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MONOPOLE FRACTALGEOMETRIE ANTENNA FOR APPLICATION OF ISM/WLAN/BLUETOOTH AS A REVIEW

Amit Kumar Tiwari
M.Tech STUDENT
Electonics& Communication DepartmentHOD
REWA INSTITUTE OF TECHNOLOGY REWA (M.P.)
Amittiwari03071989@gmail.com

Swatantra Tiwari
HOD
Electonics& Communication Department
REWA INSTITUTE OF TECHNOLOGY REWA (M.P.)
Swatantratiwari84@gmail.com

Abstract

Modern communication system require antenna with wider bandwidth, smaller dimension, high gain and high efficiency. Various antennas for wide band operation have been studied for communication and radar system. The proposed antenna has been simulated and optimized using IE3D Simulator to cover standard frequency bands like at (3.54GHz,4.071GHz,9.061GHz), ISM/WLAN/Bluetooth band (Operating freuencuies:2.32GHz), Wi-Max(3.4-3.69GHz,Operating Frequencies: 3.54GHz), Hiper Lan2(2.12-2.32GHz, operating frequencies: 2.32GHz) communication. In this Dissertation, We compare both result and we analyze that like VSWR (VSWR≤2) and Return Loss dB (Return loss ≤-9.5 dB) and almost 100% radiation Efficiency for 2.53GHz frequencies . I also fabricate this antenna and measure return loss for various resonant frequencies. Practical result shows antenna resonant at ten different frequencies within range 1-20GHz. which shows antenna work as good multiband antenna.

Keywords: Monopole, circular polarized, application of ISM/WLAN/BLUETOOTH optimized using IE3D

Introduction

In Today's world, in order to face the technological development, men need to keep up with the evolution. This evolution leads to the development of cellular devices. This brought up many new areas of investigation the one with main interest for this dissertation is the research of antennas with fractal geometries. The main problem of common antennas is that they only operate at one or two frequencies, restricting the number of bands that equipment is capable of supporting. Another issue is the size of a common antenna. Due to the very strict space that a handset has, setting up more than one antenna is very difficult. To help these problems, the use of fractal shaped antennas is being studied.

This has initiated antenna research in various directions, one of which is by using fractal shaped antenna elements.

History

A microstrip antenna idea was firstly introduced in 1950's but it became popular and took place in various applications in 1970's. Recently, microstripantennas are widely used in several applications where small size, low weight and cost, high performance and easily fabricated and installed antennas are required such as air borne, space borne commercial and military applications and mobile and wireless technologies. Some other advantages of microstrip antennas are that they are conformable to planar and non-planar surfaces, easily fabricated using printed circuit technology, and they are mechanically robust. Microstrip patches are resonant type antennas. Thus, impedance bandwidths are narrow. For reducing the size of antenna, fractal geometries have been introduced.[1]

In 1951, Mandelbrot proposed the fractal geometries, which were extensively used in various science and engineering fields. The word of fractal comes from the word of Latin language's facts. The concept of fractals applied for geological application. The most famous application is use by Mandelbort. He use the concept of fractal for synthesize landscape of cost line in Britain. Mandelbort also called as father of fractal geometry. However some mathematicians had remarked and proposed many geometry of fractal such as Georg Cantor (1872), Giuseppe Peano (1890), David Hilbert (1891), Helg Von Koch (1904),WaclawSierpinski (1916) ,Gaston Julia (1919) and FalixHausdroff (1919). These mathematicians played a key role in Mandelbrot's concept a new geometry. Then Mandelbrot demonstrate that these early mathematical fractals have many features in common with shapes found in nature. For this reason he publishes his book with the title "The Fractal Geometry in Nature" in 1982 [1].

Literature Survey

It is focusing on various types of fractal geometry antenna uses for multiband

HomayoonOraizi and ShahramHedayati**"Miniaturized UWB Monopole Microstrip Antenna design by the Combination of Giuseppe Peano and Sierpinski Carpet Fractals" [1]**

A fractal monopole antenna is presented for the application in the UWB frequency range, which is designed by the combination of two fractal geometries. The first iterations of Giuseppe Peano fractal are applied on the edges of a square patch, and a Sierpinski Carpet fractal is formed on its surface. The feed circuit is a microstrip line with a matching section over.

Kin-Lu Wong, Senior Member, IEEE, Gwo-Yun Lee, and Tzung-WernChiou "A Low-Profile Planar Monopole Antenna for Multiband Operation of Mobile Handsets" [3]

A novel planar monopole antenna with a very low profile (antenna height less than 0.04 times the operating wavelength in the free space) and capable of multiband operation is presented. The presented antenna has a planar rectangular radiating patch in which a folded slit is inserted at the patch's bottom edge.

Douglas H. Werner, Randy L. Haupt and Pingjuan L. Werne J "Fractal Antenna Engineering: The Theory and Design of Fractal Antenna Arrays"[5]

Fractal antenna engineering represents a relatively new field of research that combines attributes of fractal geometry with antenna theory. Research in this area has recently yielded a rich class of new designs for antenna elements as well as arrays.

AbolfazlAzari"A New Super Wideband Fractal Microstrip Antenna" [6]

The concepts of fractals can be applied to the design of ultra wideband antennas. Applying fractals to antennas allows for miniaturization of antennas with multi-band and broad-band B. R. Franciscatto ,T. P. Vuong and G. Fontgalland properties.

B. R. Franciscatto ,T. P. Vuong and G. Fontgalland "High gain Sierpinski Gasket fractal shape antenna designed for RFID"[7]

In this paper a high gain Sierpinski fractal shape antenna (reader) for RFID applications is presented. It has been observed that the fractal geometry presented in the preceding literature could be an interesting solution for the antenna design in RFID applications,

AsitK.Panda, ManojK.Panda and SudhansuS.Patra"A Compact Multiband Gasket Enable Rectangular Fractal Antenna"[9]

A compact printed CPW feed multiband Gasketed carpet antenna is investigated in this paper. The simulated results indicate that the antenna exhibits a good return loss, and the antenna gain is above 5 dB at the designed frequency and other multiband frequencies suitable for IEEE WLAN (2.4-2.484 GHz), WiMAX (3.4-3.69 GHz) & WIFI (5.1-5.825GHz) as well other wireless communication system.

Ashish A. Lale, Bhagwan V. Khiste and Sanjay Khobragade"Study of Sierpinski triangle gasket" [11]

A set of Sierpinski triangle antennas using a coplanar capacitive feed strip has been presented in this paper. Based on experimental studies it is demonstrated that the triangular patch antenna gives the best performance having bandwidth, and with a good broadside radiation patterns throughout this band.

L. S. Araújo, C. P. doNascimento Silva, L. C. Barbosa, A. J. Belfort de Oliveira"AnovelSierpinski carpet fractal dipole"[12]

The inclusion of slots in the geometry of iteration 2 of the original Sierpinski dipole, creating the fractal generator, permitted currents to flow near their edges, which changed significantly the electromagnetic performance of the antenna. Squares formed by the slots in the dipole determine the number of resonances that appear for each iteration.

Problem Identification

In literature survey I discussed various fractal geometry were applied for the design and realization of frequency-independent and multiband antennas. Multiplication of an antenna size by a factor generally decreases the operating frequency of the antenna by the same factor. If an antenna is much smaller than the wavelength of the operating frequency, its efficiency deteriorates drastically since its radiation resistance decreases and the reactive energy stored in its near field increases. These two factors make the matching of a small antenna to its feeding network difficult. Consequently, fractal antennas are a viable candidate for their miniaturization. Antenna geometries and dimensions are the main factors determining their operating frequencies.[5] In order for an antenna to work equally well at all frequencies, it must satisfy two criteria: it must be symmetrical about a point, and it must be self-similar, having the same basic appearance at every scale: that is, it has to be a fractal. Most of researcher works on designing fractal antenna by use of common fractal geometries like such as Koch, Tee-Type, Sierpinski carpet, Sierpinski gasket, Hilbert curves and Cantor Set. These types fractal antenna can achieve multiband behavior by implementing more than 2nd iteration. Most of researcher conclude that when going to higher iteration antenna achieve more multiband behavior. As the iterations go on increasing the loading causes multiple resonance and a shift down in resonance frequency, which may lead to an effective antenna miniaturization and multiband characteristics. However, for iterations higher than the second iteration, the antenna design becomes quite complicated and its fabrication becomes very difficult. So that the Hybrid techniques is very useful for achieve multiband behavior of antenna.[3]

ANTENNA PARAMETERS

Gain and Directivity

The gain of an antenna is the radiation intensity in a given direction divided by the radiation intensity that would be obtained if the antenna radiated all of the power delivered equally to all directions [9]. The definition of gain requires the concept of an isotropic radiator that is one that radiates the same power in all directions. GdBd-GdBd=GdbiGdbi-2.15dBi

Antenna Polarization

Polarization of radiated wave is define as the property of electromagnetic wave describing the time varying direction and relative magnitude of the electric field vector at a fixed location in space, and the sense in which it is traced, as observed along the direction of propagation. Polarization then is the curve traced by the end point of arrow representing the instantaneous electric field [7].

Input Impedance

Antenna impedance relates the voltage to the current at the input to the antenna. Let's say an antenna has an impedance of 50 ohms. This means that if a sinusoidal voltage is applied at the antenna terminals with an amplitude of 1 Volt, then the current will have an amplitude of 1/50 = 0.02 Amps. Since the impedance is a real number, the voltage is in-phase with the current. Alternatively, suppose the impedance is given by a complex number, say Z=50 + j*50 ohms [7,26].

Voltage Standing Wave Ratio

The VSWR, which also known as SWR is not strictly an antenna characteristic, but is used to describe the performance of an antenna when attached to a transmission line. It is a measure of how well the antenna terminal impedance is matched to the characteristic impedance of the transmission line. The VSWR is the ratio of the maximum to the minimum RF voltage along the transmission line. The maxima and minima along the lines are caused by partial reinforcement and cancellation of a forward moving RF signal on the transmission line and its reflection from the antenna terminals.

Bandwidth

The impedance of an antenna normally varies as a function of frequency, and therefore the matching also varies as a function of frequency.

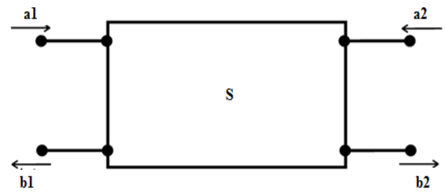
Quality Factor

The quality factor is responsible for antenna losses. Typically there are radiation, conduction, dielectric and surface wave losses.

(1/Qt) = (1/Qrad) +(1/Qc) +(1/Qd) +(1/Qsc)

- 1/Qt= Total Quality of factor
- 1/Qrad=Quality factor due to radiation lost
- 1/Qc = Quality factor for conduction lost
- 1/Qd=Quality factor due to dielectric lost
- 1/Qsc=Quality factor due to surface lost.

- **Scattering Parameter**
- Scattering parameters also known as S-Parameters, are the reflection and transmission descriptors between the incident and reflection waves, which for a two port system is given by.



- Fig. Generalized Two Port Networks[15]
- [S] represents the scattering matrix
- $\begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \end{bmatrix}$

- **Antenna Efficiency**
- The efficiency of an antenna relates the power delivered to the antenna and the power radiated or dissipated within the antenna [26]. A high efficiency antenna has most of the power present at the antenna's input radiated away. A low efficiency antenna has absorbed most of the power as losses within the antenna, or reflected away due to impedance mismatch.

Antenna efficiency = Pradiated/ Pinput**Proposed Work**

In this paper, aim to designing multifunctional and small antenna by using fractal geometries. Although many fractal geometries are identified, and mathematically studied for long time, their applications into electromagnetic is fairly recent. Within the past decade few fractal geometries have been proposed as antenna elements and special antenna characteristics introduced by the use of these geometries have been widely acclaimed. It has been claimed that the self-similarity of the geometry is the cause of multi-band characteristics of the resulting antenna. This thesis aims at furthering the understanding the effectiveness of these geometries in antennas, and to bring about true advantages of their use in antenna engineering. Fractal microstrip antenna is used for multiband application in this dissertation provides a simple and efficient method for obtaining the compactness.

Conclusion

This paper presents new concept of implementation of Fractal geometry on Carpet fractal geometry and designed multiband antenna.The aim of this dissertation work find how implementation of Fractal geometry on Carpet fractal geometry gives better result in achieving antenna parameters like return loss

(RL),VSWR, antenna efficiency ,Gain, directivity and bandwidth. In this dissertation work I first design multiband i Carpet fractal microstripe patch antenna and simulate its results with IE3D software.

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