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Literature Survey on Monopole Fractal Antennas

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Abstract-Antenna plays a vital role in Wireless Communication System. The demand for WCS has been increasing while its size is decreasing. The basic requirements of antenna used in wireless communication system are size reduction, multiple frequency characteristics, high gain, wide-band, reduction in return-loss, Omni-directional radiation pattern, reduction in cost. In this paper, the two fractal antenna geometries are described. They are Small Koch Fractal Geometry, ternary fractal tree geometry for WLAN applications. In this paper we reviewed on literature survey on monopole fractal antennas and obtained that how different structure of monopole antenna improves the results.
Keywords---- Tree Fractal, Koch Fractal, Application in WCS, Performance Comparison

I. INTRODUCTION

The name fractal itself indicates discontinues broken shapes with self-similarity in its fractal shapes. The efficiency of space filling of some fractal shapes helps in reduction of size. The first fractal geometry for WLAN applications is Koch monopole. Koch monopole and other bent wired monopole antennas are found to be more effective inlowering resonant frequency when compared to theirEuclidean geometries. Two Koch monopole antennas are mounted on the reduced ground plane in this paper. If the antenna size is reduced more than the operatingwavelength it becomes highly inefficient. The two mentioned antennas are simulated using Electro-magnetic simulator to studythe performance parameters related to size reduction. Secondly, the new novel tree shaped fractal antenna i.e., ternary fractal tree geometry is described using rectangular and triangular patch to overcome the limitation of return losses. The tree mounted over a large conducting ground plane having first iteration contains poor matching property of resonant frequency.

II. FRACTAL GEOMETRY

A. Koch Fractal

The geometric construction of the standard Koch Curve is fairly simple. It starts with a straight line as initiators. Initiator is divided into three equal parts and the portion at the middle is replaced two other at equal lengths. Generator is the first iterated version of it. The process is used in the generation of higher iteration [12].

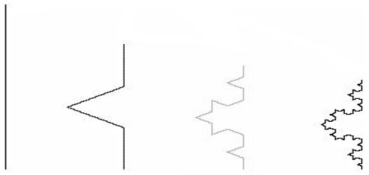


Fig: Von Koch curve [19]

B. Ternary Tree Geometry

This is quite different when we consider the actual generation of tree. It starts with stem, and that stem gives an end to two branch offs. Then that each branch off give rise to two new branch offs. In the first approach, the angular separation is varied at every iteration stage. The length of the branch is varied in relation with the other.[20]

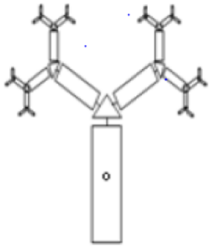


Fig: Ternary tree geometry [20]

There are two equations prescribed to change the length of the stem and branches which will change the dimensions of the fractal.

$$W_1 = \begin{bmatrix} \frac{1}{s}cos\theta & \frac{-1}{a}sin\theta \\ \frac{1}{a}sin\theta & \frac{1}{s}cos\theta \end{bmatrix} \begin{pmatrix} Y \\ Z \end{pmatrix} + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \text{.....(1)}$$

$$W_2 = \begin{bmatrix} \frac{1}{s}cos\theta & \frac{1}{a}sin\theta \\ \frac{1}{a}sin\theta & \frac{1}{s}cos\theta \end{bmatrix} \begin{pmatrix} Y \\ Z \end{pmatrix} + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \text{.....(2)}$$

To obtain the fractal geometry with desired dimension D, the below equation is used

$$\left(\frac{1}{1+x}\right)^D + 2\left(\frac{x}{1+x}\right)^D = 1 \text{.....(3)}$$

III. LITERATURE REVIEW

A. *Fractal Multiband Antenna Based On The Sierpinski Gasket*

In 1996, researchers C. Puente, J. Romeu, R. Pous,X. Garcia and F. Benitz investigated towards monopole antenna which is design on the basis of one of the fractal geometry so it is also called fractal monopole antenna and the fractal geometry which is used for designing the antenna is Sierpinski gasket. In this paper authors described the property of fractal geometry that is self-similarity and due to this property antenna behaves as multi-resonating antenna. To verify the theoretical results antenna is simulate using FDTD technique which is one of the type of full wave analysis method. Authors concluded that property of self-similarity antenna resonates in five bands because using this antenna is designed up to for five iterations and this property is converted into electromagnetic behavior.

B. *Sierpinski Multiband Fractal Antenna*

In 1998, Researchers, Carles Puente-Baliarda, Jordi Romeue, Rafael Pous, Angel Cardama members of IEEE investigated the behavior of multiband fractal antenna which is based on Sierpinski gasket geometry. In this paper authors introduced an antenna which shows the multiband behavior of that antenna and is compared to single band bow-tie antenna. Authors experimentally shown the results using simulator software. Authors concluded that obtained results from numerically and experimentally described the multiband behavior of antenna and consistent behavior in terms of return loss and radiation pattern.

C. *Sierpinski Monopole Antenna With Controlled Band Spacing And Input Impedance*

In 1999, Authors proposed a Sierpinski gasket antenna which is generally triangular in shape to controlled the band spacing and input impedance. Antenna is suitable for the application of GSM, DECT and WLAN. Antenna is fed by using 50Ω with stripline technique and designed antenna is simulated using software which is based on FDTD method. Authors concluded that fundamental frequency match got improved. Further optimization of antenna and its ground plane results gets improved.

D. *Multiple Circular Loop Monopole Antenna*

In 2000, Researchers, C.T.P. Song, P.S Hall, H. Ghafouri-Shiraz and D. Wake introduced a new design of antenna which is also type of monopole antenna whose outer three loop have size ratio of 2 while feed monopole is disk. In this paper authors designed an antenna using method for controlling the radiation pattern and gives better results in terms of return loss and radiation pattern at higher operating than the circular disk monopole and antenna is designed on the principle of fractal Sierpinski gasket monopole. This antenna is suitable for the applications of GSM, DECT and HIPERLAN. Authors concluded that this antenna achieves better control for radiation pattern.

E. *Fractal Antenna Research At University Of Birmingham*

In 2001, Researchers, C.T.P. Song, P.S Hall, H. Ghafouri-Shiraz and I. Henning investigated for new design antenna so they introduced two development of fractal monopole antennas. The first antenna described the multiband behavior of a perturbed fractal Sierpinski gasket and other one is a perturbed Parany monopole antenna. Through the experimental results authors concluded that there is difficulty to feed the perturbed Sierpinski gasket and perturbed Parany monopole antenna and described two for the matching of antennas without using matching circuits.

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F. Multiband Multiple Ring Monopole Antennas

In 2003, Researchers, C.T.P. Song, Peter S. Hall proposed two novel design of antennas using multiple ring. One is based on circular structure and other one is based on by varied the shape of circular to elliptical one. These two antenna obtained better results in terms of return loss and radiation pattern than the previous Sierpinski gasket and Parany monopole antenna. In this paper authors concluded that due to the discrete structure of multiple ring so they well defined the current path so antenna gives better control for the radiation pattern than the circular disk monopole antenna at higher operating bands.

G. A New Ultra wideband Printed Monopole Antenna (PICA)

In 2004, Researchers Seong. Yousuh, Warren L. Stutzman and William A. Davis investigated toward the monopole antenna and they proposed and antenna in this paper. Antenna provides the ultawideband performance and achieves radiation pattern like monopole disk antenna but this antenna achieves better size reduction. Authors concluded that proposed antenna is suitable for10:1impedance bandwidth experimentally and by measurement antenna provides omnidirectional pattern over 7:1 impedance bandwidth.

H. CPW-fed Circular Ring Monopole Antenna

In 2005, Researchers investigated towards the antenna design field and proposed an antenna which is circular ring monopole antenna and is fed by coplanar waveguide. This antenna is also suitable for ultrawideband application.Authors concluded that proposed antenna exhibits the similar properties of circular disk monopole antenna and also that resonant frequency is dependent on outer radius of the ring.

I. An Ultrawideband Bidirectional Antenna with Modified Circular Disc Monopole Excited Elliptical Ring

In 2007, Authors Krittaya Chawanonphithak,Chuwong Phongcharoenpanich, Sompel Kosulvit and Monai Kairiksh. Investigated and introduced an antenna for UWB application and is bidirectional antenna. Antenna is simulated using CST software and authors found the results that antenna achieves better return loss over the frequency range of 3 to 25 GHz. Researchers concluded that antenna proposed antenna is for bidirectional and is low cost with simple fabrication. Antenna could be further optimized by parametric study for more better results. This antenna is suitable for modern base station.

J. A Broadband Center Fed Circular Patch-Ring Antenna with a Monopole like Radiation Pattern

In 2009, Researchers Asem Al. Zoubi, Fan Yang, and Ahmed Kisk investigated towards antenna field and proposed an antenna. In this paper authors introduced a circular microstrip patch antenna with a coupled annular ring for universal mobile communication systems (UMTS) and UWB applications. Proposed antenna resonates at frequency 5.8 GHz. Authors done the parametric study and their discussion and they concluded that antenna achieves at this resonating frequency 5.7dBi and antenna is simulated using HFSS software and fabricated and tested.

In the same year authors K.G Thomas M. Sreenivasan investigated and introduced a planar elliptical disc monopole antenna for universal mobile communication systems (UMTS) and UWB applications. Antenna is excited by microstrip transmission line and printed on FR4 dielectric substrate. Authors concluded that antenna provides better impedance bandwidth and improved radiation pattern almost omnidirectional pattern as like monopole antenna.

K. Numerical Research of Bowtie Sierpinski Fractal Patch Antenna in RFID

In 2010, Researchers, Qin Wang, Jinquan Huang investigated numerically that using Mom model which is made by RWG vector basis function and is suitable for transmission lines and surfaces. Authors numerically noted that current flows mainly at surface of triangle and obtained radiation pattern at different flare angle are 30°, 60° and 90°. Authors concluded that broader the flare angle, resonant frequencies move towards the lower band. Broader flare angle improved radiation pattern in higher frequencies and improved bandwidth.

L. A New Triple- Band Circular Ring Patch Antenna With Monopole Like Radiation Pattern Using a Hybrid Technique

In 2011, Researchers, Mahmoud Niroo- Jazi and Tayeb A. Denidni investigated and proposed a conical shape radiation pattern antenna and this antenna was based on hybrid technique. Proposed antenna is circular-ring patch antenna and is excited with dominant mode $TM_{02.}$ Authors concluded that proposed antenna gave multiband operating response and also improves radiation pattern of the antenna and is good for multiband communication systems.

M. Design And Implementation Of New Multipolarization Antenna

In 2012, Researchers, Zong-Quang Lui, Zuping Qian, Zhenping Han, and Shui- Wei Zhou investigated and proposed an antenna

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to meet wide angular width so they designed a new multipolarization (Circular and linear). This could be achieved by a circular patch and monopole antenna loaded with disk respectively. Authors concluded that antenna have abiliy to receive three orthogonal components of electric field in space. So at a time antenna can receive as well as send the signals and is suitable for vehicle and mobile applications.

N. A Modified Three –Circular Ring Monopole Antenna For Wlan/Wimax Triple Band Operations

In 2013, Researchers, Jong Han Yoon, Young Chul Rhee proposed a new antenna which operates in three band and is implanted version of three circular ring monopole antenna with rectangular slots in the ground plane for WLAN/WiMAX applications. The proposed consists of three circular rings in which one ring is pen ended. They concluded that smallest and biggest circular rings yield to different resonances (2.5/5 GHz) and open slot enable the antenna to operate at 3.5 GHz band.

O. Wideband Omnidirectional Circularly Polarized Patch Antenna Based On Vortex Slots And Shorting Vias

In 2014, Researchers, Dan Yu, Shu-Xi Gong, Yang-Tao Wan, Ya-Li Yao,Yun-Xue Xu, and Fu- Wei Wang investigated and proposed an antenna that wideband omnidirectional circularly polarized microstrip antenna. The proposed antenna consists of a disk loaded coaxial probe, six Shorting vias and a circular patch with six vortex slots. Disk loaded coaxial probe is responsible for wideband operation, shorting vias and vortex slots are responsible for polarizations. They concluded that antenna achieved wideband and improved impedance bandwidth of 57.9% (2.4-3.5 GHz) and 51.7% in frequency range of (2.05-3.72 GHz) and proposed antenna radiates omnidirectional pattern with maximum gain of 1dBi.

IV. CONCLUSION

In Koch geometry by reduceing the height the performance is increased but in Tree geometry even thoughthe size is reduced by using triangle and wired structure, the performance depends on many parameters like like length of stem, separation between ground and feed, iterations, scale factor, angle. Koch shows the Omni-directional radiation pattern in 2.45-5GHz (ISM band) range. Tree geometry in simulated in 2.8GHz for WLAN application(Wireless Video Operation). Matching circuitary is not required for both Koch and Tree geometry.In literaure survey authors concluded that monopole antennna with multiple circular structure provides better radiation pattern and return loss because discrete structure defines the current on the edge of the circular ring means resonating frequency is depend on the outer raadiusof the ring and most of the antenna is printed on dilectric substrate FR4 which is mostly fed by 50Ω either by coaxial feed or microstrip line fee.

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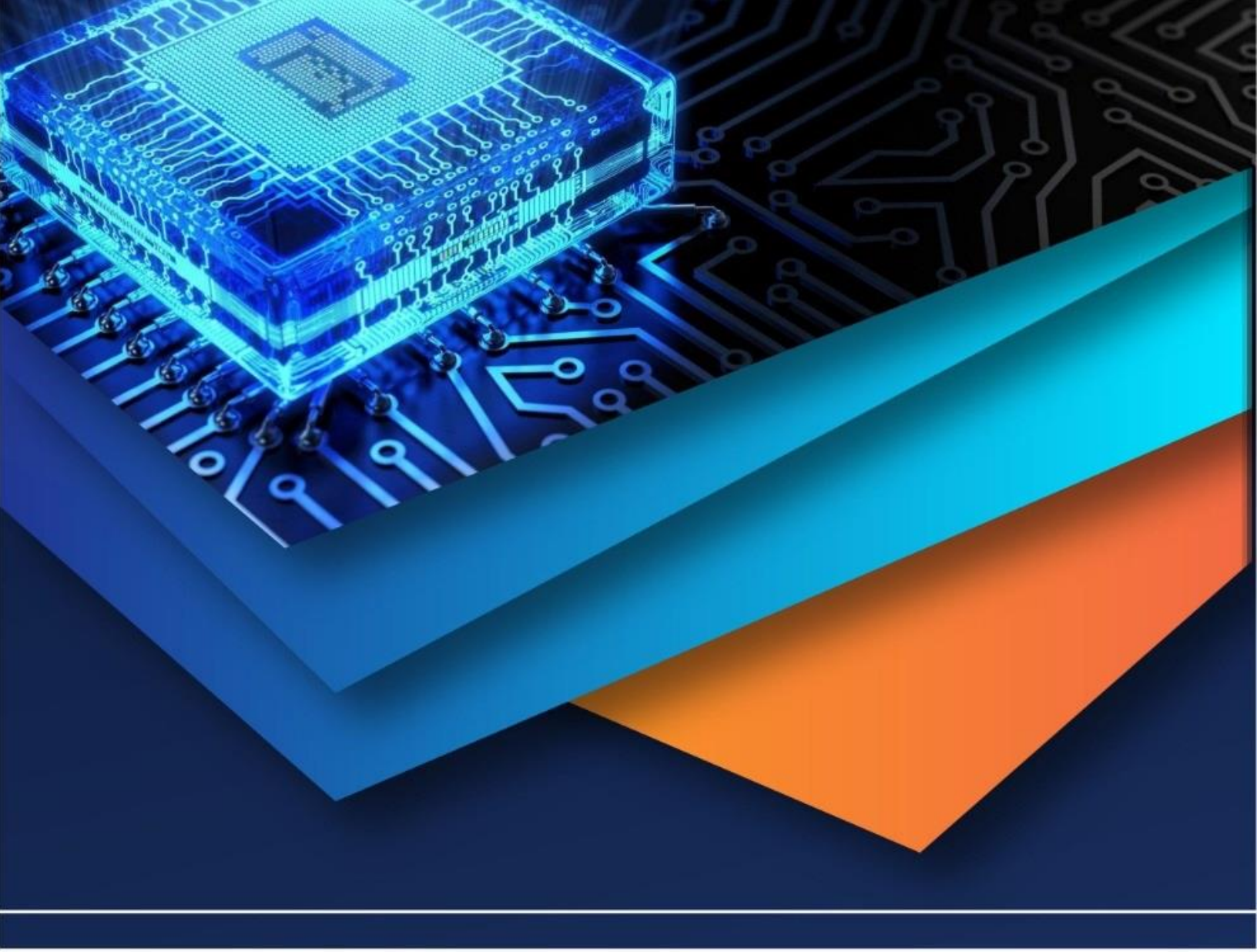
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