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A Novel Hexagonal Shaped Star Slotted Fractal Antenna for Wi-Fi, WiMAX & WLAN Application

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Abstract- *In this paper, A new design of Fractal Antenna is proposed for the application in wide-band frequency range. This proposed Antenna is simulated by CST-MWS (Computer Simulation Technology – Microwave Studio) and different simulated results are analyzed. The Proposed antenna is designed and implemented to support Wi-Fi (2.4GHz), WiMAX which operate 2.5GHz (2.4GHz-2.9GHz). The proposed antenna also resonates on WLAN (2.4GHz, 4.9GHz, 5GHz). Achievement of fractal owns property of increasing electrical length of antenna largely and size reduction achieved compared to an ordinary microstrip antenna at same resonance frequency. The self similarity property of the fractal antenna is utilized for size reduction and multiband operation. Its radiation characteristics such as Return loss,* ***VSWR, Gain, Directivity, Polar plot etc…. are analyzed*** *and compared.*

Key Words : Fractal Antenna, Multi-band, CST Software, Return loss, Patch Antenna.

1. INTRODUCTION

FRACTAL term was coined in 1975 by the French mathematician, Benoit B. Mandelbrot. Fractal's products deliver unprecedented frequency coverage, versatility, and performance in form factors that area fraction of the size of traditional antennas. Modern wireless communication system require antenna with smaller dimensions and wider bandwidth [1]. A fractal can be described as a rough or fragmented geometric shape that can be separated into parts which are an approximation to the whole geometry but in a reduced size. Fractals are known as infinitely complex because of its similarity at all levels of magnification [2]. These concepts reduce the size of an antenna but length remains same with consecutive iteration. With fractal antennas we can achieve resonant frequencies that are multiband and these frequencies are not harmonics [3]. FRACTAL antennas have stimulated significant research interest lately due to their advantages of multiband operation. The multiband behavior of fractal antennas is due to their self-similarity structure, which means that some of their parts have the same shape as the whole object but at a different scale [4]. One of them is the fractalizing of antennas boundary where new qualitative effect as the higher mode localization appears that result in directive radiation patterns [5]. Microstrip filters are essential parts of microwave system and play important role in many communication applications especially wireless and mobile communications. These are getting popular due their compact size, light weight, low cost and ease of fabrication [6].

2. ANTENNA DESIGN SPECIFICATIONS

The overall dimension of antenna is 30mm×50mm×1.676mm. Hexagonal star slotted structure is constructed with the help of cylinder having outer radius 9.5 mm with 6 segments which is shown in figure (1).Defected Ground plane structure is shown in figure (2) which has the dimension 30mm×37.5mm×0.038mm . The effective reflection coefficient and characteristics impedances calculated with the help of equation (1) and (2).

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r+1}{2}\left[\frac{1}{\sqrt{1+12\frac{h}{w}}}\right] \quad (1)$$

$$z_0 = \frac{120\pi}{\sqrt{\varepsilon_{eff}}\left[\frac{w}{h}+1.393+0.667\ln\left(\frac{w}{h}+1.444\right)\right]} \quad (2)$$

The selected substrate is FR4 (lossy) with dielectric constant ε_r = 4.4 and substrate thickness h=1.6mm. proposed fractal dimensions are optimized by CST (Computer Simulation Technology) microwave studio simulation software.

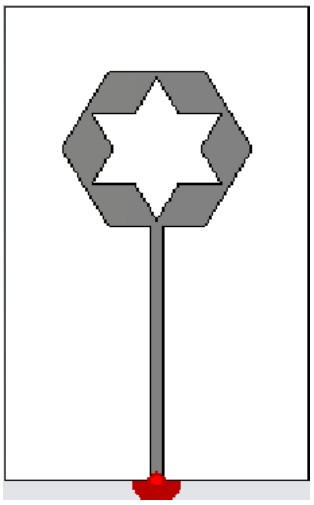


Fig- 1: Front view structure of fractal antenna

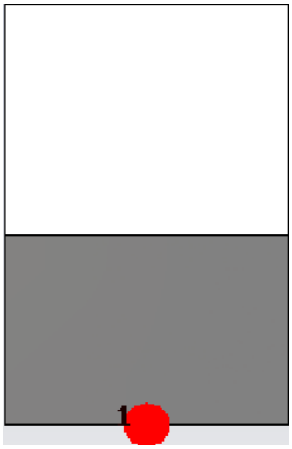


Fig- 2 : Back view structure of fractal antenna

3. SIMULATION RESULTS AND DISCUSSION

Fabricated hexagonal shaped star slotted antenna is shown in figure (3) , which is very small in size as compared to a coin. The return loss curve of fractal antenna (s- parameter versus frequency) is shown in figure (4) which has two frequency bands first from 2.363 Ghz to 3 Ghz and second frequency band from 4.196 Ghz to 6.172 Ghz .polar plot and smith chart is shown in figure (5) and (6) respectively.

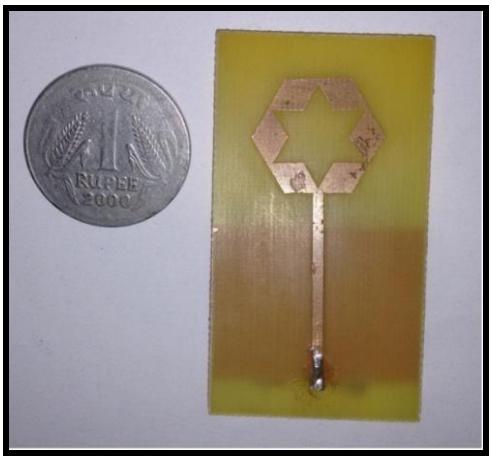


Fig- 3: Fabricated fractal antenna

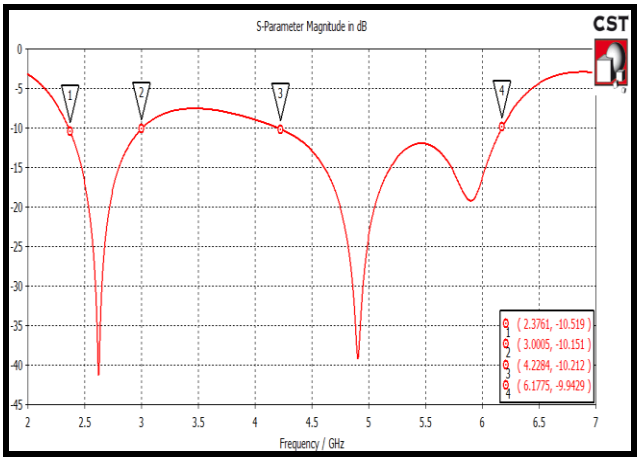


Fig- 4**: Return** loss for fractal antenna

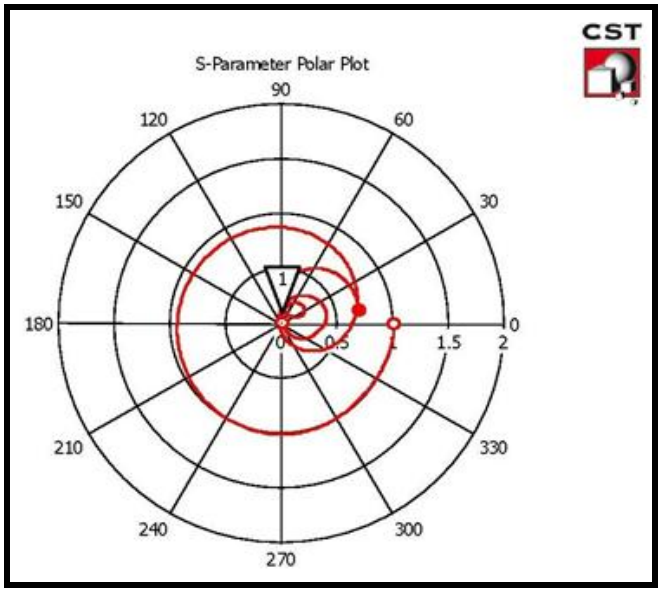


Fig- 5: Polar plot of fractal antenna

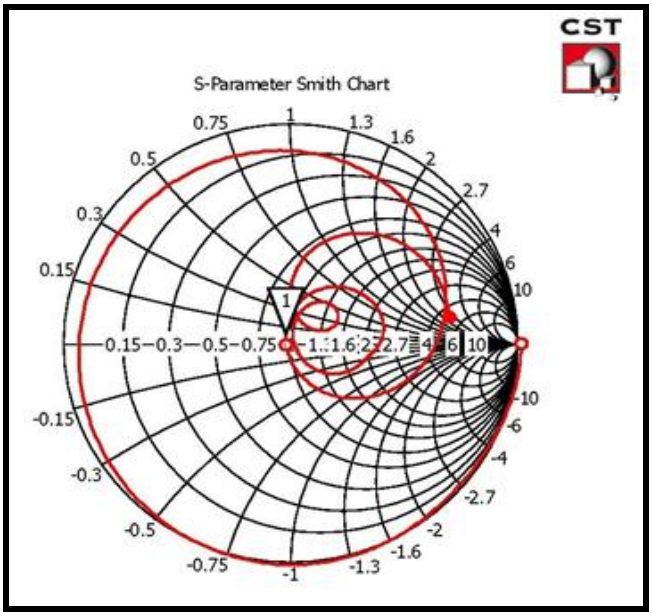


Fig- 6: Smith chart of fractal antenna

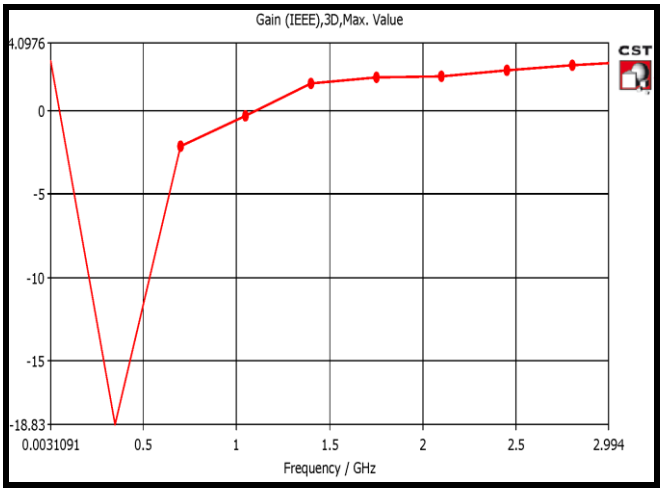


Fig- 7: Gain of fractal antenna

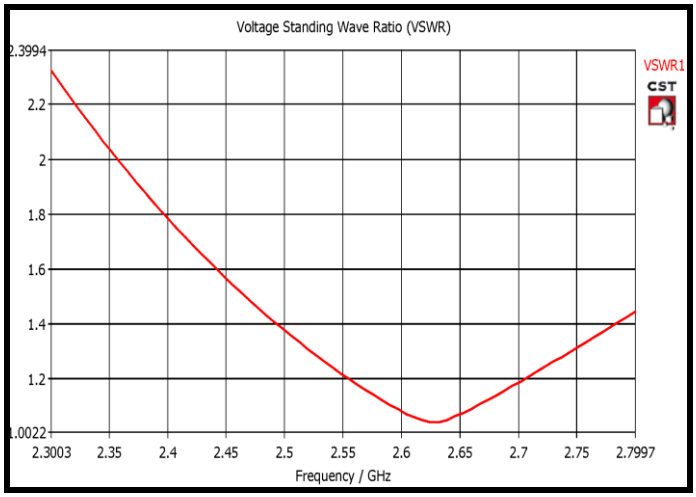


Fig- 8: Voltage Standing Wave Ratio of fractal antenna

Gain and voltage standing wave ratio of hexagonal shaped star slotted fractal antenna is shown in figure 7& 8 respectively. Fig. 9 & 10 shows the transparent radiation pattern with antenna design of hexagonal shaped star slotted fractal antenna with defected ground structure. In this antenna maximum directivity is about the horizontal axis.

Fig- 9: Absolute radiation pattern of fractal antenna

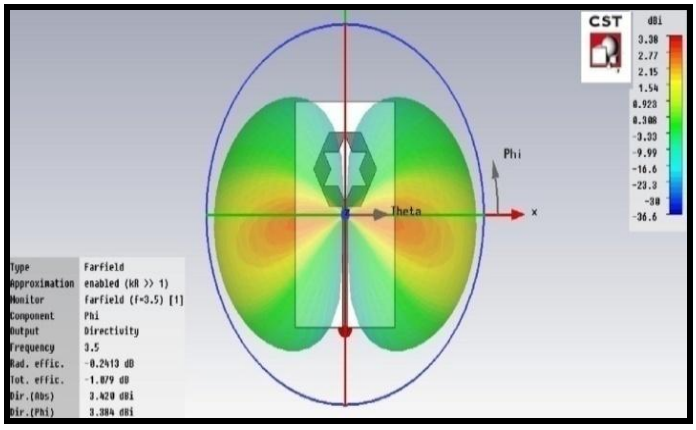
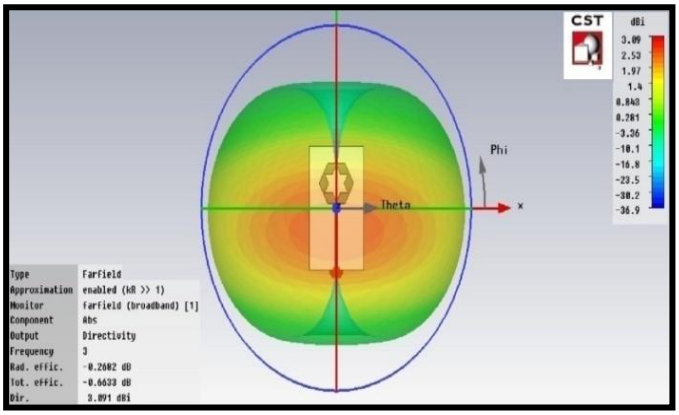


Fig- 10: Angular radiation pattern of fractal antenna

Fig- 11: Measurement with the help of spectrum analyzer

4. CONCLUSION

The concepts of fractals can be applied to the design of multi band antennas. In this paper, proposed fractal antenna has two wide bands at different frequencies 2.62 GHz, 4.90 GHz with bandwidth of 640Mhz (2.376-3.00Mhz) and 1.95Ghz (6.177-4.2284Ghz) which is shown in fig 9. This frequency band is useful for many wireless applications such as Wi-Fi and WiMAX and etc. This fractal antenna provide different band at different frequencies with increasing in number of iteration. Since



a single antenna can be used for multi band application that is the major advantage of this geometry. This proposed antenna has high gain about 41.278db and 39.2 db.

5 . REFERENCES

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BIOGRAPHY

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