ISSN 2249-894X
ORIGINAL ARTICLE
REVIEW OF RESEARCH

COMPARATIVE REVIEW ON DIFFERENT FRACTAL ANTENNA IN COMMUNICATION

NITIN MANIK GAIKWAD
BE (E& Tc),ME(Second Year)

ABSTRACT:-

Nowadays latest wireless communications systems require compact antennas which are capable of operating at different bands. Fractal antenna geometry is being studied in order to answer those requirements. Recent studies on fractal antennas show that these structures have their own specific characteristics that improve certain properties when talking about low profile antennas. Fractal antenna can fulfill the requirements of designing a multiband, low profile and small antenna. In this review paper, researcher provide a comparative review of latest Developments in fractal antenna. Finally, researcher discusses latest work done in the area of fractal antennas.

KEYWORDS: Fractal shapes, multiband.

1. INTRODUCTION

In modern wireless communication system changes day to day and increasing new wireless applications having different band-width is required. Traditionally each antenna operates at a single frequency band, where a separate antenna is needed for different application. Therefore large space is required for different antennas. In order to overcome this problem, multiband antenna can be used where a single antenna can operate at many frequency bands. So that multiband behavior can be obtained by fractal antenna geometry. Fractal antennas are based on the concept of a natural fractal, which is a recursively generated geometry that has fractional dimensions. Fractal antenna contain different geometry which shows that

1) Sierpinski gasket geometry ,its shape is triangular also fractal is triangular
2) Sierpinski carpet geometry, its shape is square.
3) Koch curve geometry, its shape is V.
4) Herbert curve geometry, its shape is U.

There are different active areas of research in fractal antenna. The purpose of this article is to provide a comparative review of recent and latest developments in the theory and design of fractal antenna elements, as well as fractal antenna geometries. Many fractal structures are based on a virtual combination of capacitors and inductors. Due to this an antenna has proper resonances which can be chosen and adjusted by choosing the proper fractal design for different frequency.

Fractal shapes have the following features:

1. Self similarity (same shape part repeated)
2. Space filling (space not empty)
3. Compact size by using iteration method, essay replace shapes.
4. It forms irregular and different shape geometry.

2. GEOMETRIES OF FRACTAL ANTENNA

A) Sierpinski Gasket Geometry

Sierpinski gasket geometry is the mostly based on self-similarity property, widely studied fractal geometry for antenna applications. This fractal are described firstly a triangle is taken in a shapes. Then in next step a central triangle is drown and removed with vertices that are located at the midpoint of the sides of the triangle as shown in the figure. This process is then repeated for remaining required triangles. The Sierpinski gasket fractal is formed by during iteration method for infinite number of times. Black triangular areas in the figure represent a metallic path and the white triangular areas represent size reduction by removing white triangle.

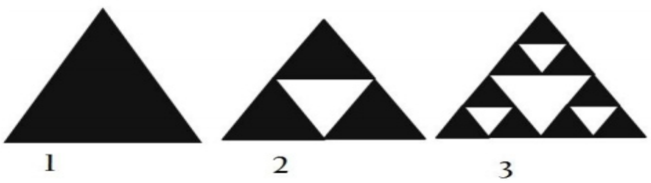
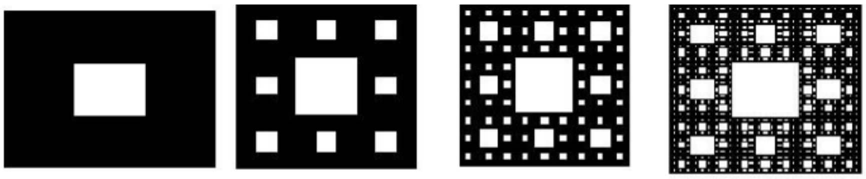


Figure 1 Construction of Sierpinski Gasket Geometry

B) Sierpinski Carpet

The Sierpinski carpet structure is constructed similar to the Sierpinski gasket, but it contains squares shapes instead of triangles. In order to start this type of fractal antenna, it contain with a square in the plane, and then divides square into nine smaller squares where the open central square is remove. Also the remaining eight squares are divided into nine smaller congruent squares.



I-Iteration II-Iteration III-Iteration IV-Iteration

Figure 2 Construction of Sierpinski Carpet geometry

C) Koch Curves

The structural construction of the standard Koch curve is fairly simple. Firstly researcher considers the straight line as starting steps. This is divided 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. It forms triangular shape also divided smaller triangle shapes.

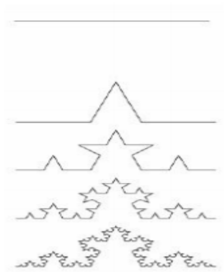


Figure 3 Construction of Koch Curve Geometry

D) Hilbert Curve

This geometry contain a space-Filling property, with a large number of iteration, from this think that it as trying to fill the area it occupies. Additionally the geometry also has the following properties: self -Avoidance (as the line segments do not intersect each other), simplicity (since the curve can be drawn with a single stroke of a pen) and self-similarity.

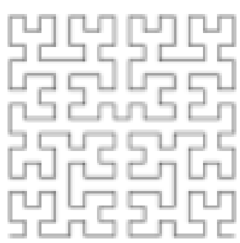


Figure 4 Hilbert curve

From all above fractal shape,

1) Sierpinski gasket is triangular shape geometry and self-similarity property is used.

2) Sierpinski carpet is square shapes geometry and self-similarity property is used.

3) For latest application the Sierpinski gasket shape is widely used to make an antenna. Because it acts as a multiband, so we don't have to accommodate more than one antenna for multiple frequencies.

3. LITERATURE REVIEW

3.1 Carles Puente-Baliarda, Jordi Romeu(1998)

The multiband behavior of the fractal Sierpinski antenna [1] is described in this paper. Due to its mainly triangular shape, the antenna is compared to the well-known single-band bow-tie antenna. It is observed that self-similarity properties of the fractal structure are translated into its electromagnetic behavior. Size reduces to half of the total area.

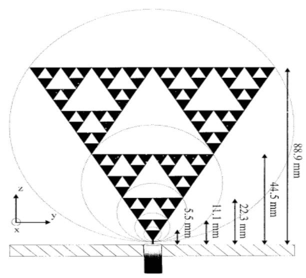


Figure 5 Sierpinski monopole

3.2 Carmen Borja and Jordi Romeu (2003)

The properties of the Koch island fractal boundary micro strip patch antenna [2] are presented. The behavior at the fundamental mode and the existence of high-order modes that exhibit localized current density distributions is discussed. It also has a higher Q that will result in a smaller bandwidth Therefore, fractal boundary micro strip patch antennas are an interesting alternative in the design of single-fed radiating elements with broadside radiation patterns and with directivity in the range of 13 dB. The side lobe level at
The E-plane is below 10 dB and the directivity is 13.4 dB. Antenna is shown in the figure 6.

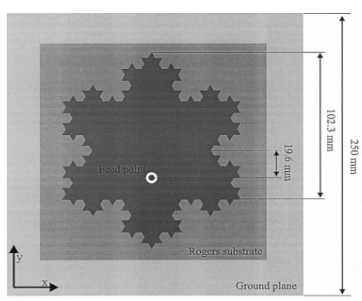


Figure 6 pentagonal slot

3.3 Rao Hanumantha Patnam (2008)

A broadband Koch fractal loop antenna configuration with a novel Coplanar Waveguide (CPW) feed [3] is presented. Impedance matching is achieved by a radial stub loaded CPW feed, which acts as a lumped matching circuit. Results show that the antenna has 2:1 VSWR bandwidth of about 19% operating in the frequency range of 1.26 GHz–1.52 GHz and 3:1 VSWR bandwidth of 57% has been measured in the frequency range of 1.21 GHz–1.99 GHz. The proposed antenna including the feed can be scaled in frequency for low cost broadband communication applications.

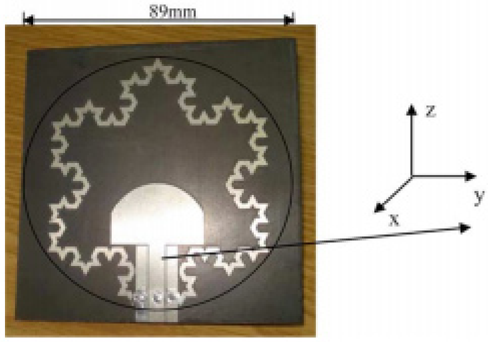


Figure 7 Koch fractal loop configuration.

3.4 Deepti Das Krishna, M. Gopikrishna, C. K. Anandan(2008)

A dual wide-band CPW-fed modified Koch fractal printed slot antenna [4], suitable for WLAN and WiMAX operations is proposed in this paper. Here, the operating frequency of a triangular slot antenna is lowered by the Koch iteration technique resulting in a compact antenna. Results showed that the introduction of a Koch fractal slot instead of the triangular slot geometry lowers the frequency of operation along with wide-band matching. The antenna size inclusive of the ground plane is compact and a simple tuning slot ensures dual wide-band operation covering the WLAN bands and WiMAX bands. The 10 dB bandwidth of the wide-band antenna (without the slot) is 3.77 GHz (2.33–6.1 GHz). With the tuning slot, the antenna gives dual wide-band performance with a 10 dB bandwidth of 1.57 GHz (2.38–3.95 GHz) and 1.1 GHz (4.95–6.05 GHz) in the lower and upper bands respectively.

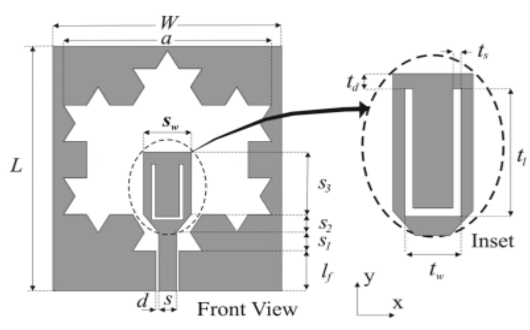


Figure 8 Koch curve configuration

3.5 V.V.Reddyand N.V.S.N.Sarma (2014)

Compact fractal boundary micro strip antenna [5] is proposed for circular polarization (CP). By replacing the sides of a square patch with asymmetrical pre-fractal curves, two orthogonal modes are excited for CP operation take place. The structure is asymmetric along the principal axes. Results show that an excellent CP is achieved with a single probe feed, besides reduction in the antenna size by applying fractal boundary concept. Measured results show that 10-dB return loss and 3-dB axial-ratio bandwidths are 6.4% and 2%, respectively. Experimental outcomes prove that an excellent compact CP operation is achieved using fractal boundary antennas.

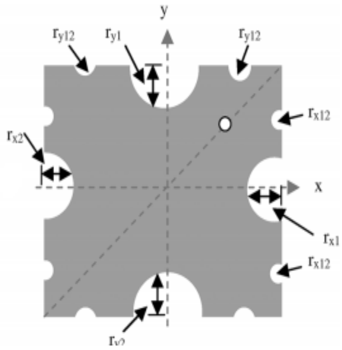


Figure 9 Fractal boundary micro strip patch antenna

3.6 V.V.Reddy and N.V.S.N.Sarma (2014)

A single-layer single-probe feed asymmetrical fractal boundary micro strip antenna [6] is considered for triband circular polarization (CP) operation. In the structure for triband CP radiation is introduced by employing optimized asymmetrical Koch fractal curves as boundaries of a square patch and embedded rectangular slot. Asymmetrical Koch single-band CP, rectangular, fractal slotted antennas for multiband operation are shown. By optimizing rotation angle and feed point of the fractal slot, multiband CP radiation is achieved. The parameters of the fractal slot are optimized for better triband operation. The measured axial-ratio 3-dB CP bandwidths are 78, 55, and 174 MHz at operating frequencies around 2.45, 3.4, and 5.8 GHz, respectively and 10-dB return-loss bandwidth 8.7%, 2.4%, 5% at operating frequencies around 2.45, 3.4, and 5.8 GHz, respectively. Size is reduced due to using fractal concept.

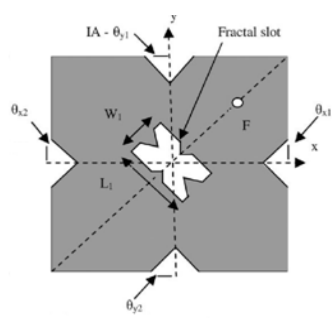


Figure 10 A symmetrical Koch fractal antennas

4. APPLICATIONS OF THE FRACTAL ANTENNA

1) Defense Applications.
2) Electronic Walfare
3) Fractal antennas applications in Signal Intelligence.
4) Tactical Communication.
5) Custom Application.
6) In-Building Communication
7) RFID
8) Telematics

9) Wireless Technology
10) Mobile Devices

5. ADVANTAGES AND DISADVANTAGES OF FRACTAL ANTENNA

5.1 Advantages of fractal antenna

1) Wideband or multiband- we can use one antenna instead of many antennas.
2) Size miniaturization techniques.
3) It gives good input impedance matching.
4) It can operate in different frequency band.

5.2 Disadvantages of fractal Antenna

1) It has mathematical limitation.
2) It is very complex. (In irregular shapes)
3) After few more iterations, it degrades the antenna parameters.

6. THE COMPARATIVE REVIEW SHOWS

1) By using Sierpinski gasket geometry contains triangular shape and self similarity property, we can use antenna for multiband operation and size reduces.
2) By using Koch island fractal boundary we can increase directivity of antenna.
3) By using Koch fractal loop antenna we can increase bandwidth of VSWR.
4) By using Koch fractal printed slot antenna reduces return loss bandwidth.
5) By using Fractal boundary micro strip antenna reduces return loss, axial ratio and excellent circular polarization.
6) By using asymmetrical Koch fractal curves as boundaries of a square patch and embedded rectangular slot used for triband operation and excellent circular polarization.

7. CONCLUSION OF THE STUDY

The review of fractal antenna presented a comparative review of the research area we call fractal antenna in communication and result shows the better output of latest antenna using different technique .By using fractal antenna , We can reduce the size of antenna and as well as get the better performance of antenna .

8. BIBLEOGRAPHY

1) Carles Puente-Baliarda, Jordi Romeu, Rafael Pous, Angel Cardama, “On the Behavior of the Sierpinski Multiband Fractal Antenna”,IEEE Transaction on antenna and propogation,vol.46,no.4,1998
2) Carmen Borja and Jordi Romeu, “On the Behavior of Koch Island Fractal Boundary Microstrip Patch Antenna” IEEE Transactions on antennas and propogation, vol 51,no,6,2003
3) Rao Hanumantha Patnam, “Broadband CPW-Fed Planar Koch Fractal Loop Antenna” IEEE antennas and wireless propogation letter,vol.7,2008
4) Deepti Das Krishna, IEEE, M. Gopikrishna, C. K. Anandan,P. Mohanan, and K. Vasudevan,” CPW-Fed Koch Fractal Slot Antenna for WLAN/WiMAX Applications” IEEE antennas and wireless propagation letter,vol.7,2008
5) V. V. Reddy and N. V. S. N. Sarma, “Compact circularly polarized asymmetrical fractal boundary microstrip antenna for wireless applications,” IEEE Antennas Wireless Propag. Lett., vol. 13, pp. 118–121, 2014
6) V. V. Reddy and N. V. S. N. Sarma, “Triband circularly polarized Koch fractal boundary micro strip antenna” .IEEE Antennas Wireless Propag. Lett., vol. 13, pp. 118–121, 2014.