Pak. J. Biotechnol. Vol. 13 (special issue on Innovations in information Embedded and Communication Systems)
Pp. 215- 219 (2016)

FRACTAL ANTENNA FOR MULTIBAND APPLICATIONS

Dhivyabharathi, R. and K. Ramprakash

Electronics and Communication Engineering, Kumaraguru College of Technology, Coimbatore
dhivyabharathimam@gmail.com; ramprakash.k.ece@kct.ac.in

ABSTRACT

This paper presents the simulation and design of a wideband H-shaped microstrip patch antenna. The shape will give the broad bandwidth which is needed in the different kinds of application for example satellite communication, mobile radio, biomedical application, remote sensing and so on. In this system (IEEE 802.11a standard) the high speed wireless local area network is used to generating the H-shaped microstrip patch antenna. The antenna is an upgrading from previous research by using H-fractal and this has been used for multiband antenna. The proposed system shows that the proposed antenna can excite much significance with sensible antenna directivity. The S parameter and Voltage Standing Wave Ratio (VSWR) show that the proposed system is better candidate for a different kind of antenna application.

Keywords— *H-shaped microstrip, antenna, S parameter and Voltage Standing Wave Ratio (VSWR), bandwidth*

I. INTRODUCTION

Microstrip patch antenna is a key concept of generating the global positioning system and wireless communication system. Since it was initially exhibit in 1886 by Heinrich Hertz and Guglielmo Marconi present the practical application in 1901 [1]. [2] Future trend in the design of microstrip, antenna communication is a compact device. The Microstrip patch antenna has lot of advantages like mechanically robust, low fabrication cost, light weight when mounted on the rigid surfaces. The capability of the triple and dual frequency operations all these features attract with different kind of researchers to examine the performance of the parch antenna in the different way. However, narrow bandwidth derived as the one of the main drawback for this kind of antenna.

Different kind's methods have been employed to overcome this drawback such as introducing the parasitic elements which means stack configuration or co-planar or altering the shape of patch itself, increasing the substrate thickness and so on. Altering the shape of the patch includes designing a U-slot patch antenna or E-shaped patch antennas and so on [3].

In this work, a new H-shaped fractal is utilized to design a multiband planer antenna. The proposed H-shaped fractal is quite easy and straightforward for implementation process and the multiband feature of the proposed design is shows by using |S11| reflection coefficients. The antenna is an upgrading from previous research by using H-fractal and this has been used for multiband antenna. The proposed system shows that the proposed antenna can excite much significance with sensible antenna directivity. The S parameter and Voltage Standing Wave Ratio (VSWR) show that the proposed system is better candidate for a different kind of antenna application.

II. RELATED WORK

In [4] author presents the patch antenna work with the intention of convinced divergence and also obtained the size reduction operation frequency. In this paper also analyzed the radiation pattern, Electric Far Field, Directivity of the antenna and Gain of the antenna. The simulation results are extracted by utilizing the electromagnetic simulation software named as feko software are showed and discussed in detail.

In [5] author presents the analysis and design of a slotted E-shaped micro strip patch antenna. The main objective of this work is to deals with the implementing an antenna structure such that it can utilizes multiple applications. In this work to attained this aim a using slotted E-shaped micro strip patch antenna which is simulated and designed over the ADS simulation software. The full-wave electromagnetic simulator with Method of Moments (MoM) is gives the results considered as S11 parameters, radiation pattern, and directivity and so on. The proposed antenna is simulated and designed to express that the designed antenna gives a directivity of 7.259 dBi and gain of 7.258 dBi and results shows that the high speed wireless LAN network.

In [6] author presents a design Rectangular micro strip patch antenna by using Rectangular patch. Here the Rectangular patch is cutting multiple nonagon void shape for designing the system. This work finds the return loss, bandwidth, and VSWR result by using probe feeding at proper position and antenna design. In this work IE3D simulation software is used for analysis the proposed work and the simulation results show the better bandwidth and VSWR.

In [7] author present the Design of 2.4 GHZ H shaped microstrip patch antenna by utilizing electromagnetic simulation software which means Ansoft HFSS. In the standard rectangular microstrip patch antenna has lot of drawback due to their narrow bandwidth. Thus, in this work to overcome this drawback in this work rectangular patch H shaped is utilized to attain broad bandwidth. In this work done by using Ansoft HFSS v.13 and the simulation results contains the different types of parameters such as axial ratio, radiation pattern, gain, and VSWR and return loss.

This section deals that the different discussions about the microstrip antenna design methodology in the wireless communication networks [8], design the sixteen faced microstrip patch antenna using the slit edge. The antenna is fed into the probing model which uses the IE3D simulator for designing the sixteen face microstrip antenna. Then the performance of the system is evaluated using the radiation parameter like scattering parameters, voltage standing wave ratio.

In [9] maximize the gain of the micro strip patch antenna. The microstrip gain has been achieved by utilizing the microstrip circular patch antenna with 5.8 GHz frequency. Then the overall antenna has been designed based on the high frequency structured simulator software which provides the better results when compared to other existing antenna design methods. Furthermore the efficient antenna design has been implemented using the coaxial feeding techniques.

In [10] proposed an wide band patch antenna which designed and worked based on the S band. During the design process the E –shaped patch is designed which determining the grooving of the E patch size. At the same time SMA connector is used to design the antenna with efficient manner and the comparative study is made with several design parameters and the result is discussed using the Voltage Standing Wave Radio(VSWR)in-band is no more than 1.5, Orthogonal polarization is better than 15 dB.

III.DESIGN OF ANTENNA

Figure 1 shows the H-shaped fractal antenna's design process, from the initial stage (Stage 1) the antenna comprises of a horizontal metal strip with the width W1 and length L1. In the stage two (Stage 2), the two vertical strips (L2)'s length is converted as $\delta \, x \, L1$, where δ defined as the scale factor with the value between $1 \; and \; 0$. Hence, L1 is greater than L2, temporarily the two vertical strips are additionally added to horizontal strip's two ends. The width of the two vertical strips is considered as the 3.0 mm and which is similar as that the horizontal strip. The same process is employed to the Stages 3 to 7 as show in figure 1. At lost, the proposed H-fractal antenna is got at Stage 7 as presented in figure 2. The strips length in each and every stage can be defined as follows

$$L(i+1) = \delta L(i) \qquad (i = 1,2,\ldots 6) \qquad (1)$$

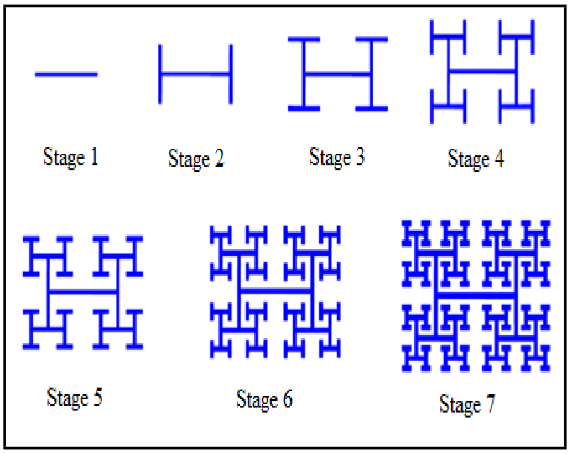

Figure 1. Different Stages of the H-shaped Fractal

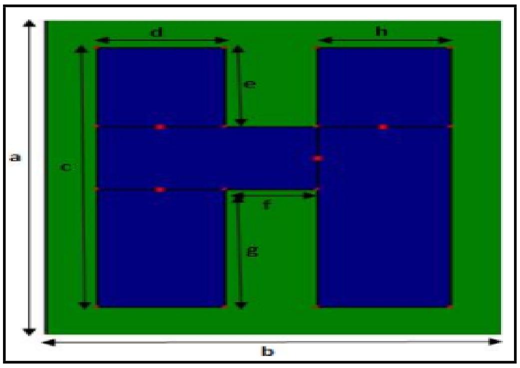

Figure 2. Geometry of the H-fractal antenna

The Microstrip patch antenna's width is as follows

$$w = \frac{1}{2f_r\sqrt{\mu_0 \epsilon_0}}\sqrt{\frac{2}{\epsilon_1 + 1}} = \frac{v_0}{2f_r}\sqrt{\frac{2}{\epsilon_1 + 1}}$$

(2)

where v_0 defined as the free space light velocity

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{-1/2} \quad (3)$$

(3)

where the patch dimensions along its length have been stretched on each and every end by a distance ΔL which is known as effective dielectric function and the width to height ration (W/h).A practical and very popular approximate relation for the length's normalized extension is defined as follows

$$\frac{\Delta L}{h} = 0.421\frac{(\epsilon_{reff} + 0.33)\left(\frac{W}{h} + 0.264\right)}{\epsilon_{reff} - 0.258\left(\frac{W}{h} + 0.8\right)} \qquad (4)$$

The actual length of the area is defined as follows

$$L = \frac{1}{2f_r\sqrt{\epsilon_{reff}}\sqrt{\mu_0 \epsilon_0}} - 2\Delta L$$

-2ΔL (5)

The different kinds of antenna's design parameters are computing by utilizing the above equation.

IV. RESULTS AND DISCUSSION

In this work, High Frequency Structure Simulator (HFSS) is used for evaluation process. The HFSS simulator is one of the better simulators which is used for complex 3D geometries and it shows automated solution process, powerful drawing capabilities and it also used to calculate far field patterns.

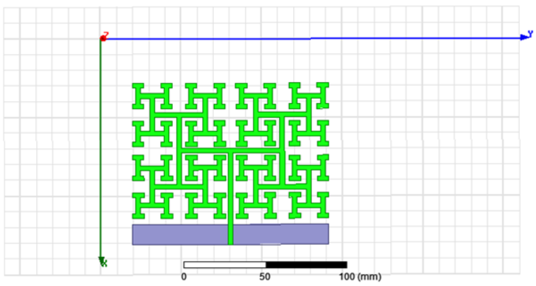

Figure 3. Reflection Coefficients |S11| H-fractal Antenna

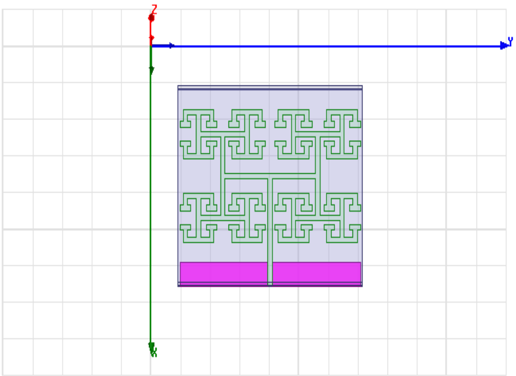

Figure 4. Reflection Coefficients |S11| E-fractal Antenna

The proposed antenna has been designed using the H-shaped and E-shaped fractal antenna's design process and the related gain total frequency value is shown in the following figure 3 and 4.

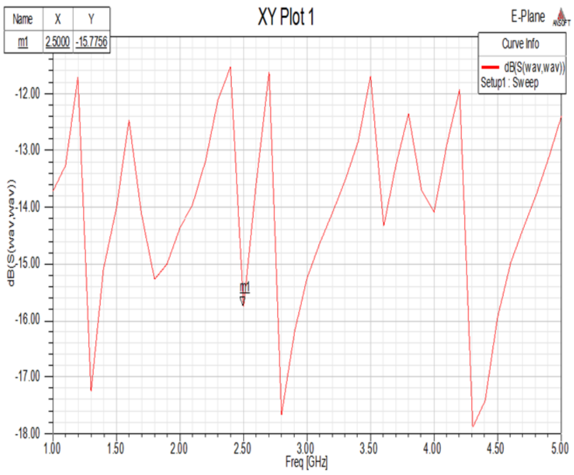

Figure 5: Gain Total Frequency for H-fractal Antenna

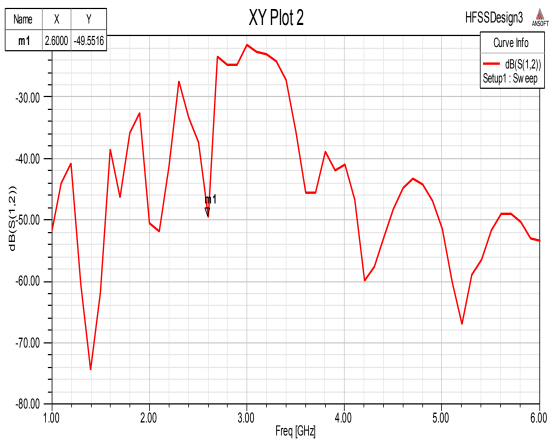

Figure 6: Gain Total Frequency for E-fractal Antenna

From the figure 5 and 6, the optimized gain total frequency is obtained in the 2.50GHz and the efficiency of the proposed designed antenna is evaluated using the s-parameter display which is shown in the figure 5 and 6.

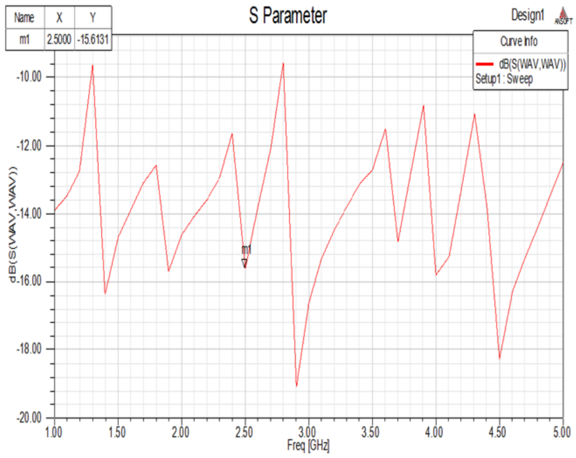

Figure 7: S-Parameter Display for H-Fractal Antenna

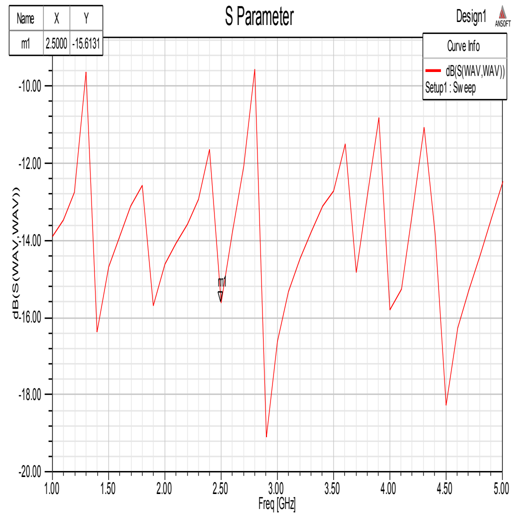

Figure 8: S-Parameter Display for E-Fractal Antenna

From the figure 7 and 8 S-parameter display of iteration is understood that the resonant occurs at the frequency in 2.50GHz for the return loss in -16.54dB. Then the simulated VSWR value is shown in the figure 7 and 8.

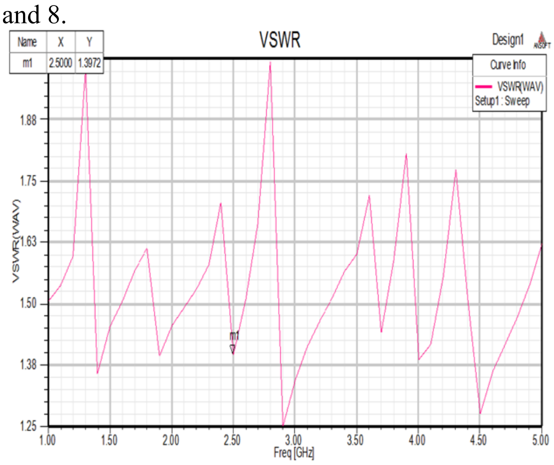

Figure 9: VSWR Value for H-Fractal Antenna

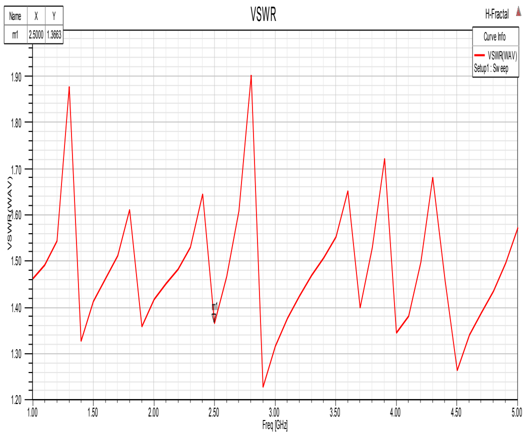

Figure 10: VSWR Value for E-Fractal Antenna

[

Then the figure 9 and 10 show that the simulated VSWR value is 1.39 for the same frequency 2.50GHz in H-Fractal antenna and 2.50 for the same frequency 1.36 GHz in E-Fractal Antenna which achieves the resonant frequency while designing the micro strip antenna with efficient manner. Finally the performance of the system is evaluated using the radiation pattern which is shown in the figure11 and 12 as well as the 3D radiation pattern as show in figure 13.

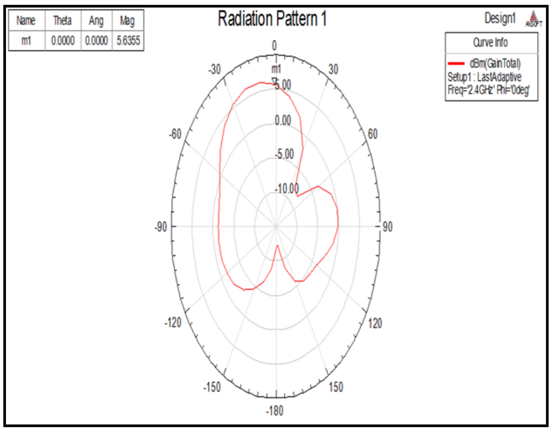

Figure 11: Radiation Pattern for H-Fractal Antenna

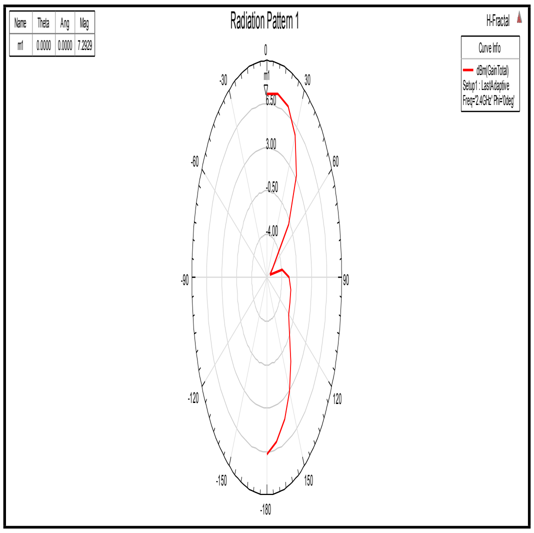

Figure 12: Radiation Pattern for E-Fractal Antenna

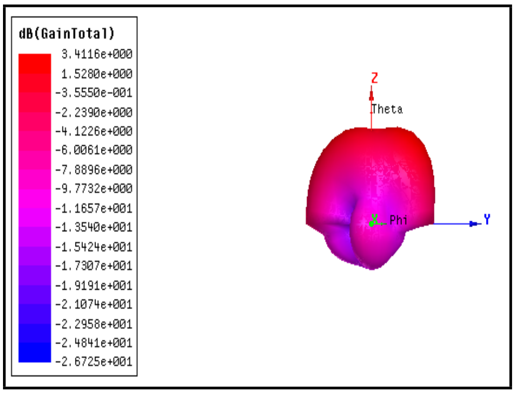

Figure 13: 3D Radiation Pattern

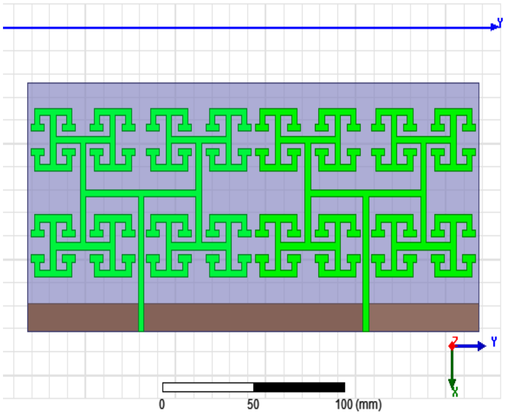

Figure 14. Reflection Coefficients |S11| E-fractal Array

Figure 14 and 15 show the proposed E-Fractal Array structure and Radiation pattern for the array respectively.

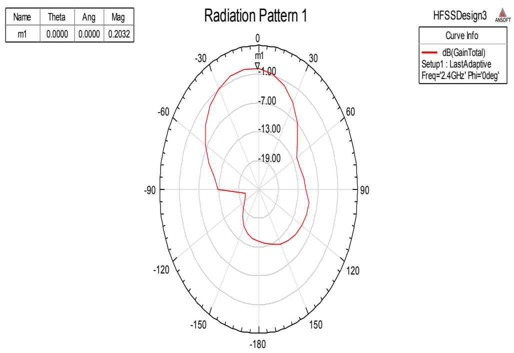

Figure 15: Radiation Pattern for E-Fractal Array

Thus the designed radiation pattern used to evaluate the efficiency of the proposed E-shaped antenna array direction. Thus the proposed system achieves the efficient results when compared to other design topologies. Comparison of existing and modified results is as shown in table I.

DESIGN	S11-PARAMETER	VSWR	DIRECTIVE GAIN
Existing H-Fractal Antenna	-16.20	1.36	7.2929(dBm)
Modified E-Fractal Antenna	-15.16	1.39	5.6355(dBm)
Modified E-Fractal Array	-49.55	1.35	0.2032(dB)

V. CONCLUSION

This paper presents the simulation and design of a wideband H-shaped and E-shaped microstrip patch antenna. The H- shaped antenna is an upgrading from previous research by using E-fractal and this has been used for multiband antenna. The proposed system shows that the proposed antenna array can excite much significance with sensible antenna directivity. The S parameter, Voltage Standing Wave Ratio (VSWR) and Radiation Pattern show that the proposed antenna array system is better candidate for a different kind of antenna application.

REFERENCES

[1] Bharatendra Singh Niboriya, Chetan Choudhary and Gyan Prabhakar, S-shape Wideband Microstrip Patch Antenna with Enhanced Gain and Bandwidth for Wireless Communication. International Journal of Computer Applications 73(7): 17-20 (2013).

[2] Kasinathan, A., V.Jayaraj and M.Pachiyaannan, E-Shape Microstrip Patch Antenna Design for Wireless Applications. International Journal of Innovative Science, Engineering & Technology 1(3): 484-490 (2014).

[3] Jitesh Kumar, Sakshi Singh, Sarthak Singh and Arvind Gaur, A Multiple Nonagon Void Slotted Rectangular Micro-Strip Patch Antenna. International Journal of Engineering and Advanced Technology (IJEAT) 2(5): 183-185 (2013).

[4] Karthikeyan, V. and V.J.Vijayalakshmi, Radiation Pattern of Patch Antenna with Slits", International Journal on Information Theory (IJIT) 3(1): 1-6 (2014).

[5] Padmanaban, L., B.Senthil, S. Immaculate Joy and R. Rekha, Design and Analysis of a Slotted Eshaped Microstrip Patch Antenna For Indoor Wireless Applications. Journal of Multi-disciplinary Engineering Science and Technology (JMEST) 1(5): 396-399 (2014).

[6] Jitesh Kumar, Sakshi Singh, Sarthak Singh and Arvind Gaur, A Multiple Nonagon Void Slotted Rectangular Micro-Strip Patch Antenna. International Journal of Engineering and Advanced Technology (IJEAT) 2(5): 183-185 (2013).

[7] Chaitali. J. Ingale and Anand. K. Pathrikar, Designing of Bandwidth Improved 'h' Shaped Microstrip Patch Antenna for Bluetooth Applications using Ansoft HFSS. International Journal of Science and Research (IJSR) 3(4): 818-823 (2014).

[8] Jie Fang, The design for S band microstrip and wide-band patch antenna. Microwave Technology & Computational Electromag-netics in IEEE Pp. 193-195 (2013).

[9] Keshav Gupta, Kiran Jain and Pratibha Singh, Analysis And Design Of Circular Microstrip Patch Antenna At 5.8GHz. International Journal of Computer Science and Information Technologies 5(3): 3895-3898 (2014).

[10] Salai Thillai Thilagam J. and P. K. Jawah, Patch Antenna Design Analysis For Wireless Communication. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering **2**(7): 3101-3109 (2013).