International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 4 Issue: 11 252 – 256

A Modified Multiband U Shaped and Microcontroller Shaped Fractal Antenna

Shweta Goyal[1], Yogendra Kumar Katiyar[2]

[1]M.tech Scholar,[2]Associate Professor
Regional College for Education research & Technology

Abstract- The aim of this paper is to describes the designs of a like structures like A modified Multiband U shaped[9] and microcontroller shaped[10] with the help of IE3D simulation software. Fractal geometry is a methodology through which size reduction is achieved. The fractal geometry generates multiple or enhancing bandwidth[5]. This paper describes the simulation of iterations of antennas and performs the characteristics of these antennas.

*****

I. Introduction

To convert electric power into the radio waves antenna is used. Antennas are generally used with the help of a radio transmitter or radio receiver. Lastly, telecommunication systems require antenna with wider bandwidth and with smaller dimension than other formally possible antennas. This has initiated antenna research in various directions, one of which is by using fractal shaped antenna elements. There is important relation between antenna dimension and wavelength that is, if the size of an antenna is less than λ/4 then antenna is not high-octane because gain ,bandwidth and radiation resistance is reduced and to get overcome from these limitations the antenna size is increased, which again is a problem for hand held devices. Fractal geometry is a very good solution for this problem. A fractal is a recursively generated object having a fractional dimension. The demand of fractal antennas for multiband antennas is discussed in [3,4,5].Most of the design have various characterstics: like infinite complexity etc. In this paper extension of microcontroller shape and U shaped fractal patch antennas are presented.

1.Design of microcontroller shaped fractal antenna

Size reduction is one of the vital advantages of fractal antenna [7,8,10]. Minkowski fractal geometry algorithm is used as shown in figure 1.

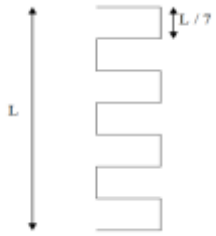

Fig 1:Minkowski fractal geometry

Minkowski algorithm has been applied to the rectangle as shown in figure 2. By dividing length into 7 parts and removing three squares from right side of the patch, this microcontroller Shape patch is formed. By applying further iterations self similar structures can be made. Initially rectangle patch is taken having dimensions of 7mm by 9.8 mm using FR-4 as substrate of thickness 1.6 mm as shown in table 1. By applying different iterations of fractal geometry self-similar structures as shown in figure 3 and 4 are obtained[10].The rectangular patch having dimension 7 mm by 9.8 mm is taken as shown in figure 2 and coaxial feed has been given[10]. Feed point has been chosen in such a way that impedance matching take place at that point.

Fig 2: Basic Rectangular Geometry

Now patch obtained in figure 3 can get by using concept of fractal geometry. Vertical length of 9.8 mm is divided into 7 parts, each of length 1.4 mm. Square cuts of 1.4 mm length to right sides and left sides of the rectangle shown in figure 3.

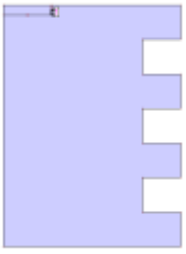

Fig 3.First iteration

Similarly, same algorithm is applied to obtain the next iteration. Two squares of 1 mm on the remaining three parts

ISSN: 2321-8169
252 – 256

of the both side patch are removed. Feed point is being taken as x= -1.5, y= 4.6 and z=0. The results so obtained in figure 4. From this, it is understood that the shape repeats itself[9].Like this alikeprocedure is also applied for iteration third and final iteration which is the extension of microcontroller shaped fractal antenna[10].

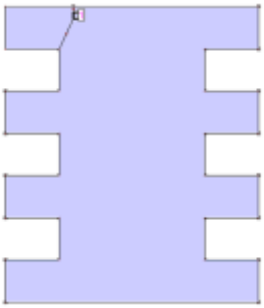

Fig 4.Second iteration

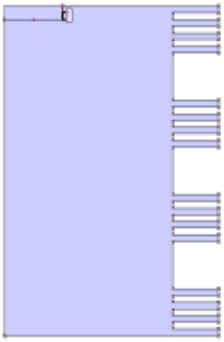

Fig 5.Third iteration

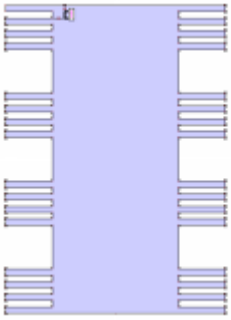

Fig6.Final iteration

II. Design of A modified multiband U shape fractal antenna

In this work, for the designing of A modified multiband U shape fractal patch antenna[9], rectangular patch is taken of the size of length and width 12mm and 15mm respectively shape patch has taken inside the geometry and the other parts are removed from the geometry. The feed point is taken at the dimension of (-4.925,7.4) from the centre point of the patch in all iterations. For the first iteration, U shape patch has taken inside the rectangular patch; the first iteration with geometrical representation is shown in figure 8. For the second iteration, two U shape patches has cut at the both ends of the U shape of first iteration with the L/3 length and W-3 width of first iteration of U shape shown in figure 9. Same procedure is repeated for the final iteration.

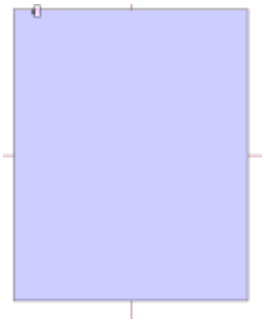

Figure 7:Basic rectangular geometry

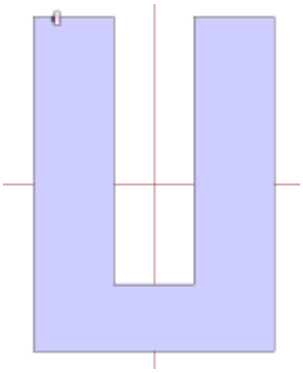

Figure:8 First iteration

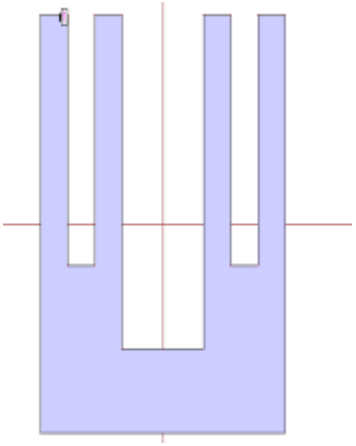

Figure:9 Second itration

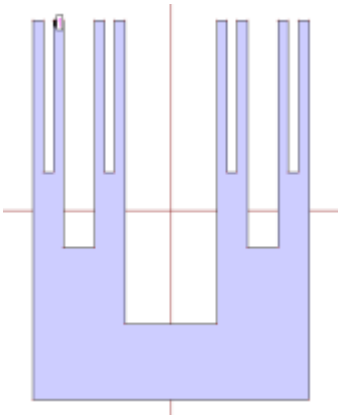

Figure:10 Final iteration

 ISSN: 2321-8169
252 – 256

III. Results and Discussion

Fractal geometry consists of self-similar structures. Generally the utilization of fractal geometries in antenna tends to miniaturize their physical sizes and produce multiband response in their resonating characteristics [4]. FR-4 has been used as substrate with a thickness 1.6 mm. In Microcontroller shaped fractal antenna by taking rectangle patch dimension of 7 mm by 9.8 mm antenna resonates at 8.75 GHz, and 13.35 GHz with return loss of -16.66 dB, and -14.84 dB respectively. Different iterations of fractal geometries have been applied one by one on rectangle patch and results are analyzed as shown in table 2. Various figures 11,12,13,14,15 shows return loss Vs frequency graphs and radiation patterns for different fractal iterations.

In first iteration, two squares of length 1.4 mm have been cut to form E-Shape patch which was shown in figure 3. This cause antenna to resonates at 12.43 GHz with -29.5 dB. In the 2nd iteration of E-Shape patch, two squares of length 1.4 mm have been cut out from the left side to the E-Shape patch as shown in figure 4.This causes antenna to resonates at 12.43GHz and 14.63GHz with return loss -18.17dB and -14.58 dB. In third iteration antenna resonates at 12.24GHz with return loss-25.79dB.

In Final iteration antenna resonates at 8.204GHz,12.43GHz and 14.63GHz with return loss-18.74dB,21.28dB and -17.54 dB respectively.Similarly in A modified multiband U shaped fractal antenna by taking rectangle patch dimension of 12mm by 15mm antenna resonates at 7.91GHz and 8.95GHz with return loss -14.2dB and -19.29dB. Different iterations of fractal geometries have been applied one by one on rectangle patch and results are analyzed as shown in table 2. Various figures 16,17,18,19 shows return loss Vs frequency graphs and radiation patterns for different fractal iterations.
In first iteration two bands occurs at 9.30GHz and 14.7GHz with return loss-23.65dB and -12.39dB.for second iteration three bands are occurs at 9.48 GHz,10.7 GHz and 15.39 GHz with return loss-21.3dB,-20.5dB and -16.51dB.For Final iteration four bands are occurs at 8.84 GHz,9.85 GHz,11.07 GHz and 15.33 GHz with return loss -11.5 dB,-23.99 dB,-22.18 dB and -13.72 dB respectively.

Table I Results of Microcontroller shape antenna

S. No.	Shape	Resonant Freq. (GHz)	Return Loss (db)	Bandwidth	VSWR
1.	Base Shape	F_{r1} =8.75	-16.66	9.30%	1.345
		F_{r2}=13.35	14.84	7.48%	1.442
2.	1st Iteration	Fr_1=12.43	-29.5	7.24%	1.069
3.	2nd Iteration	F_{r1}=12.43	-18.17	8.03%	1.28
		F_{r2}=14.63	-14.58	3.41%	1.45
4.	3rd Iteration	F_{r1}=12.24	-25.79	7.92%	1.259
5.	Final Iteration	F_{r1}=8.204	-16.74	13.4%	1.341
		F_{r2}=12.43	-21.28	8.68%	1.189
		F_{r3}=14.63	-17.54	3.34%	1.306

Table II Results of Modified multiband U shape antenna

S. No.	Shape	Resonant Freq. (GHz)	Return Loss (db)	Bandwidth	VSWR
1.	Base Shape	F_{r1} =7.91	-14.2	2.02%	1.484
		F_{r2} =8.95	-19.29	2.23%	1.243
2.	1st Iteration	Fr_1 =9.30	-23.65	5.37%	1.141
		F_{r2} =14.7	-12.39	3.12%	1.632
3.	2nd Iteration	Fr_1 =9.48	-21.3	5.80%	1.188
		F_{r2} =10.7	-20.5	4.39%	1.208
		F_{r3}=15.39	-16.51	7.08%	1.351
4.	Final Iteration	F_{r1}=8.84	-11.5	2.26%	1.725
		F_{r2}=9.85	-23.99	3.04%	1.135
		F_{r3}=11.07	-22.18	9.57%	1.169
		F_{r4}=15.33	-13.72	4.63%	1.519

 ISSN: 2321-8169
252 – 256

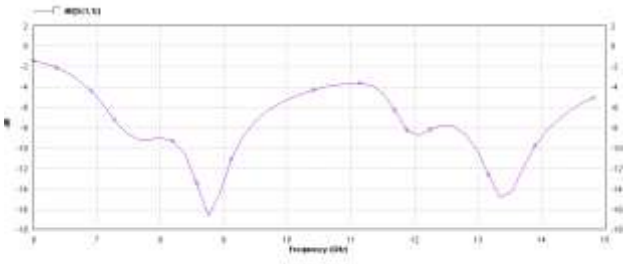

Fig 11. Base iteration

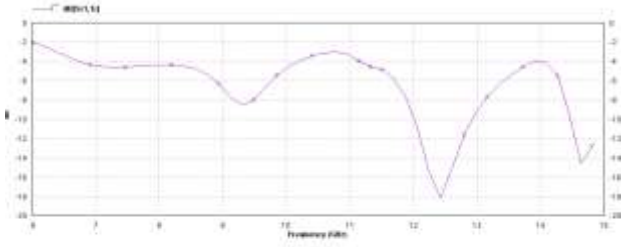

Fig 12. First iteration

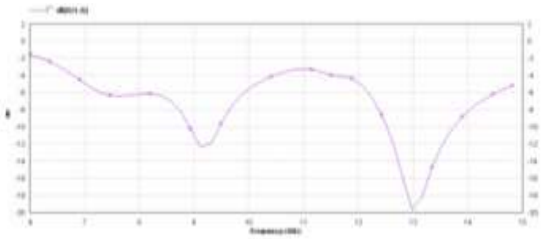

Fig 13. Second iteration

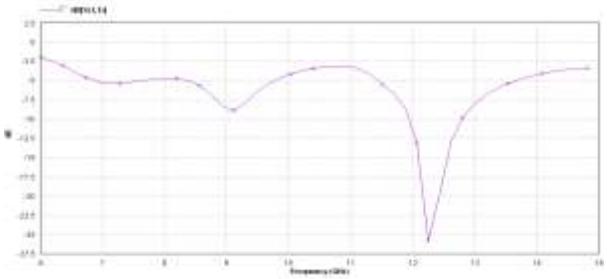

Fig14 .Third iteration

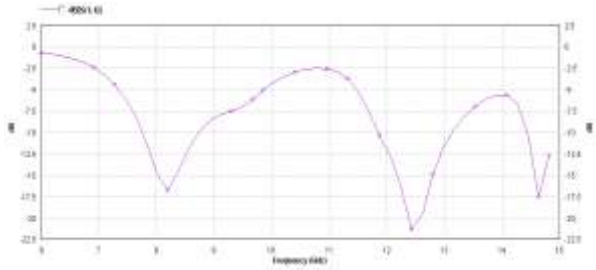

Fig15.final iteration

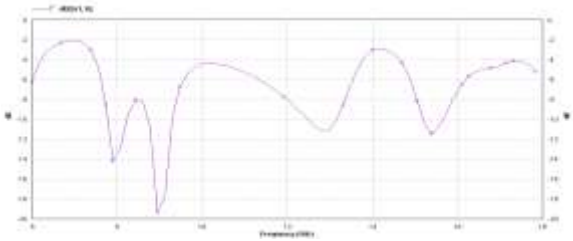

Fig16.Base iteration

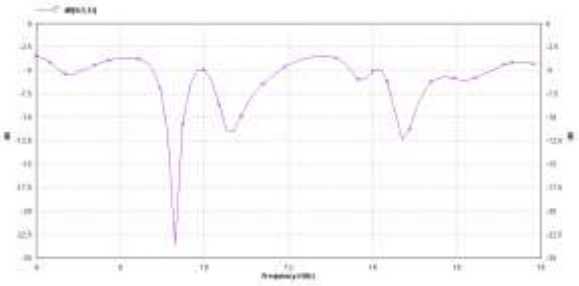

Fig17.First iteration

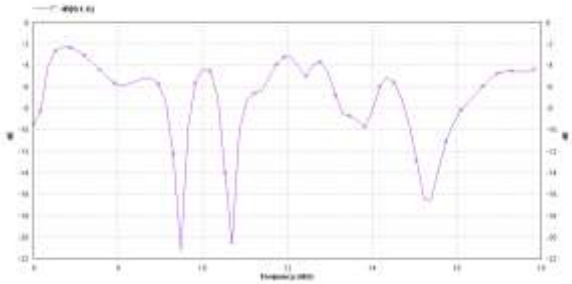

Fig18.Second iteration

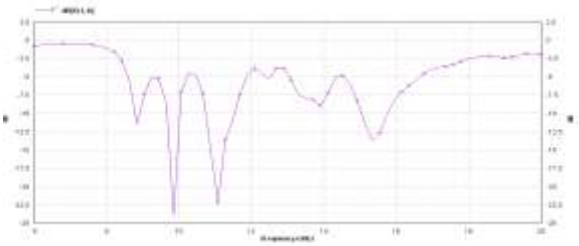

Fig19.Final iteration

Conclusion

Microcontroller shaped fractal antenna and A modified multiband U shaped fractal antenna can be used for X and Ku frequency band. This work can be extended if we apply more iterations on microcontroller fractal antenna so that the size of antenna can be reduced.

References

[1] Yadav Ajay, Chauhan Bhadrasheela, Jain Aanchal, 2012. "Microstrip Symmetrical E-Shape Patch Antenna for the Wireless Communication Systems", *IJETAE*

International Journal of Emerging Technology and Advance Engineering, Vol. 2, Issue 12, pp 241-244.

[2] Oraizi Homayoon, Hedayati Shahram, 2012. "Miniaturization of Microstrip Antennas by the Novel Application of the Giuseppe Peano Fractal Geometrices", *IEEE Transactions on Antennas and Propagation*, Vol.60, No.8, pp 3559-3567.

[3] Zheng Shufeng, Yin Yingzeng, Fan Jun, Yang Xi, Li Biao, Liu Weixing, 2012. "Analysis of Miniature Frequency Selective Surfaces Based on Fractal Antenna–Filter–Antenna Arrays", *IEEE Antennas and Wireless Propagation Letters*, Vol. 11, pp 240-243.

[4] Chen Yikai, Yang Shiwen and Nie Zaiping, 2010. "Bandwidth Enhancement Method for Low Profile E-Shaped Microstrip Patch Antennas", *IEEE Transactions on Antennas and Propagation*, Vol. 58, No. 7, pp 2442-2447.

[5] Douglas H. Werner and Suman Gangul "An Overview' of Fractal Antenna Engineering Research" IEEE Antennas and Propagation Magazine, Vol. 45, NO. I , February 2000, PP38-57

[6] J. Gianvitorio and Y. Rahmat "Fractal antennas: a novel antenna miniaturization technique and applications", IEEE Antennas and Propagation Magazine, vol. 44, No. 1, February 2002

[7] Ravi Kant, Pawan Singh, D. C. Dhubkarya "Performance of H-Shaped Microstrip Antenna using IE3D" 2009 International Conference on ELECTRO.

[8] K M Luk, R Chair and K F Lee, "Small rectangular patch antenna", *Electronics Letters, vol.* 34, 1998, pp. 2366-2367.

[9] Nikhar Trivedi, Ashwanee Kumar Singh, 2013 "Behaviour of U & E Shape Multiband Fractal Patch Antenna" International conference on Communication and Signal Processing, pp 541-544.

[10] Shweta Goyal,Yogendra Kumar Katiyar "Microcontroller shaped fractal Antenna using IE3D",International Journal of Engineering and Technical Research, Volume 5,Issue August 2016 pp.65-67.