ANALYSIS OF FRACTAL ANTENNA STRUCTURES WITH RECONFIGURABLE FEED

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Abstract

This paper aims to analysis the variousfractal antenna structures with a moving feeding technique. In this paper Frequency-Reconfigurable antenna is designed with the help of variable feed position technique. The Sierpinski fractal and Octagonal fractal antenna structure with the use of movement of feed position achieve reconfigurability. The concept is performed on Ansoft HFSS Simulator software and the experimental results indicate that it provides an Overall efficiency of about 98.28%. When compared to the other methods; the Reconfigurable feed based method increases the overall efficiency.

Keywords: Fractal Antenna, Reconfigurable feed, Ansoft HFSS Simulator.

I. Introduction

For analysis of various antennas structure Fractal-shaped antennas have been proved to have unique characteristics. With the continuous advancement in communication, reconfigurable antennas got great attention. Reconfigurable antennas [1] have benefits and good prospects compared with conventional antennas. The self-similarity property of fractals makes them specially suitable to design Reconfigurable antennas. Due to their Reconfigurable nature, these antennas find their applications in communication and space. A frequency-reconfigurable antenna is one in which the radiating antenna structure changes its source frequency by hopping different frequency bands. According to literature survey reveals that the frequency change occurs by changing the antenna physical structure. In this paper, the reconfigurability is obtained not by changing the antennas physical structure, but by using a variable feed instead of the standard static feed. For this proposed approach Figure 1, a Sierpinski gasket antenna and Octagonal fractal antenna was taken as the candidate antenna. For different positions of the moving feed on the main microstripline feed, the antenna structure resonates either at a single frequency or at multiple frequencies.

II. Proposed Method

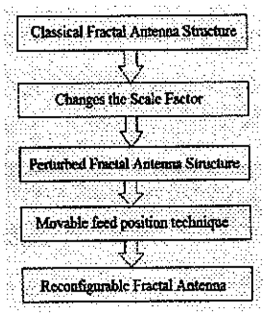

Figure 1: Design Flow

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A. Fractal Antennas : The Fractal structure means that broken or irregular fragments, was entitled by Mandelbrot [2] to describe a family of complex shapes that have an inherent selfsimilarity in their structure. A lot of example for fractal in nature can be seen as clouds, snowflakes, trees, leaves, galaxies and much more.

Fractals as multiband antennas: To work well as amultiband antenna the antenna must be symmetrical (mirror image) and should be self-similar (small copies of the whole figure).

Characteristics of Fractal Antennas

1. Self-similar
2. For bandwidth enhancement
3. Multiple resonances
4. Compact and complex shape
5. Construction is based on iteration
6. Fractal antennas for multiband operation.

B. Sierpinski Fractal Antenna

The Sierpinski triangle is also named as the Sierpinski gasket is a fractal structure with the shape of an equilateral triangle, subdivided iteratively into smaller triangles. One of the basic examples of self-similar structure. Sierpinski gasket is named after the Polish mathematicianWacBaw Sierpinski.

C. Octagonal Fractal Antenna

The Octagonal fractal shape is taken because of its good performances in bandwidth. The standard octagonal fractal arrays are formed by pieces in an equilateral triangular grid. Octagonal arrays can be viewed as several concentric circular arrays.

D. Reconfigurable Antennas

A reconfigurable antenna is capable of modifying its frequency and radiation properties in a controlled manner. Nowadays in communication technology Fractals structure used as multiband antennas with good efficiency. In fractal antenna structure coupling between sharp angles produce different current paths achieving multiband operations.

III. Design and Simulation

A. Design of Sierpinski Fractal Antenna

The Sierpinski gasket was designed for operation at frequencies (1-5) GHz to work at Bluetooth and WLAN applications. A two-iterated Sierpinski fractal Figure 2 was taken as candidate for this proposed work. A scale factor [2][6] of 0.6 and 0.75 (Perturbed Structure)with the use of Arlon substrate (□∏ r=3.2andh=1.524mm).The dimensions of the Sierpinski structure were decided and then optimized using the ANSOFT HFSS simulator.

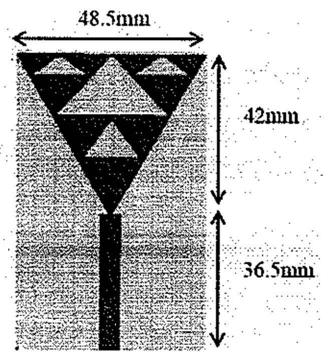

Fig 2: 0.6 scale Fractal antenna

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Area of Sierpinski triangle is given as,

$$S_{k+1} = (3/4)^{k+1} \quad (3.1)$$

B. Design of Octagonal Fractal Antenna

The design of Octagonal arrays via a repeated manner, consider the eight-element circular generating sub-array. With respect to the Octagonal properties, the interior angle is 1350 and the exterior angle is 450The width (W) and length (L) of the outside radiating patch covering the Octagonal fractal array and the permittivity of the microstrip structure operates at the required resonant frequency shown in Figure3,

The width (W) and length (L) of the radiating patch,

$$W = \frac{C}{2f_o\sqrt{\frac{\varepsilon_r+1}{2}}} \quad (3.2)$$

$$L = \frac{C}{2f_o\sqrt{\varepsilon_r}} \quad (3.3)$$

Radius of circle with the microstrip patch,

$$r = \frac{d/2}{\cos\left(\frac{135^0}{2}\right)} \quad (3.4)$$

Octagonal sub-array with radiating patch,

$$d = \lambda/2 \quad (3.5)$$

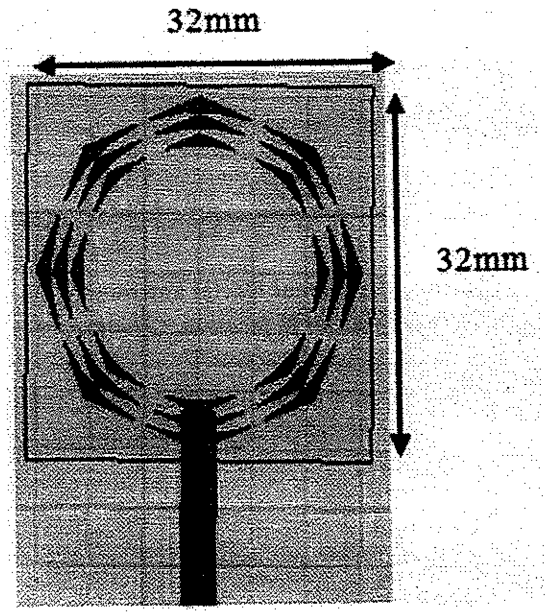

Figure 3: Octagonal Fractal antenna

IV. Results and Discussion

The antenna's return losses are measured at various 130 positions of the feed point. Single and multiple frequencies are observed. Few plots corresponding to single and multiple resonances are shown below Figure 4 and Figure 5.

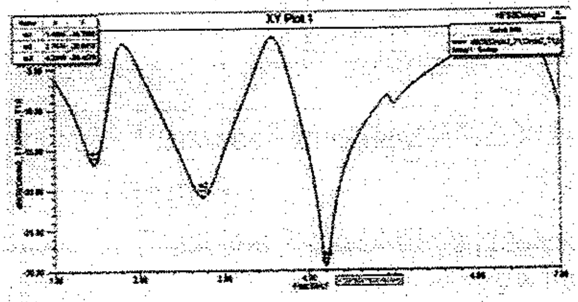

Figure 4 : Sierpinski fractal antenna by placing the feed at position = 18mm

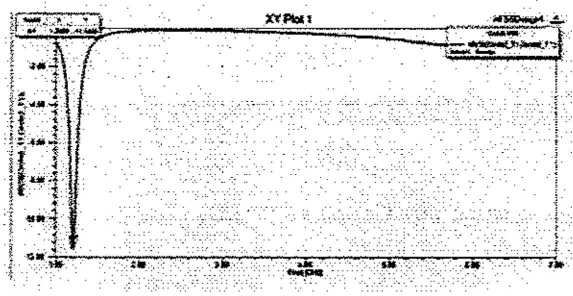

Figure 5 : Octagonal fractal antenna by placing the feed at position = 18mm

Table 1: Characteristics of reconfigurable feed in Sierpinski fractal antenna

Measured feed position	Frequency (in GHz)	Return loss (dB)
18mm	2.6067 4.4548	-15 -24
30mm	2.1884 3.2403	-18 -20
5.5mm	4.1784	-24

Table 2: Characteristics of reconfigurable feed in Octagonal fractal antenna

Measured feed position	Frequency (in GHz)	Return loss (dB)
18mm	1.2069	-11
30mm	2.1159 2.8818	-8 -13
5.5mm	2.0732 3.9824	-16 -32

Current distribution of Octagonal Fractal Antenna is better compare to Sierpinski Fractal Antenna because of feed structure. Table 1 and Table 2give the frequency response at various feed position. Radiation pattern for Sierpinski Fractal for different feed position is shown in Figure 6,

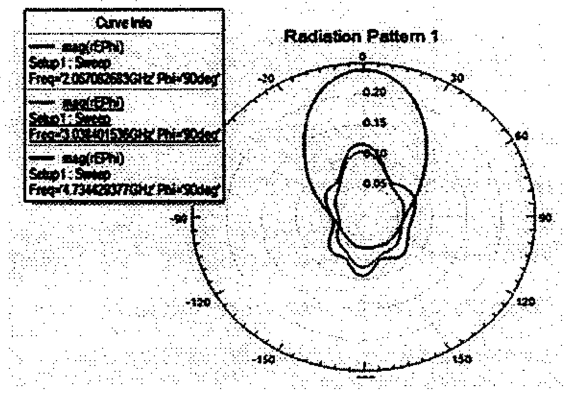

Figure 6: Radiation pattern of Sierpinski Fractal antenna structure

Radiation pattern for Octagonal Fractal for different feed position is shown in Figure 7,

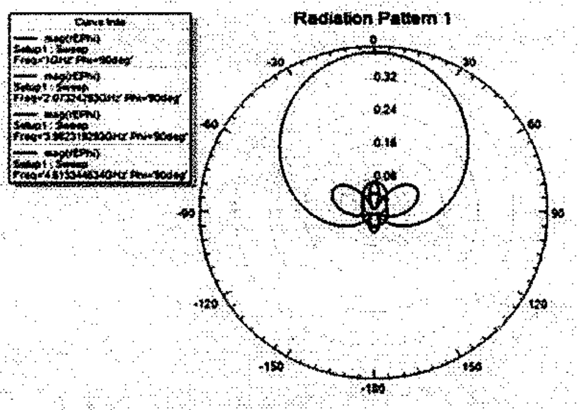

Figure 7: Radiation pattern of Octagonal Fractal antenna structure

The pattern changes because of the modified feed, and furthermore the ground plane size contributes to the alteration of the patterns. It is possible to get different gain for different feed position because the changing nature of current distribution on the antenna.

V Conclusion

In this Paper, demonstrated the feasibility of a variable feed in frequencyreconfigurable antenna. Perturbed Sierpinski gasket monopole antenna to give varying resonance patterns for different positions of the feed. It gives better result compare to other reconfigurable technique.

VI. Reference

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