Comparative Analysis of Koch Curve Fractal Antenna With CPW Feeding Techniques for Wireless Application

Babita[#1], Simranjit Kaur[*2]

[#]*Student, Department of ECE,*
SSCET, Badhani, India.
[1]babitaharchandra21@gmail.com

[*]*Assistant Professor, Department of ECE,*
SSCET, Badhani, India.
[2]simran.saini@gmail.com

Abstract— **In this paper a high gain Koch Curve fractal shape antenna for wireless applications is proposed. With the increasing needs of multiband, high gain, very directive antennas and good capability of integration of various wireless technologies, the antenna's research can be oriented following different ways. The antenna is microstrip line fed and its structure is based on fractal geometry where the resonance frequency of antenna is lowered by applying iteration techniques. The antenna size inclusive of the ground plane is compact and has a wide operating bandwidth. The antenna exhibits omnidirectional direction radiation coverage with a gain better than 2.0 dBi in the entire operating band.**

Keywords— **CPW Feed, Koch Curve, Fractal, CST Microwave Studio Software.**

I. INTRODUCTION

In modern wireless communication systems wider bandwidth, multiband and low profile antennas are in great demand for both commercial and military applications. Fractals were first defined by Benoit Mandelbrot in 1975 as a way of classifying structures whose dimensions were not whole numbers. Fractal geometry has unique geometrical features occurring in nature. It can be used to describe the branching of tree leaves and plants, rough terrain, jaggedness of coastline, and many more examples in nature. Fractals have been applied in various field like image compression, analysis of high altitude lightning phenomena, and rapid studies are apply to creating new type of antennas. The geometric construction of the standard Koch curve [4] is fairly simple. It starts with a straight line as an initiator. This is partitioned into three equal parts, and the segment at the middle is replaced with two others of the same length. This is the first iterated version of the geometry and is called the generator. The process is reused in the generation of higher iterations. Koch Curve [5] is one of the popular design for multiband operation of antenna in addition, the author presented Novel Miniaturization Technique for Wireless Communications. In [6] it proposed the Fractal Geometry of nature of different types of shapes. In [7] author presented the design of Triangular Sierpinski Gasket Fractal Antenna using iterations.

II. PROPOSED ANTENNA DESIGN

The proposed model is designed using three iterative steps. Here the same radiating patch is used throughout the steps. But, the ground plane shape is modified in the consecutive steps. Starting from a triangle and superimposing another similar inverted triangle upon it and so on we have obtained the required geometry.

TABLE I
PHYSICAL DIMENSIONS OF KOCH CURVE FRACTAL ANTENNA

Parameter	Value
L	33.5mm
W	28.5mm
H	16mm
A	26mm
L_f	5.5mm
D	0.35mm
S	2.2mm
S_1	2.5mm
S_2	2.5mm
S_3	9.1mm
S_W	6.2mm
€r	4.4mm

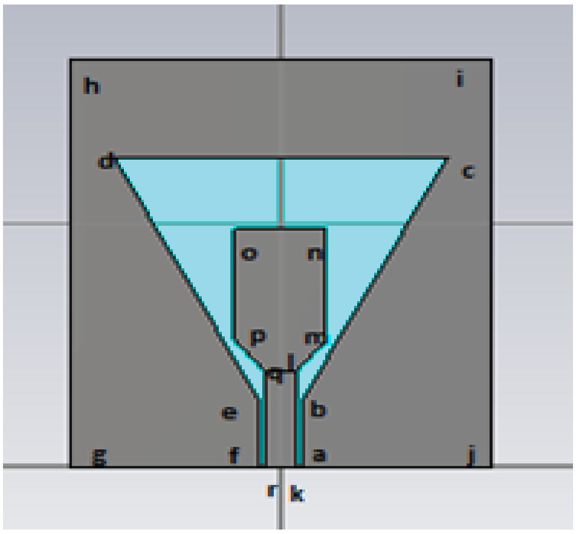

Fig. 1 Geometry of Koch Curve with 1st Iteration

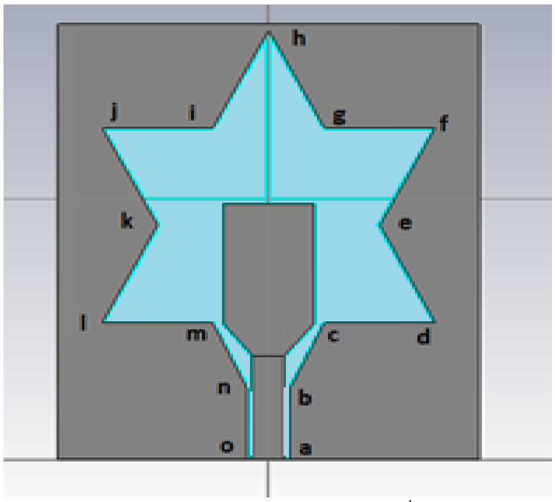

Fig. 3 Geometry of Koch Curve with 2nd Iteration

III. RESULT AND DISCUSSION

The proposed design has been simulated using CST Microwave software. The variations of resonant frequency with increase in number of fractals in successive iterations shows the variations of frequency and return loss for base shape that we have taken. Similar results for first iteration are shown in fig. 7. It is observed that as the number of iterations is increased considerable bandwidth is observed at a number of resonant frequencies. These results clearly show that as the number of iterations is increased in this CPW-fed slot antenna the bandwidth is increased. Koch fractal geometry is applied in this antenna. WLANs (Wireless Local Area Networks) are proposed to operate in the 2.4 GHz frequency bands (2.4 - 2.48 GHz) and 5 GHz frequency bands (5.15–5.35 GHz).

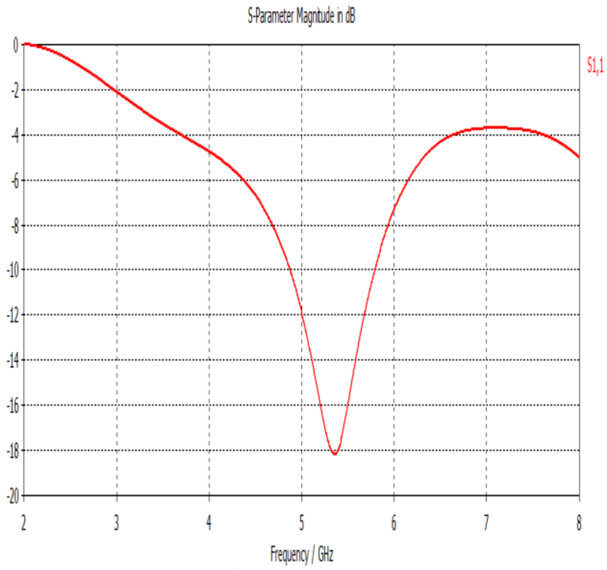

Fig. 2 first iteration Return loss

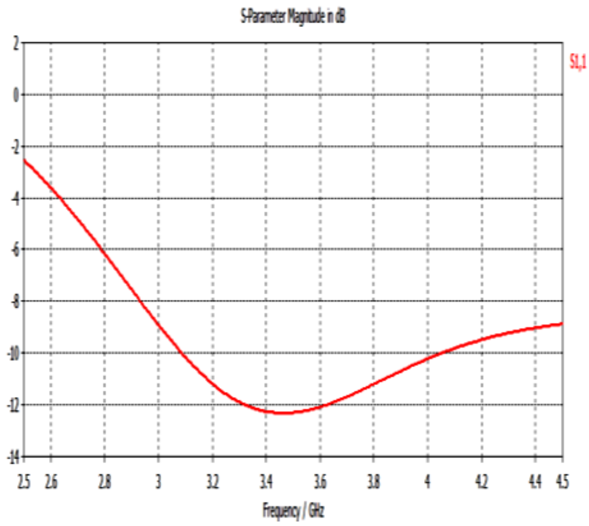

Fig .4 Second iteration Return loss

WiMAX (Worldwide Interoperability for Microwave Access) is designed to operate in the range 2.5 - 2.69/3.4 - 3.69/5.25 - 5.85 GHz bands. Since this range of frequencies can be used simultaneously in many systems, we need a single antenna that covers all these ranges. The minimum resonance of the wide slot antenna depends on the slot boundary .The concept of space filling of the Koch curves used in the design of miniature and multi-band patch antennas can also be applied for wide-slot antennas. Here we use a CPW-fed modified Koch Snowflake slot antenna operating over a wide frequency band, covering the 2.4/5.2/5.8 GHz range for WLAN and 2.5/3.5/4.5 GHz range for WiMAX. The definitions for some terms used to describe the simulated result are provided below.

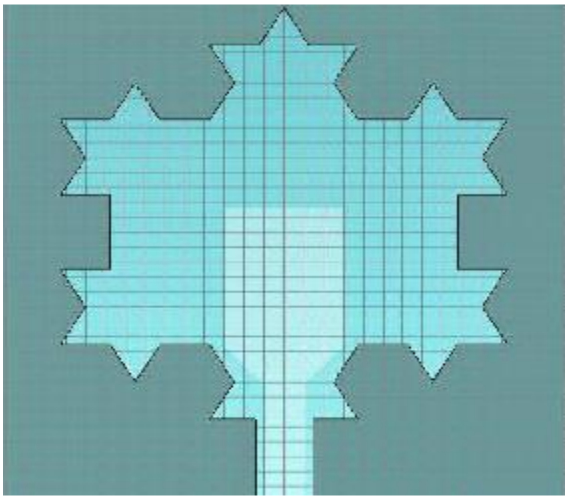

Fig. 5 Geometry of Koch Curve with 3rd Iteration

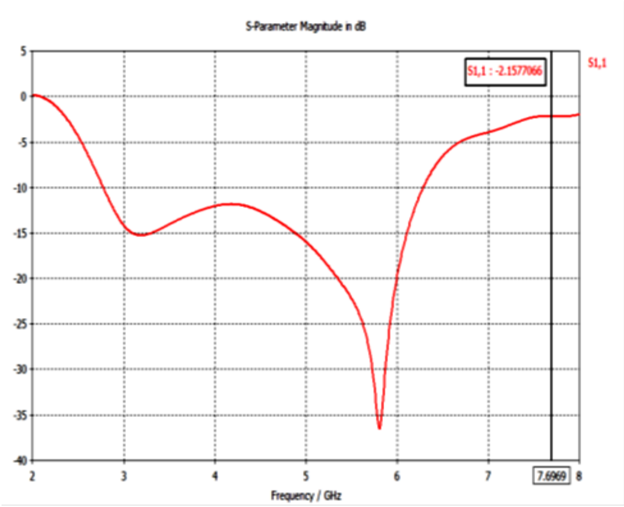

Fig. 6 Third iteration Return loss

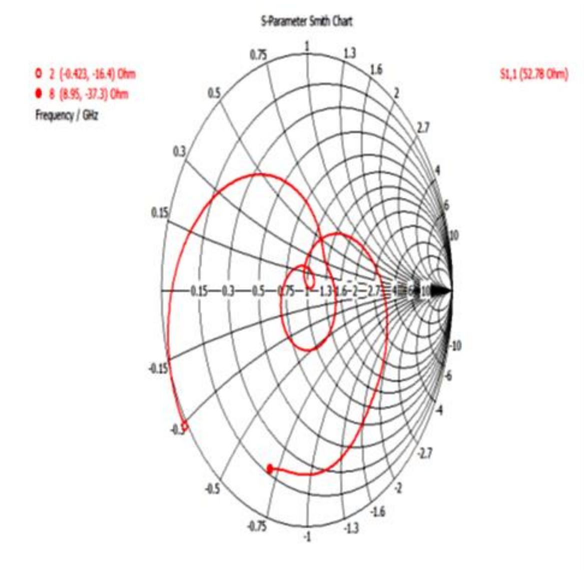

Fig. 7 Smith Chart plot for Koch Antenna

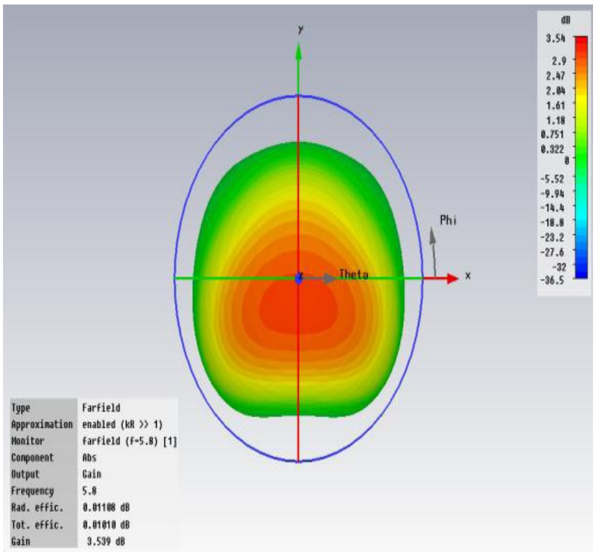

Fig .8 Radiation Far field plots for Koch Antenna

IV. CONCLUSIONS

The present work has been carried out for the 1st iteration, 2nd iteration and 3rd iteration. From the above discussions it can be concluded that on increasing the number of iterations, the return loss and bandwidth of antenna are also increased. the simulation results show that a compact design of antenna is achieved without degrading the antenna performance. CPW-fed koch fractal printed slot antenna is suitable for WLAN 3.4/5.2/5.5 GHZ and WIMAX 3.4/3.5/5.8 GHZ operations. This geometry lowers the frequency of operation along with wide band matching and antenna size is compact as well as simple.

Table II
COMPARATIVE TABLE OF KOCH CURVE FRACTAL PATCH ANTENNA

S.No	Shape	Resonant Frequency	Return Loss	Bandwidth
1	1st Iteration	5.3	-18dB	900MHz
2	2nd Iteration	3.4	-12dB	920MHz
3	3rd Iteration	5.8	-36dB	1200MHz

REFERENCES

[1] Constantine A. Balanis, Antenna Theory Analysis & Design, John Wiley & Sons, 1997.

[2] 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, 2008 .

[3] Introduction to antenna and near-field simulation in CSTMicrowave Studio® software By Jorge R. Costa Jerzy Guterman .

[4] Vinoy, K. J., "Fractal shaped antenna elements for wide and multi-band wireless applications," Thesis, Pennsylvania, Aug. 2002.

[5] Kulbir Singh, Vinit Grewal, Rajiv Saxena,"Fractal Antennas: A Novel Miniaturization Technique for WirelessCommunications", International Journal of Recent Trends in Engineering, Vol. 2, No. 5, November 2009.

[6] Mandelbrot, B.B.,"The Fractal Geometry of Nature", W.H. Freeman and Company, New York, 1983.

[7] Sachin Chauhan, Jitendra Kr. Deegwal, Rachna Gera "Design of Triangular Sierpinski Gasket Fractal Antenna", IJECT Vol. 4, Issue Spl - 4, April - June 2013, ISSN : 2230-7109 (Online) | ISSN : 2230-9543 (Print).

[8] Kin-Lu Wong, "Compact and Broadband Microstrip Antenna",John wiley and sons,Inc, New York ,2002.

