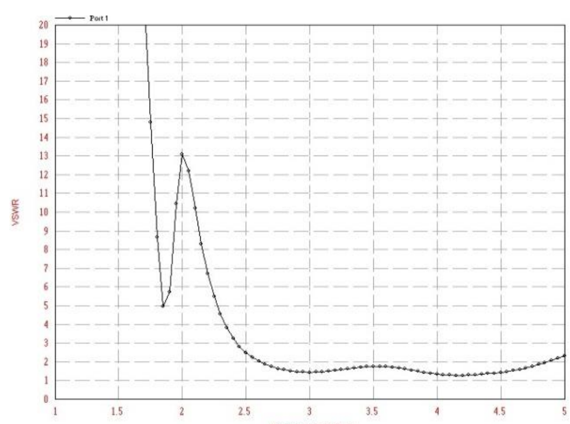

Fig.7. VSWR of proposed antenna

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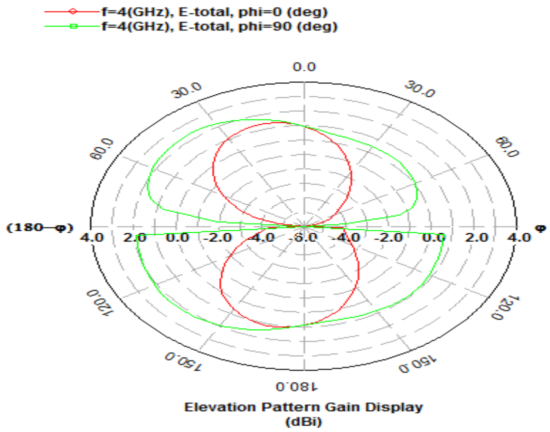

Fig.7. 2D radiation pattern of antenna

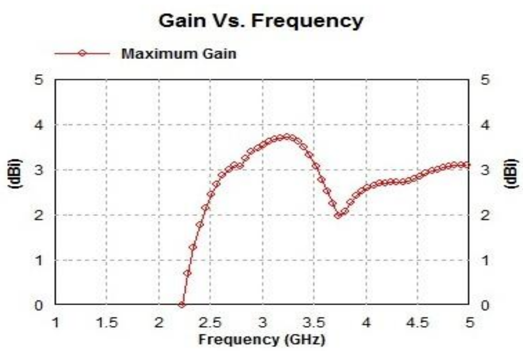

Fig.8. Gain vs. frequency plot.

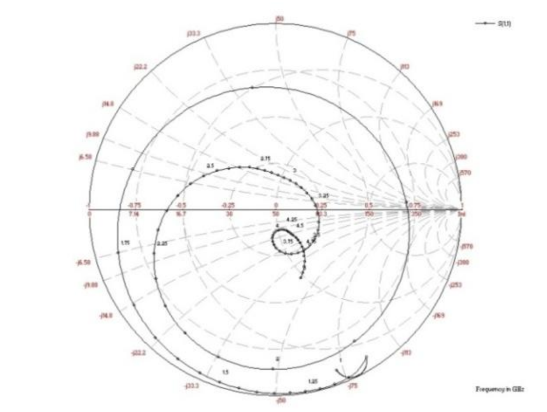

Fig-9: Smith chart

VI. Results of L shape Slotted micro strip patch Antenna

As the design process goes the calculation of the parameters are done above and with the dimensions the L-shape microstrip patch antenna has been designed by the probe feeding techniques. Here we take the microstrip feed technique in practice and the results are as shown below. The table gives the possible parameters for the design of the microstrip patch antenna which would be used in the software for the results to examine

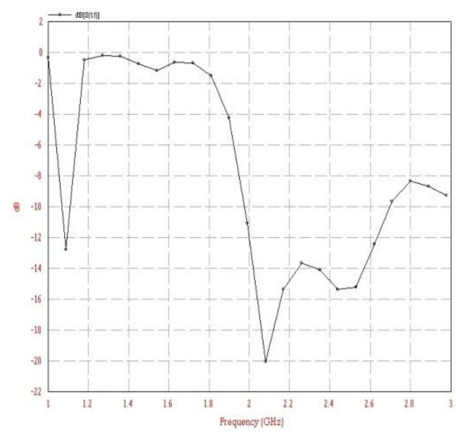

Fig.10. Return loss v/s frequency graph.

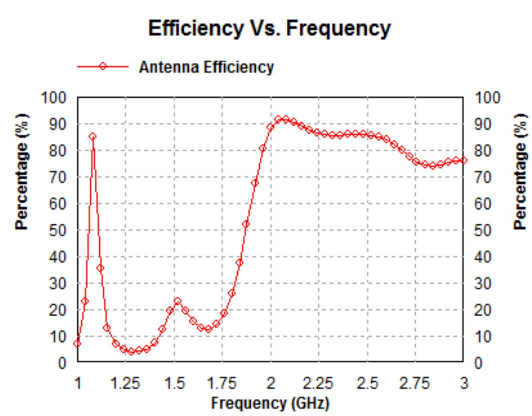

Fig.11.Efficiency graph of proposed antenna.

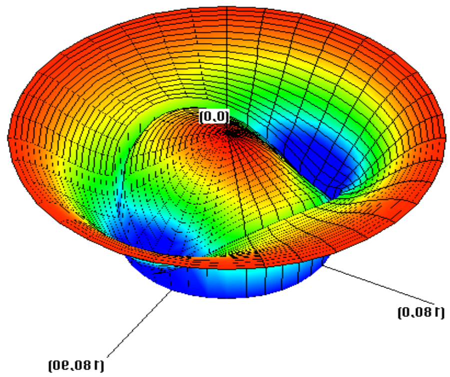

Fig.12. 3D Radiation pattern of proposed antenna

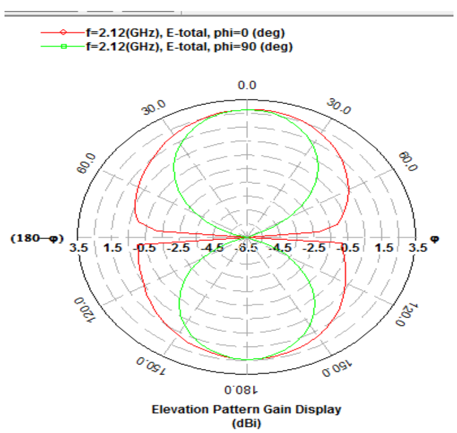

Fig.13. 2D radiation pattern of antenna

VIII. Conclusion

The characteristics of proposed repeated fractal structured antenna are studied. In general, the impedance bandwidth of the traditional Micro strip antenna is only a few percent (2%-5%) [5]. Therefore, it becomes very important to develop a technique to enhance the bandwidth of the Micro strip antenna. Proposed antenna improved the fractional bandwidth upto58.1%. The proposed antenna has been designed on glass epoxy substrate to give a maximum radiating efficiency of about 79.59% and gain of about 2.62 db

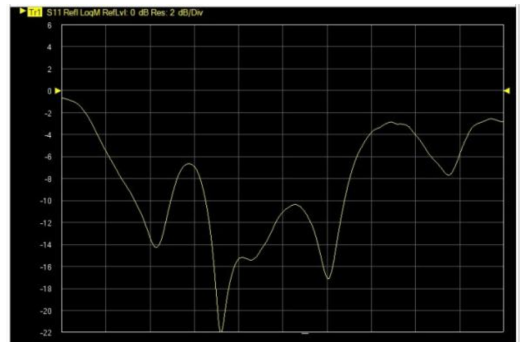

Fig. 14. Experimental result

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