Scientific Journal Impact Factor (SJIF): 1.711
International Journal of Modern Trends in Engineering and Research
IJMTER
ISSN (ONLINE) : 2349 - 9745
ISSN (PRINT) : 2393 - 8161

Design and analysis of Slot Fractal Antenna Using Koch Curve

Naman Bhargava[1] , Komal Tanwar[2] , Suraj Nagpal[3]
Dept. of ECE, GIMT college, kanipla, kurukshetra, India

Abstract—In this paper, Slot fractal antenna using koch curve is proposed . The fractal geometry is used in antenna design for achieving the desired miniaturization and multiband properties. In this proposed antenna iterations are performed by applying koch curve in each side of the slot geometry. The design of antenna is slotted with 2 times. The material used for substrate is FR4 with relative permittivity of 4.4 and thickness is about 1.6mm.microstrip line probe is used to feed the antenna. This antenna is designed and simulated by using HFSS software. The results show that the proposed antenna offers good performance in multiband frequencies (2GHz to10GHz) which is suitable for wireless applications.

Keywords—antenna, fractal, koch curve, microstrip line probe

I.INTRODUCTION

The fractals are useful in designing multiband antenna and for miniaturization of an antenna In modern wireless communication systems by increasing the electrical length into a antennas are needed with smaller size and wider compact physical volume. Sharp edges, corners bandwidth. This has initiated antenna research and discontinuities help to make antenna to in various directions; one of them is using radiate efficiently. By increasing number of fractal shaped antenna elements. The microstrip iterations in antenna design the resonant patch antenna consists of a radiating patch on frequency is decreased while electrical length is one side of a dielectric substrate and a ground increased. Many fractal geometries have been plane on the other side of the substrate. The found to be useful in developing new and patch can take any possible shape and is made innovative design for antennas. It includes Koch of conducting material such as copper or gold. curve, Sierpinski gasket geometry, Sierpinski Fractals have self-similarity and space-filling carpet geometry, Hilbert curve and Minkowski properties which provide design of antennas loop. Koch curve is one of the self-similar and with smaller size. Fractal geometry has unique space-filling fractals which is used to obtain geometrical features occurring in nature. It can wideband, multiband and/or miniaturized be used to describe the branching of tree leaves antennas. It has highly rough and uneven shape and plants, lightning, coastline, snowflake and which helps to work as a very efficient radiator. many more examples in nature. Fractal antenna A relation exists between antenna dimensions design has two things such as initiator and and wavelength. It states that antenna size generator. Initiator is the basic shape of the should be greater than quarter of wavelength geometry and it can be any shape either triangle, unless antenna will not be efficient. Since rectangle or any other quadrilateral. Generator antenna size is increased because of gain, is the shape which is obtained by scaling the radiation resistance, and bandwidth are reduced. initiator and will be repeated either inside or Hexagonal geometry is designed with substrate outside on the initiator to obtain subsequent of having relative permittivity of 2.3 and stages to reach final fractal geometry. So thickness is about 2 mm and iterations have generator is obtained from the initiator itself. done to improve the gain of the antenna. In The selfsimilarity and space-filling properties of this paper a new fractal antenna which is designed by applying Koch curve in an U-Slot geometry is proposed. FR4 material is chosen for the dielectric substrate which has relative permittivity of 4.4 and thickness is about 1.6 mm[1]. This antenna is designed and simulated by HFSS software. It is observed that in the second iteration of the antenna design has good return loss than the base shape fig1 and first iteration1th fig2 and 2^{nd} time fig3.

II ANTENNA DESIGN

In this paper a new fractal antenna which is designed by applying Koch curve in an octagonal geometry is proposed. FR4 material is chosen for the dielectric substrate which has relative permittivity of 4.4 and thickness is about 1.6 mm. This antenna is designed and simulated by HFSS software. It is observed that in the second iteration of the antenna design has good return loss than the base shape and first iteration.

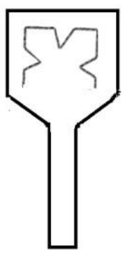
The base shape of the proposed fractal antenna is constructed by applying Koch curve to the each three sides of the slot geometry. And then one more slot is subtracted from the radiating patch. By this way base shape is designed. Koch curve is one of the self-similar and space-filling fractals which is used to obtain wideband/multiband and /or miniaturized antennas. It has highly rough and uneven shape

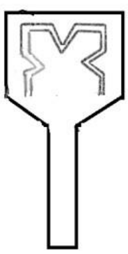
TableI: Antenna dimensions

PARAMETERS	**VALUES(mm)**
Substrate length*width	45*40
Substrate height	1.6
Ground length	45
Ground width	40
Feed line	20*3
Patch length *width	19.575*22.4

III.SIMULATION RESULTS

The proposed fractal antenna is designed and simulated using HFSS software. The return loss should be below -10 dB (S11 < -10 dB) and VSWR should be below 2 (VSWR < 2). Fig. 5 shows the return loss of the base shape of the first iteration antenna. The graph is plotted between the return loss in dB and frequency in GHz. Fig. 7 shows the graph of the return loss vs frequency for the first iteration of1th time the fractal antenna. Fig. 9shows the graph of the return loss vs frequency for the first iteration of nd
which helps to work as a very efficient radiator. 2 time the proposed fractal antenna.





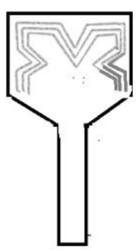


Fig1 Base shape of first iteration ***Fig2 First iteration of 1 time*** ***Fig 3 First iteration of 2 time***

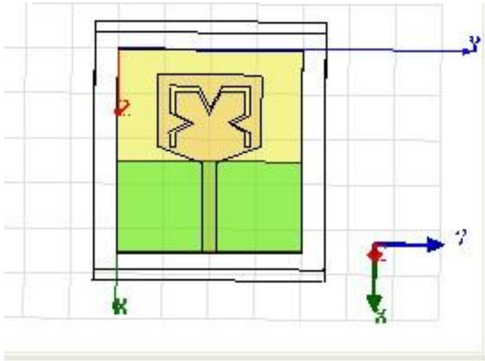


Fig4:Base shape of first iteration

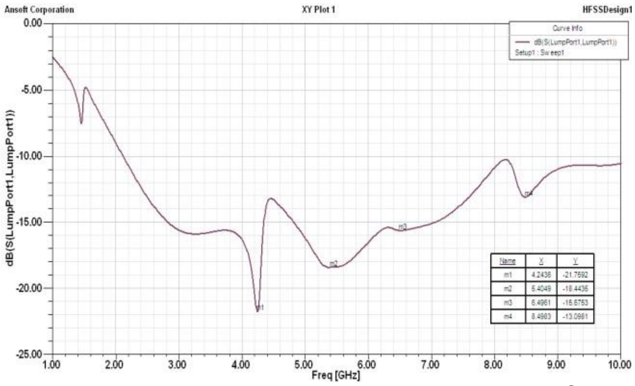


Fig5: return loss vs frequency of first iteration 2nd time

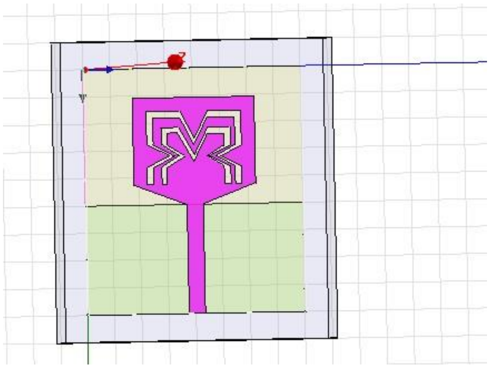


Fig6: first iteration of 1th time

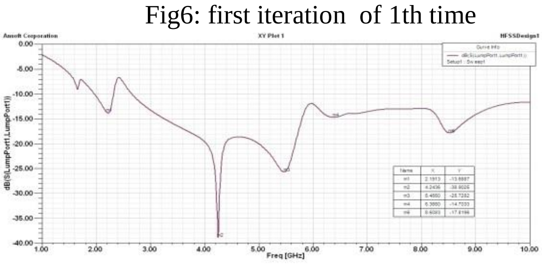


Fig7: return loss vs frequency of first iteration of 1th

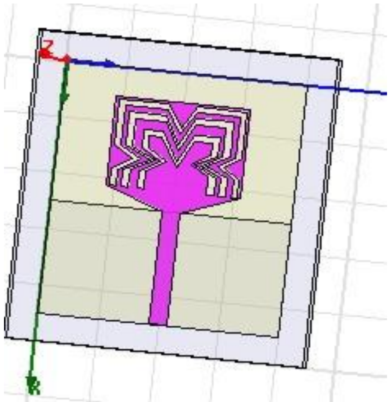


Fig8:first iteration of 2nd time

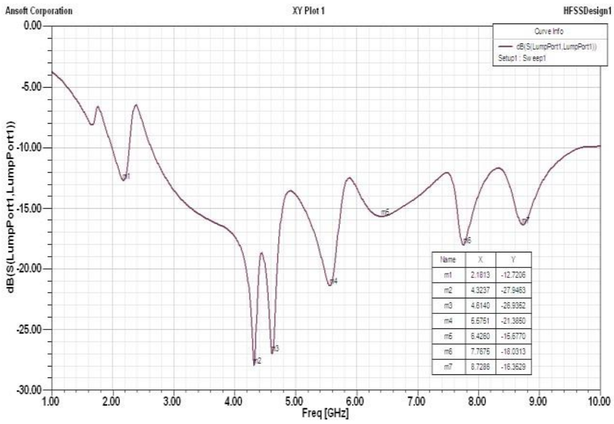


Fig9: return loss vs frequency of first iteration of

The simulated results of the antenna (base shape, first iteration and second iteration) are given by following tabulations respectively. The Table II, III and IV shows the simulated results of the base shape, first iteration and second iteration of the octagonal fractal antenna respectively.

TABLE II Simulated Results of FIRST ITERATION 1st time

Selected points	**Frequencies (GHz)**	**Return losses (dB)**
m1	4.243	-21.759
m2	5.404	-18.443
m3	6.496	-15.675
m4	8.498	-13.098

TABLE III Simulated results of FIRST ITERATION OF 1th TME

Selected points	**Frequencies (GHz)**	**Return losses (dB)**
m1	2.191	-13.666
m2	4.243	-38.902
m3	6.486	-26.728
m4	6.366	-14.703
m5	8.508	-17.819

TABLE IVSimulated results of FIRST ITERATION OF 2nd TIMES

Selected points	**Frequencies (GHz)**	**Return losses (dB)**
m1	2.181	-12.720
m2	4.323	-27.946
m3	4.614	-26.935
m4	5.575	-21.385
m5	6.426	-15.677
m6	7.767	-18.031
m7	8.728	-16.352

According to the results it is observed that the first iteration of two times of the slot fractal antenna has good return loss than the base shape and first iteration of one time. In the first iteration of one time the return loss is obtained 38.902 dB at 4.24 GHz frequency range. In the first iteration of two times , the return loss is obtained multiband frequency from 2GHz to 9GHz range. It is used for broadcasting.

IV. CONCLUSION

A slot fractal antenna using Koch curve is presented in this paper. The proposed structure has a dimension of 45mm x 40 mm. The dimensions of the substrate and ground plane are kept constant and iterations are done in radiating patch only. The simulated results are obtained using HFSS software. The proposed antenna exhibits good performance in multiband frequencies (2 GHz and 10 GHz) which is suitable for wireless applications such as media streaming and STM-1 (Synchronous Transport Module level 1).

REFERENCES

1. A.Azari, J.Rowhani, "Ultra wideband fractal microstrip antenna design",progress In Electromagnetics Research, vol 2, pp.7-12, 2008.
2. Abolfazl Azari, "A New Super Wideband Fractal Microstrip Antenna", IEEE transactions on antennas and propagation, vol.59, no.5, pp.17241727, 2011.
3. Muhammad Waqas, Zubair Ahmed, Mojeeb Bin Ihsan,"Multiband Sierpinski Fractal Antenna", IEEE, 2009.
4. Saira Joseph, Binu Paul, Shanta Mridula, Pezholil Mohanan, "A Novel Planar Fractal Antenna with CPW-Feed for Multiband Applications", a novel planar fractal antenna with cpw feed for radio engineering, vol.22, no.4, pp.1262-1266,2013.
5. Douglas H. Werner, Suman Ganguly, "An Overview of Fractal Antenna Engineering Research", IEEE Antennas and Propagation Magazine, Vol.45, No.1, 2003.
6. Chakkrit Kamtongdee1 and Nantakan Wongkasem," a Novel Design of Compact 2.4 GHz Microstrip Antennas", IEEE, pp.766-769, 2009.
7. Deepti Das Krishna, Student Member, IEEE, M. Gopikrishna, Student Member, IEEE, C. K. Anandan, P. Mohanan, Senior Member, IEEE, and K. Vasudevan, Senior Member, IEEE, " CPW-Fed Koch Fractal Slot Antenna for WLAN/WiMAX Applications",IEEE antennas and wireless propagation letters, vol. 7,pp.389392,2008.
8. A.A.Lotfi-Neyestanak, M.R.Azadi and A.Emami-Forooshani," Compact Size Ultra Wideband Hexagonal Fractal Antenna", IEEE, pp.387-390, 2010.
9. Muhammad Naeem Iqbal, Hamood-UrRahman, and Syeda Fizzah Jilani," an Ultra wideband Monopole Fractal Antenna with Coplanar Waveguide Feed", International Journal of Antennas and Propagation Volume 2014, Article ID 510913, 7 pages, 2014.
10. S. Suganthi, Member IACSIT, D. Kumar, and S. Raghavan," Design and Simulation of Miniaturized Multiband Fractal Antennas for Microwave Applications", International Journal of Information and Electronics Engineering, Vol. 2, No. 5, pp.825-830,2012.