WLAN SINGLE LAYER MONOPOLE FRACTAL GEOMETRIE ANTENNA FOR 5 TO 9 GHZ: A REVIEW

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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 use of fractal geometry in designing antenna has been a recent topic of interest. Fractal antenna is preferred due to small size, light weight and easy installation. The proposed antenna has been simulated and optimized using IE3D Simulator to cover standard frequency bands like UWB at (6GHz,9.061GHz), ISM/WLAN/Bluetooth band (Operating freuencuies:2.32GHz), Wi-Max (3.4-3.69)GHz, Operating Frequencies: 3.54GHz), Hiper Lan4(8.5) communication.

Keywords- IE3D; FR-4 substrate, WLAN Application

I. INTRODUCTION

Recently, the wireless communication technology is developed rapidly; So that we introduced Micro strip patch antennas (MPA) have the advantages compared to the traditional microwave antennas such as low profile, light weight, easy fabrication and integration with other circuit elements However, it inherits narrow bandwidth and relative large size in microwave frequency range. There are several methods to obtain dual frequency, size reduction with improvement in bandwidth and gain by the use of thick substrate, cutting a resonant slot inside the patch, the use of a low dielectric substrate, multi-resonator stack configurations, the use of various impedance matching and feeding techniques, and the use of slot antenna geometry. Proposed design uses probe feeding method with slot on the patch to improve the different parameters of micro strip antenna.

II. HISTORY

A microstrip antenna was firstly introduced in 1950's but it became popular and took place in various applications in 1970's. Recently, microstrip antennas 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.

III. LITERATURE SURVEY

The invention of microstrip patch antenna has been attributed to several authors, but it was certainly dates in the 1960s with the first work published by Deschamps, Greig and Engleman, and Lewin, among others. After the 1970s research publications started to flow with the appearance of the first design equations. Since then different authors started investigations on Microstrip patch antennas like James Hall and David M. Pozar and there are so many works done by many author. During the course of development of this work, I have gone through many international papers and publications which helped me understand the concepts of the microstrip patch antenna their utility and gave me a clear view of the goals and challenges that lie ahead in designing this antenna in a practically realizable way. The following section discusses some of the more important papers which were referred for this work. All the authors have been duly mentioned whenever and wherever referred in my text.

In this literature survey an overview of some representative works in the area of Design of Fractal patch antenna is given.

It is focusing on various types of fractal geometry antenna uses for multiband application. Various fractal geometry antennas represent the multiband applications.

1. Homayoon Oraizi and Shahram Hedayati "Miniaturized UWB Monopole Microstrip Antenna design by the Combination of Giuseppe Peano and Sierpinski Carpet Fractals" IEEE Antenna andWireless Propagation Letter, vol.-10,no.-,pp.67-70.2011

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. The presented C antenna has an omnidirectional radiation pattern, a good gain, and high efficiency. In this design, Giuseppe Peano fractal is applied on the edges of a square patch and Sierpinski Carpet fractal is formed on its surface. This design antenna covers only Ultra Wide Band frequency range.[1]

2. Homayoon Oraizi and Shahram Hedayati "Miniaturization of Microstrip Antennas by the Novel Application of the Giuseppe Peano Fractal Geometries" IEEE Transaction on Antenna and Propagation, vol. - 60, NO. 8, pp.3559-3567 August 2012.

In this work they investigate the possibilities and properties of the application of Giuseppe Peano fractal geometry for the miniaturization of microstrip patch antennas and compare its performance with those of the usual fractals, such as Koch, Tee-Type and Sierpinski. The length of the Giuseppe Peano fractal patch perimeter increases, while its surface area remains constant without any more space occupation. Consequently the antenna miniaturization, maintenance of its gain and increase of its relative frequency bandwidth are achieved. The proposed antenna has circular polarization at one of its resonance frequencies, which is realized by producing a perturbation on its initial structure. Further miniaturization of antenna may be obtained by cutting slots on its structure and its broad banding may be achieved by placing an air gap under its metallic patch and more effective miniaturization is obtained by placing a Giuseppe Peano fractal strip along the microstrip patch antenna. The length of the Giuseppe Peano fractal patch perimeter increases, while its surface area remains constant without any more space occupation consequently, the antenna miniaturization, and maintenance of its gain and increase of its relative frequency bandwidth are achieved. The application of Giuseppe Peano fractal geometry to microstrip antennas has revealed interesting characteristics and may be pursued in further investigations. [2]

IV. 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.

Proposed Design

V. PROPOSED FRACTAL GEOMETRY

In this dissertation, I design two fractal antennas one by using single layered and second by fractal geometries implemented on multilayer using air gap.

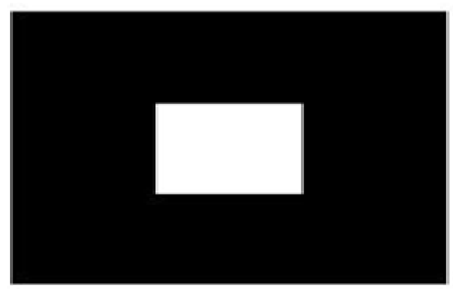
a. Fractal Antenna

Sierpinski carpet geometry is the most widely studied fractal geometry for antenna applications. This has been investigated extensively for monopole and dipole antenna configurations [17]. It has been found that by perturbing the geometry the multi-band nature of these antennas can be controlled. Variations of the flare angle of these geometries have also been explored to change the band characteristics of the antenna. Antennas using this geometry have their performance closely linked to conventional bow-tie antennas. However some minor differences can be noticed in their performance characteristics. It has been found that the multi-band nature of the antenna can be transformed into wideband characteristics by using a very high dielectric constant substrate and suitable absorbing materials.

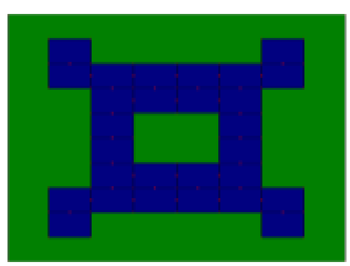
The Sierpinski carpet fractal is generated by geometric transformations on squares. Sierpinski Carpet fractal antenna can realize by applying successive iteration on square patch as shown in Figure 4.1(a). The 0^{th} iteration is resulted by a simple rectangular patch. Here, the dimension of square is equal to one third of the main patch is subtracted from the center of patch to retrieve first order iteration as shown in Figure 4.1 (b).The next step is to each squares which are nine time and twenty seven time smaller than the main patch as shown in Figure 4.1 (c) and (d) respectively.

The second and third are carried out eight times and sixty four time respectively on the main patch. This fractal can be termed as third order fractal as it is designed by carried out three iterations. The pattern can be define in such a way that each consequent etched square in one third dimension as compared to previous one sharing the same center point. The self-similar current distribution on these antennas is expected to cause its multi-band characteristics [18].

(a)Stage 1 (1^{st} iteration)



(b)Stage 2 (2^{nd} iteration)



(c)Stage 3 (3^{rd} iteration)

Fig. 4.1 Construction of Sierpinski Carpet Fractal geometry

VI. RETURN LOSS PLOT OF CARPET SINGLE LAYER ANTENNA

The Inset feed used at point (8, 0) to design the rectangular patch antenna. The center frequency is selected as the one at which the return loss is minimum. The bandwidth can be calculated from the return loss (RL) plot. The bandwidth of the antenna is said to be those range of frequencies over which the return loss is below than -7.5 dB. The Implemented Sierpinski carpet antenna simulated return loss data and its operating frequency are as shown figure.

a. Return Loss Plot for Ist Iteration

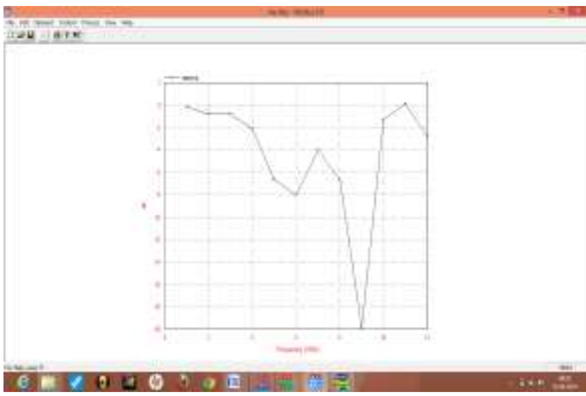


Fig. (a) Return Loss Graph of Carpet single layer Antenna

b. Return Loss Plot for 2nd Iteration

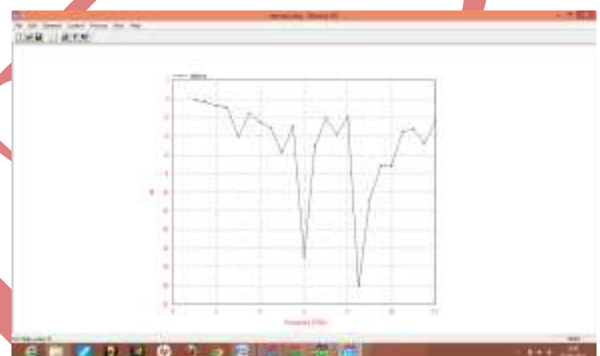


Fig. (b) Return Loss Graph of 2nd Iteration Sierpinski Carpet Antenna

VII. CONCLUSION

This Paper work presents new concept of implementation of Fractal geometry on multilayer Sieperinski Carpet fractal geometry and designed multiband antenna.The aim of this paper work is to find how implementation Sieperinski Carpet fractal geometry on multilayer gives better result in achieving antenna parameters like return loss (RL),VSWR, antenna efficiency ,Gain, directivity and bandwidth. In this paper work I first design multiband Carpet fractal microstripe patch antenna and simulate its results with IE3D software. I find that as iteration increases, there is increase in number of bands. Hence fractal geometry is a used to obtain multiband application antennas but after more than 3rd iteration system.

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