International Journal of Modern Trends in Engineering and Research
www.ijmter.com
e-ISSN No.:2349-9745, Date: 2-4 July, 2015

Design of Hexagonal Fractal Antenna Array for Multiband Wireless Application

Jyoti Ananda Jadhav[1], Prof.Ramesh Pawase[2], Prof.RekhaLabade[3]

[1]*Department of E&TC, AVCOE.Sangamner, jyotijadhav006@gmail.com*
[2]*Department of E&TC, AVCOE.Sangamner, rameshpawase@gmail.com*
[3]*Department of E&TC, AVCOE.Sangamner, rplabade@gmail.com*

Abstract—In this paper describes the concept of new fractal multi-band antenna based on the hexagonal shape. Three iterations of the hexagonal fractal &array multiband antenna arranged are examined.With this structure it is possible to configure the multi-band frequency and radiation patterns with high directivity and gain. Antenna is simulated using CAD FEKO suite (6.2) using method of moment .The fractal antenna is fabricated using FR4 dielectric constant of 4.4 and loss tangent of 0.02.The software is used to design and analyze the antenna array for application at 1.2, 1.8 GHz, 2.7 GHz & 2.9 GHz.

Keywords-- Fractal multiband antenna,hexagonal fractal multiband antenna, and iteration function system, sierpinski gasket, sierpinski gasket antenna, CAD FEKO suite 6.2.

I. INTRODUCTION

In modern wireless communication systems and applications, wider bandwidth, multiband and low profile antennas are in great demand for both commercial and military applications. .The rapid increase of wireless communications leads to a large demand in designing of a multiband antenna. Traditionally, each antenna operates at single or dual frequency bands, where different antenna is used for different applications. There are different configurations used for multiband antenna. The fractal antenna geometry concept is a special technique used to design multiband antenna. the name "fractal" from the latin "fractus" meaning broken, was given to highly irregular sets by Benoit Mandelbrot in his foundational essay in 1975 [1].fractal is recursively generated structure having self-similar shape, which means that some of the parts have same shape as whole object but at the different scale. Due to self-similarity property of the fractal they are especially suitable for the design of multiband frequency antenna. Due to the concept self-similarity and infinite complexities, the proposed geometry of the antenna is very versatile is in term of polarization radiation pattern, gain and bandwidth. In this paper the self-similarity property of hexagonal is used to achieve the multiband operation.

II. HEXAGONAL FRACTAL ANTENNA

The geometry of fractal is important because effective length of fractal antenna can be increased while keeping total area same. Most of the fractal geometries have the following characteristic features: infinite complexity and detail, fractional dimension and self-similarity. These characteristic features of fractal can be utilized in antenna design to get the following advantage:

Better Efficiency: fractals have sharp corners and edges that cause abrupt changes in the direction of current and hence enhance radiation. Therefore fractals are efficient radiator of electromagnetic energy [2].

Multiband antenna: due to the self-similarity property of fractals there are multiple copies of the geometry in a fractal object and hence they can be utilized for multiband antennas [2].
Size: Compact size compared to antennas of conventional designs, while maintaining good to excellent efficiencies and gains. The first three iteration of hexagonal fractal antenna is shown in figure 1which shows that the area remains same but length of antenna get increase due to iteration.

III. ANTENNA GEOMETRY

The hexagonal fractal microstrip antenna for three iterations has shown in fig.1 the hexagonal fractal antenna is mounted on FR4-printed circuit board (PCB) with dielectric constant of 4.4 and thickness of h= 1.6mm.,a=24,.substrate length=110mm, width=110mm. Third iteration geometry of an antenna consist of eight small shaped hexagonal which are constructed by reducing and grouping these hexagon generator shape to one third its first iteration.

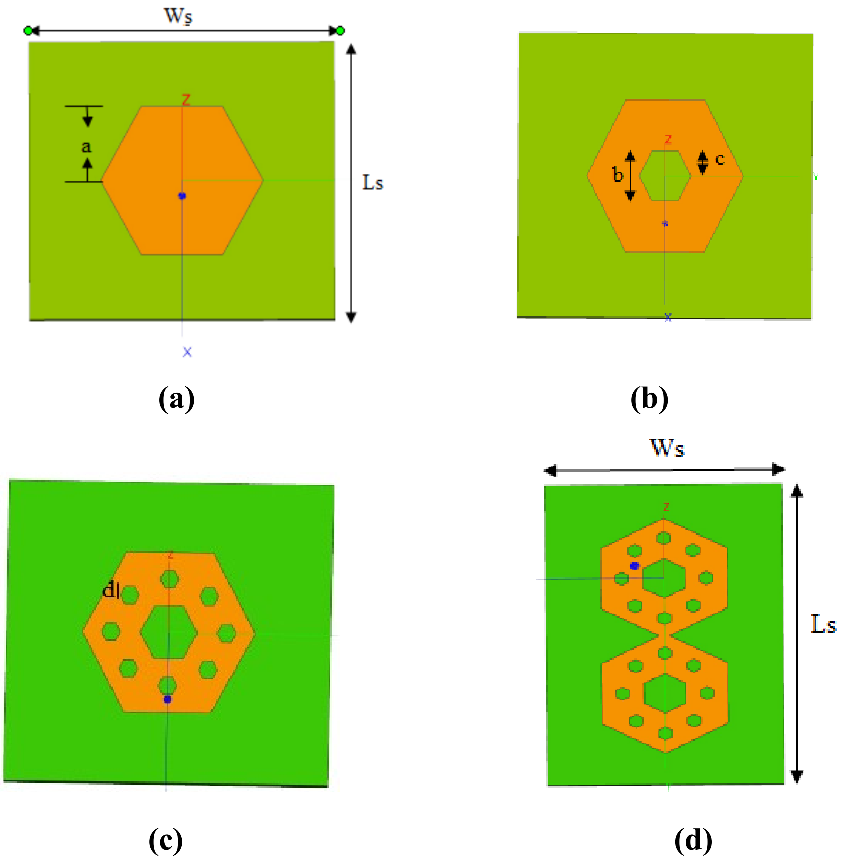

Figure 1. first three iteration of hexagonal fractal antenna.

IV. SIMULATED RESULT

The first three iteration of corner fed hexagonal fractal dipole measured and have been examined using finite element method. The hexagonal fractal antenna is design for four iterations i.e.0^{th} iteration, 1st iteration, 2nd iteration and 3^{rd} iteration and the result are noted for different parameter as shown in table below.

Table 1. Simulated results

Iteration	Frequency	Reflection Coefficient	VSWR	Gain (dBi)	Bandwidth
0th iteration	1.56966	-17.2216	1.3193	4.581	10
1st iteration	1.50124	-15.3327	1.44	5.220	11
2nd iteration	1.50628	-30.92	1.0585		
	2.57822	-25.5933	1.1087		29
3rd iteration	1.12	-13.1	1.57		72
	1.8645	-26.56	1.1		53
	2.786	-18.15	1.28	2.612	147
	2.98869	-18.6797	1.27		108

4.1. Return Loss

The return loss for the 3rd iteration of the hexagonal fractal antenna is plotted in figure 2. The hexagonal fractal produced a high return loss compared to the sierpinski carpet fractal antenna. The proposed scheme is tested using ordinarily image processing. From the simulation of the experiment results, we can draw to the conclusion that this method is robust to many kinds of watermark images.

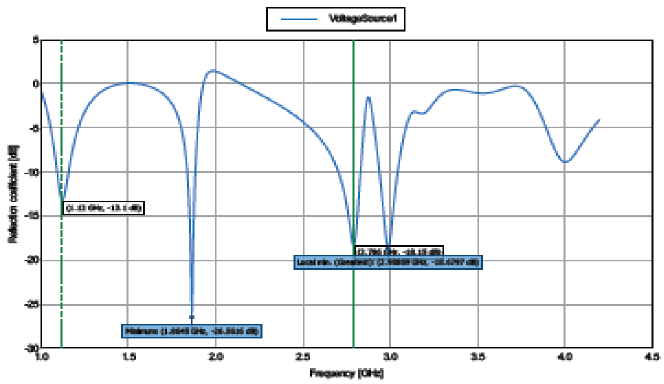

Fig2: reflection coefficient magnitude [dB]- fractal_3rd iteration array.

4.2. Vswr:

Voltage Standing Wave Ratio (VSWR) is a ratio between maximum voltage and minimum voltage along transmission line. [6]. The VSWR is given by

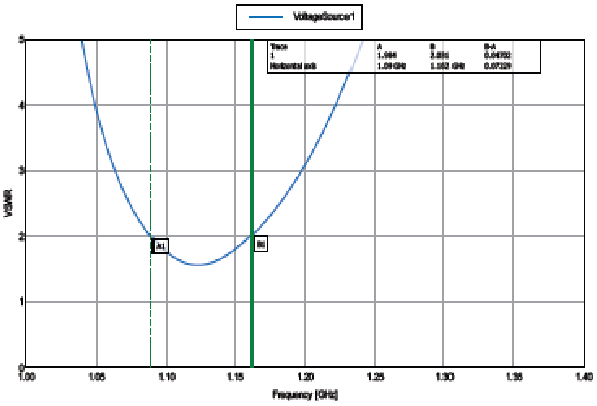

Fig 3: VSWR-Fractal_ 3rd iteration array

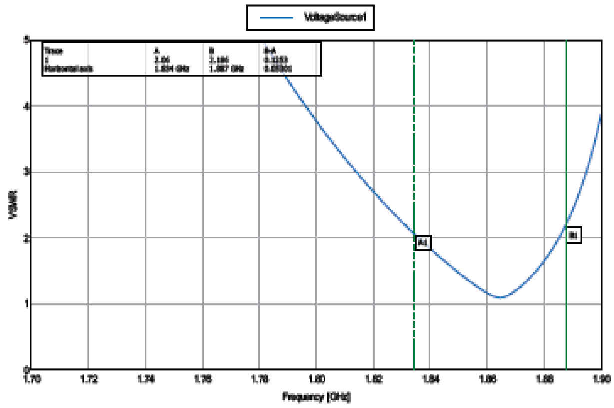

Fig 4: VSWR-Fractal_3rd iteration array

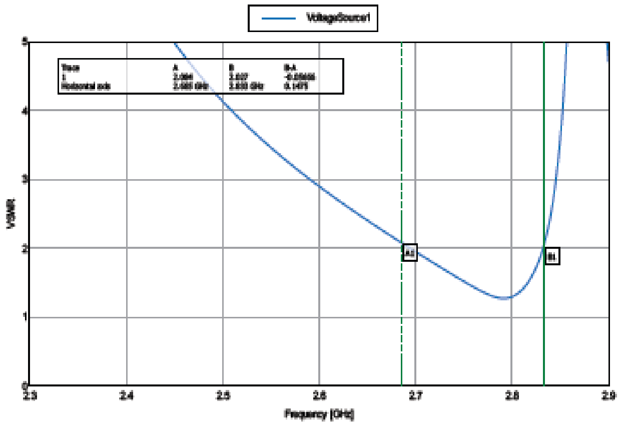

Fig5: VSWR –Fractal_3rd iteration array

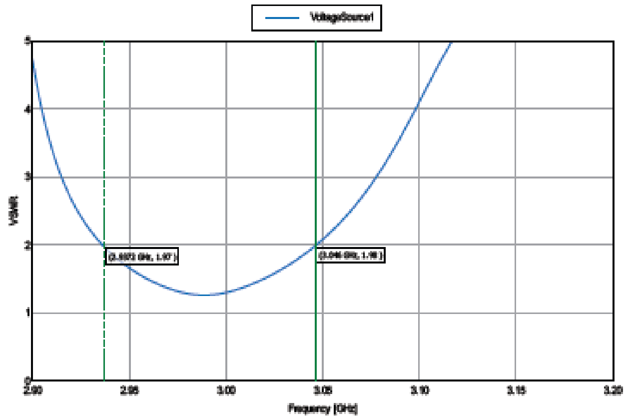

Fig6: VSWR –Fractal_3rd iteration array

4.3. Directivity:

Directivity, d is an important parameter that shows the ability of the antenna focusing radiated energy. Directivity is a ratio of maximum radiated to radiate by reference antenna. Reference antenna is an isotropic radiator where the radiated energy is same in all the direction and has directivity of 1.

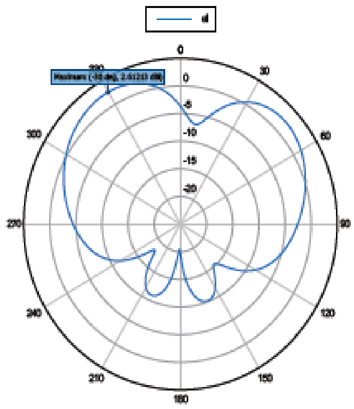

Figure 7. phi gain [dBi] (frequency =2.81818GHz; phi= 90 deg) – fractal_3rd iteration array

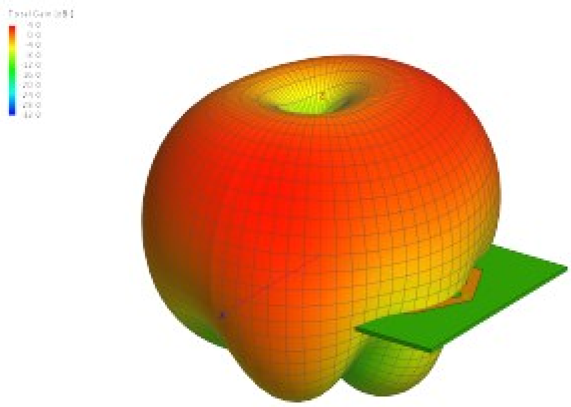

Figure 8. 3D VIEW

CONCLUSION

The hexagonal fractal antenna has designed and simulated on CAD FEKO suit (6.2). By which can improve antenna parameter with different iteration methods, by changing the structure and keepingthe size constant. The simulated results have shown a good radiation structure, which has high directivity and gain, when compared to a simple patch antenna. The return loss measurements show an excellent dip and suitable bandwidth. The directivity and gain are directly proportional to the number of fed array element which can be used for multiband application. Thus , designed antenna can be used for various application GPS at 1.2 GHz, application of mobile operating at 1.9 GHz, USB Dongle operating at 2.7 GHz and 2.9 GHz for satellite system.

REFERENCES

[1] C.puente.J.Romeu, R.Pous, And A.Cardama, "On the behavior of the Sierpinski multiband fractal antenna," *IEEE trans. Antennas propagate.* vol. 46, pp. 517-524,apr. 1998.

[2] Manas Jena, B.B. Mangaraj And Debases Mishra, "Bandwidth and gain enhancement of multiband fractal antenna based on the sierpinski carpet geometry," ICTACT Journal On Communication Technology, March 2013, vol. 04, issue:01

[3] C.Puente ,J.Romeu.R. Pous X.Garcia , And F. Benitez , "fractal multiband antenna baesd on the sierpinski gasket," electron. Let, vol.32, no.1. pp .517

[4] Prashant More, Sanjay V. Khobragade, "A hexagonal–shaped fractal antenna array for multiband applications.

[5] Dethalia Manjibhai, Prof.Jayeshkumar Parjapati, Dipakkumar Barasara., "An Overview Of Fractal Geometries And Antenna." International Journal Of Engineering And Science, ISSN 2278-4721, Vlo.1,Issue2(Sept 2012), PP 01-04.

[6] Rahul Batra, P.L.Zade, Dipika Sagne, "design and implementation of sierpinski carpet fractal antenna for wirelesscommunication." International journal of scientific research engg & technology (IJSRET) vol.1. Issue3.pp.043-047, july2012.

