Design Of Sierpinski Gasket Multiband Fractal Antenna For Wireless Applications

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Abstract: The multiband behavior of the Fractal Sierpinski Gasket Antenna is described in this paper. An analysis is performed to examine the parameters of an antenna with a frequency range in between 1 GHz to 6 GHz. The behaviors of an antenna are investigated such as return loss and bandwidth. Simulations have been done by using different iterations. This multiband Fractal antenna is also used for different wireless applications. Sierpinski gasket antenna using a coplanar waveguide (CPW) feed which is proposed for multiband applications**.**

Keywords: Fractal antenna, CPW feeding, multiband, Sierpinski gasket,

I. Introduction

The Sierpinski Gasket (also known as Sierpinski Triangle) was described by Waclaw Sierpinski in 1915, and it became an important sample of Fractal set. The objective of this paper is to be design and simulate Sierpinski gasket Fractal antenna. The behavior and properties of an antenna are investigated. The interaction of electromagnetic waves with Fractal bodies has been recently studied [1] − [7]. The construction of many ideal Fractal shapes is usually carried out by applying an infinite number of times an iterative algorithm such as the multiple reduction copy machine (MRCM) algorithm [8]. In such iterative procedure, an initial structure called generator is replicated many times at different scales, positions and directions, to grow the final Fractal structure. Fractal's antennas are widely preferred for wireless communication systems as they are of small size, light weight, low profile, low cost, and are easy to fabricate and assemble [9]. The Sierpinski triangle geometry drew the attention of researchers as it is smaller than other patch geometries [10]. In this paper CPW feeding technique is used. The design of Sierpinski starts with an equilateral triangle with an operating frequency in between 1 GHz to 6 GHz at various iterations. Four different iterations of triangular patch are compared in terms of their return loss and bandwidths.

II. Antenna Design

An equilateral (gasket) triangle patch antenna may be designed by following procedure which assumes that the specified information includes the dielectric constant of the substrate, height of the substrate. Sierpinski gasket antenna is a representative Fractal antenna. Usually, it is inverse triangle configuration 1/2 side triangle of $2\sqrt{3}$ cm of its length of each side of the triangle, when it's zero iteration. The dimension of the substrate is 40mm×40mm. The material used for this design is **FR$_4$** with dielectric constant (4.4), thickness of the substrate is 1.59 and loss tangent (0.02). The feeding technique used for this design is CPW.

Figure 1. shoes the Sierpinski triangle for zero, first and second iteration (Figure 1).
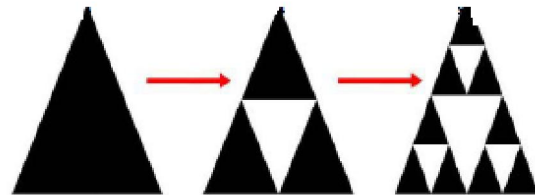

Figure 1. The Sierpinski triangle for zero, first and second iteration

III. Simulation Results
2.1 Return loss characteristics

The plot shows the simulation results of zero iteration. The triangle patch resonates at the frequency band 3.88GHz having bandwidth 288MHz with a return loss of -36 dB which is quite good (Figure 2).
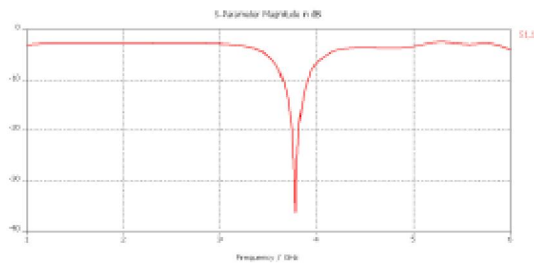
Figrue 2. The simulation results of zero iteration. The triangle patch resonates at the frequency band 3.88GHz having bandwidth 288MHz with a return loss of -36 dB which is quite good

The figure shows the simulation results of the first iteration. The triangle patch resonates at the two frequency bands one is at 3.2GHz having bandwidth 172MHz with a return loss of -23.8dB and second at 5.8GHz having bandwidth 368MHz with return loss -23.7dB and these are covered WIMAX applications (Figure 13).
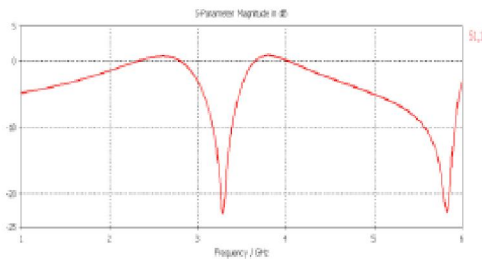

Figrue 3. The simulation results of the first iteration. The triangle patch resonates at the two frequency bands one is at 3.2GHz having bandwidth 172MHz with a return loss of -23.8dB and second at 5.8GHz having bandwidth 368MHz with return loss -23.7dB and these are covered WIMAX applications

The figure shows the simulation results of the second iteration. This triangle patch resonates at different frequency bands i.e. 2.5GHz has bandwidth 339MHz with a return loss of -17dB, 3.5GHz has bandwidth 633MHz with return loss -16.2dB and 5.2GHz has a bandwidth 143MHz with return loss -16.3dB and these are covered WIMAX applications (Figure 4).
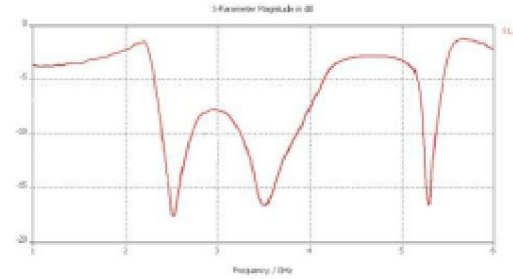

Figrue 4. The simulation results of the second iteration. This triangle patch resonates at different frequency bands i.e. 2.5GHz has bandwidth 339MHz with a return loss of -17dB, 3.5GHz has bandwidth 633MHz with return loss -16.2dB and 5.2GHz has a bandwidth 143MHz with return loss -16.3dB and these are covered WIMAX applications

IV. Conclusion

From result and discussion, it can be concluded that the self similarity in the structure for the 2nd iteration Sierpinski Gasket Fractal antenna is observed to possess multiband behavior. These multiband Sierpinski gasket antenna can cover the frequency bands of WLAN/WIMAX applications. Furthermore, as the no. of iterations increases number of resonant frequencies which gives a multiband performance to the designed antenna structures. The simulated results indicate that the antennas exhibit a good return loss, and multiband frequencies suitable for IEEE Bluetooth/WLAN (2.4-2.484 GHz), WiMAX (3.4-3.69 GHz) & WIFI (5.1-5.825 GHz) wireless communication applications.

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