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Analysis of Koch Curve Fractal Antenna Techniques

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Abstract
In this paper, the Koch fractal antenna techniques (upto 3 iterations) is used and the VSWR and RETURN LOSS result is simulated on HFSS software .we observe that Koch curve antenna techniques is very much beneficial then other technique . As the number of iteration level increased , we obtain a better capable antenna.

Keywords
Fractal geometry, Koch Fractal Antenna, VSWR loss, RETURN loss.

I. Introduction

There has been a rapid growth of wearable antennas in today's communication. They are widely used in paramedic monitoring, fire fighters and military sectors. The various designs of textile antennas for wearable applications such as dipole, monopole and microstrip patch antenna has been developed by the researchers. For the designing of wearable antenna the size is the main issue. To reduce the size of antenna Fractal geometry is used. To produce compact size antenna, Koch fractal antenna is introduced in the design [4]. A Fractal geometry Fractals mean irregular or broken fragments. Fractal composes of multiple copies which repeat within themselves at different scales. This model is customized in Word 2007 and it is saved as "Word 97-2003 Document" in pc, which provides the author with most of the formatting condition needed for the preparation of electronic version of their papers.

In all standard papers, reasons for design of components are : (1) They are simple in use (2) automatic complete the electronic requirements that provides the same or the late manufacturing of electronic products, and (3) the submission of the style in the conference proceedings.Some type styles example are : such as Margins, column widths, spacing between the lines,are provided in the whole document and are identified in italic , within parentheses, following the examples. Some of the components, such as multi-leveled equations, graphics, they do not have predefined size, which makes them promising in antenna design.The similarity and the space filling property, which enable the Koch fractal antenna to attain the characteristics such as Multiband operation and miniaturization.

A. Fractal geometry

Fractal geometry Fractals mean irregular or broken fragments. Fractal composes of multiple copies which repeat within themselves at different scales. Hence they do not have predefined size, which make them promising in antenna design.

A self similar set consists of scale down version of itself. More no. of iterations exploits space filling property due to this it enables shrink of antenna size.The lower side-lobes [2] [3] exhibit in a fractal antenna. In the area of fractal antenna engineering many more researches are done by the researchers. The loops, dipoles [5], monopoles [6],patch, slot and antenna array can also used fractal techniques. It has been discovered that fractals shape radiates electromagnetic energy well and also been indicated that fractal antennas display lower resonant frequency than a Euclidean dipole antenna of same overall size [1] [7]. All the discovered properties shows that fractal shapes has an advantage over traditional antennas, which have smaller size and useful in application which requires small size at VHF and UHF range. The designed frequency has application for Portable radios and Amateur (ham) radio.

B. Koch Fractal Technique

The concept of Koch fractal geometry is established by the Helge Von Koch in the year 1904 .For the designing of koch curve geometry an iterative function system, also known as IFS is used and it can be replace by set of affirmative transformation [2] [7] The geometrical development for the approved Koch curve is shown in fig.1. The initial straight line is (L0), called the initiator .The First iteration in Koch curve called the generator. The first iteration can be achieved, when it is divided into three equal parts and then change that segment in two others parts of same length at certain angle. The same method is reused in the second and higher iterations.

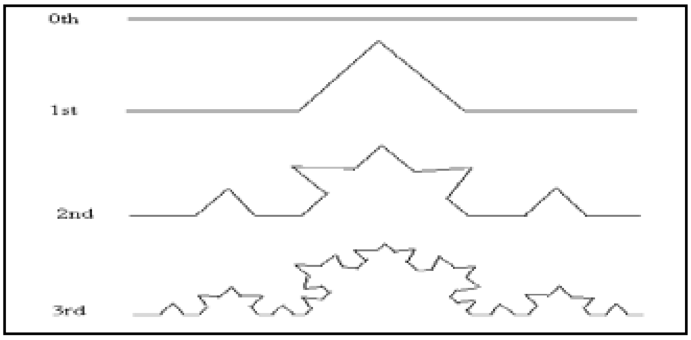

Fig. 1: Iterations level of Koch fractal antenna

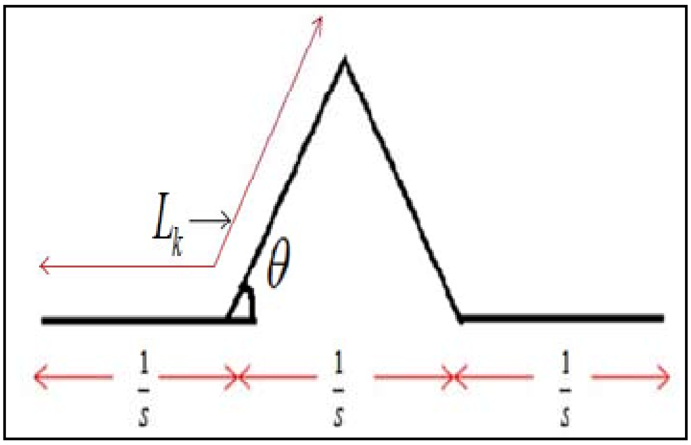

Fig. 2: The four segments that form general basis of Koch fractal

S is the scaling factor which is angle dependent and θ is indentation angle. θ is taken as 60°. So the scaling factor S comes out to be 3.

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Scaling factor is given as

$$S=2\ (1+\cos\theta) \quad (1)$$

II. Antenna Design

A. Effective Length For Koch Curve Iterations

The Koch fractal antenna design is shown in fig. 1. Width of antenna is 3.75 mm. Substrate dimension for this design is 230 X 50 mm. The design of Koch fractal is done using the following equations.

$$L_K = L_o[4/3]^n$$

Lk is the total effective length of Koch fractal antenna

L_o is the length of conventional dipole

n is the number of iteration

For first iteration, n=1 then effective length

$$L1= 333[4/3]^1=444$$

For second iteration, n=2 then effective length

$$L2=333[4/3]^2 =592$$

For third iteration, n=3 then effective length

$$L3=333[4/3]^3=789.3$$

B. Dimension For Koch Curve Iterations

Self similarity dimension for Koch curve iterations

$$n = \frac{1}{s^D}$$

Where , n is the number of line segment

D is the dimension

S is the scaling factor

Dimension for first iteration ,

$4=1/1/3^D$

$4=3^D$

$\text{Log}4=\log 3^D$ (take log both sides)

$D=\log 4/\log 3=1.26$

Dimension for second iteration,

$16= 1/1/9^D$

$16=9^D$

Log 16=log9D (take log both sides)

$D=\log 16/\log 9=1.204/0.954=1.26$

Dimension for third iteration,

$64=1/1/27^D$

$64=27^D$

$\text{Log } 64=\log 27^D$ (take log both sides)

$D= \log 64/\log 27=1.80/1.43=1.26$

So with every iteration level the effective length(L_K) increases by $(4/3)^n$, and the Dimension of antenna reduces by around 1.2 times.

III. Results

A . Return Loss

The return loss of Koch curve fractal antenna for the various iterations is shown below.

Table 1 :

Ref no.	Resonant frequency (Ghz)	Iteration 1st return loss(db)	Iteration 2nd return loss(db)	Iteration 3rd return loss(db)
1	2.35	-5.47	-2.60	-2.70
2	5.25	-3.25	-8.50	-9.0
3	7.35	-3.15	-15.35	-27
4	7.50	-3.14	-15.25	-28.5

B. VSWR Loss

The VSWR loss of Koch curve fractal antenna for the various iterations is shown below.

Table 2 :

Ref no.	Resonant Frequency (Ghz)	Iteration 1st VSWR (db)	Iteration 2nd VSWR (db)	Iteration 3rd VSWR (db)
1	7.45	15	3.0	0.05
2	8.0	15.20	3.1	1.5
3	9.0	15.40	5.0	4.0

IV. Conclusion

This paper presents the dissimilar types of fractal antenna designs (upto 3rd iterations) and the fractals plays a significant role to reduce the antenna size. A Koch fractal antenna upto 3rd iterations has been simulated and tested successfully.The comparison between different parameters of antenna such as antenna return loss, vswr loss is measured. As the no. of iteration level is increased we obtain a better efficient antenna.

V. Acknowledgment

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