Multifrequency Fractal Antenna

Dipakkumar J. Barasara, Prof. Jayeshkumar C. Prajapati, Ankitkumar M. Dethalia

Abstract— This paper presents the fifth iterative micro strip fractal antenna for multifrequency operation. The fractal antenna has been designed on substrate with dielectric constant ε_r=2.2 and substrate thickness h=1.57mm. This fractal antenna offer operation at cutoff frequencies 2.1GHz, 4.4GHz, 5.4GHz, and 7.7GHz.

Index Terms— Fractal Antenna, Multi Frequency, Resonant Frequency, Micro Strip, Impedance Matching, Return Loss, Radiation Pattern.

1 Introduction

WITH the advance of wireless communication systems and increasing importance of wireless application in recent years, the demand for small size and miniaturized, broadband, multifrequency and multiband antenna was realized. In application such as Global Positioning System and Wi-Max, operation at two or more sub-bends is necessary; a valid alternative to the broadening of total bandwidth is the use of multifrequency antenna [1]. It has been shown that fractal antenna exhibit a multiple resonant behavior in a single radiating structure [2]. When the system requires operation at two or more frequencies, multifrequency antenna may avoid the use of different antennas. Applying fractal to antennas allow for miniaturization of antenna with multi-band and broad-band operation. Fractal geometries have two common properties, space filling and self similarity. It has been shown that the self similarity property of fractal shapes can be applied to the design of multiband fractal antennas and the space filling property of fractals can be utilized to reduce antenna size [3-7].

In this paper multifrequency fifth iterative fractal antenna is simulated. In section II detailed information of antenna geometry is discussed, while in section III simulation results with return loss and radiation pattern characteristics are discussed.

2 Antenna Geometry Design

The proposed multifrequency fractal patch antenna designed up to five iteration. At initial stage antenna geometry looks like simple square patch designed on Roger/RT duroid substrate with ε_r=2.2, and substrate thickness of 1.57mm. The square patch has dimension of 41.08 × 41.08mm.

The first iteration of fractal antenna has been constructed by inscribing the circular patch of diameter 40.48mm and subtracted it from square. The second iteration has been constructed by making the square of dimension 30 × 30mm and an inscribed circle with diameter of 29.4mm and subtracted it from the square. Likewise third iteration is constructed by making square of 22 × 22mm and inscribing the circle with diameter of 21.4mm and subtracted it from square. In the fourth iteration, a square of dimension 16 × 16mm is made and an inscribed circle of diameter 15.4mm is subtracted from it. In the fifth iteration, a square of dimension 12 × 12mm is made and an inscribed circle of diameter 11.4mm is subtracted from square. All the five iteration of antenna along with patch dimension is shown in Fig. 1. This fractal antenna has been fed with micro strip feed line. An impedance transformer is used in between antenna patch and feed line to achieve better impedance matching [8].

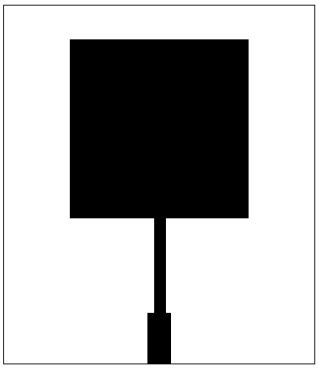

Fig. 1.1 Initial Iteration

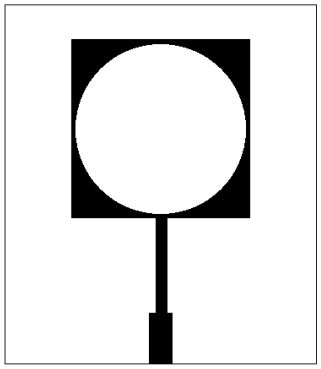

Fig. 1.2 First Iteration

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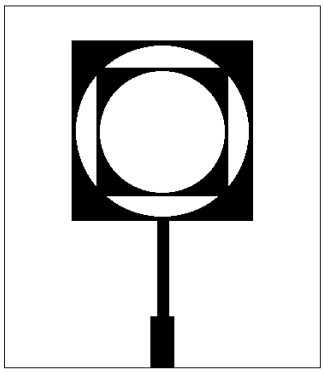

Fig. 1.3 Second Iteration

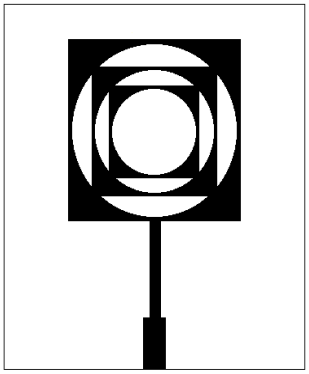

Fig. 1.4 Third Iteration

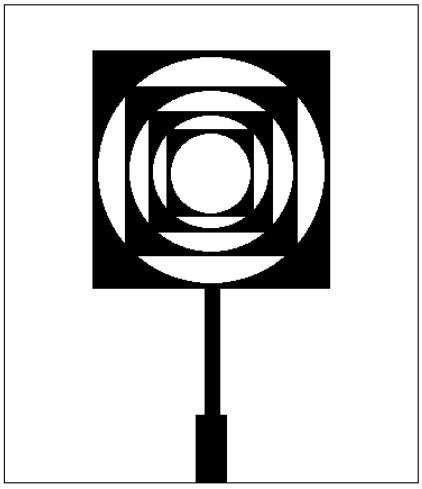

Fig. 1.5 Fourth Iteration

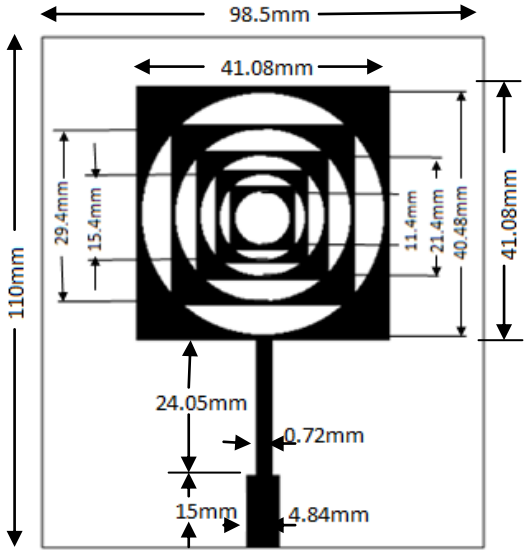

Fig. 1.6 Fifth Iterative Fractal Antenna Geometry

3 Simulation Result

After simulating this fractal antenna, it is noticed that the operating resonant frequency of antenna is depends on patch size, width of impedance transformer and substrate thickness of proposed antenna. So, these parameter should be optimized for better performance of antenna. First, simple monopole square patch antenna has been studied. Fig. 2 shows the S_{11} vs frequency plot for square monopole patch, which indicates at 2.4 GHz frequency, return loss is minimum.

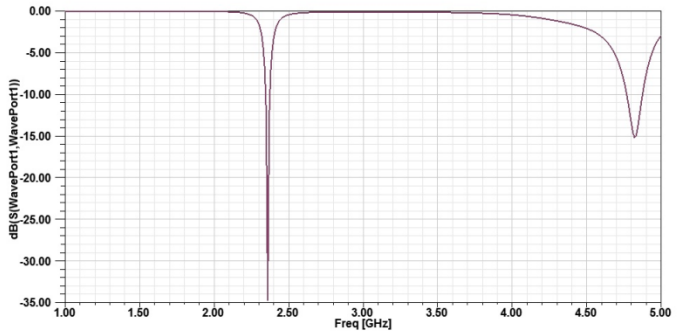

Fig. 2 Return loss plot for initial simple square patch antenna

Fig. 3 shows the return loss for the proposed fifth iterative fractal antenna. From Fig. 3, this fractal antenna could be resonating at four different corner frequencies. Fig. 4-6 shows the radiation pattern at different pass band center frequency which is nearly omnidirectional.

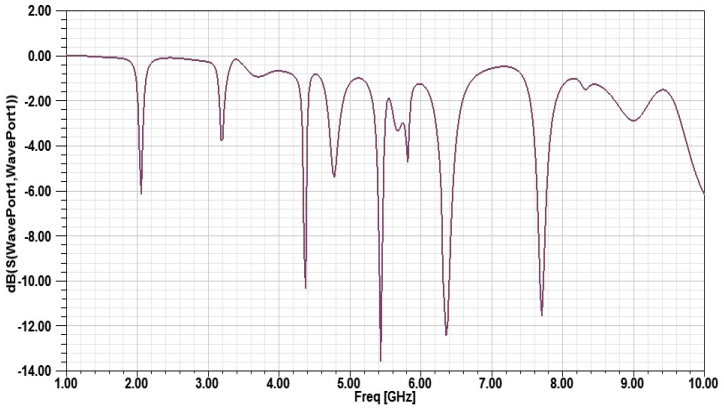

Fig. 3 Return loss plot for fifth iteration fractal antenna

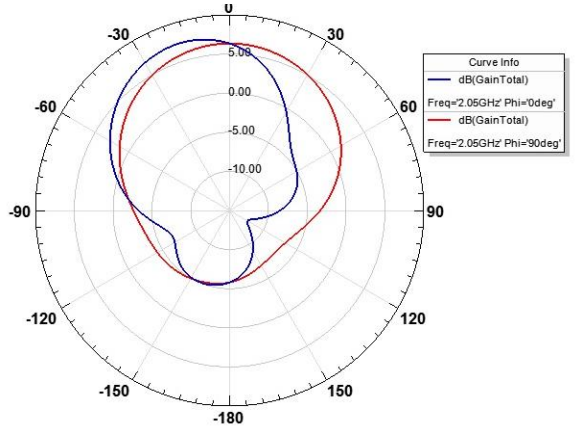

Fig. 4 Radiation Pattern of fractal antenna at 2.05GHz

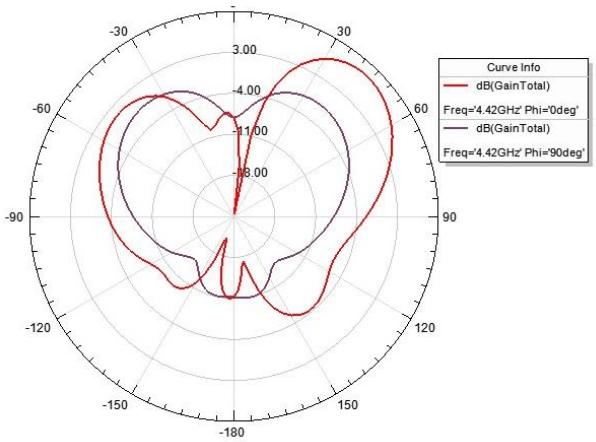

Fig. 5 Radiation Pattern of fractal antenna at 4.42GHz

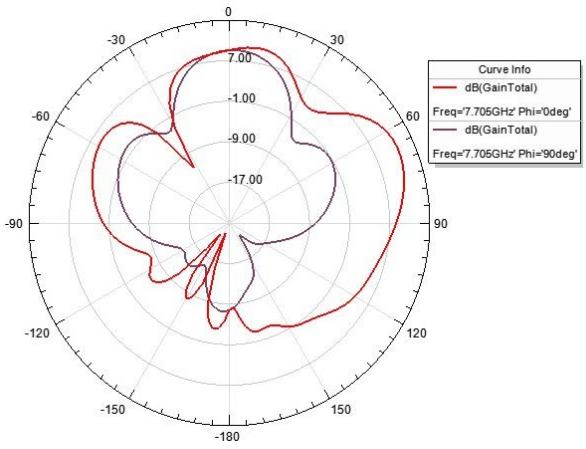

Fig. 6 Radiation Pattern of fractal antenna at 7.705GHz

4 Conclusion

This paper describes the design of a multifrequency fractal antenna for multi band operation. The proposed antenna is built on full ground plane and fed through a microstrip feed line. It is shown that the proposed antenna has operational corner frequency at 2.1GHz, 4.4GHz, 5.4GHz, 6.4GHz, and 7.7GHz normalized to 10dB return loss value, which is covered in WLAN and Wi-Max bands for communication.

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