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Design and Development of Hexagonal Shaped Fractal Antenna for Wireless Communications

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ABSTRACT

Wireless has become the most popular mode of communication. Antenna is an important part of wireless communication. The development of small sized multiband antenna has become prime interest of the industry. Multiband antennae can be developed by applying fractal geometry to conventional antennae. This letter discusses a hexagon fractal antenna.

Keywords : Fractal Antenna, Hexagonal , Resonant Frequency , Directivity

I. INTRODUCTION

HEXAGON FRACTAL ANTENNA

To design hexagon fractal antenna draw a hexagon of side length x. Now draw six hexagons of side length $x/3$ such that a corner point of smaller hexagons must touch a corner point of larger hexagons, two sides of smaller hexagons must overlap on two sides of larger hexagon and, no two smaller hexagons must overlap each other. Then erase the larger hexagon. These steps can be repeated to get successive fractal iterations of the design. The designs are shown Figure 1, Figure 2 and Figure 3 All the dimensions are in millimeters.

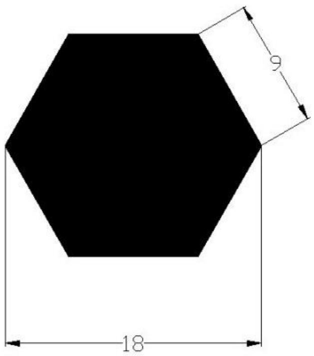

Figure 1

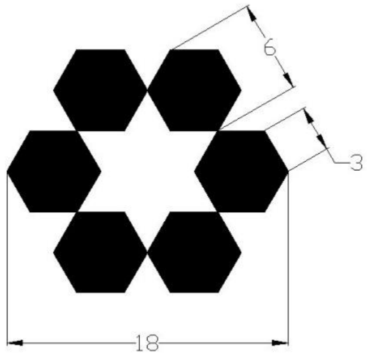

Figure 2: Base design

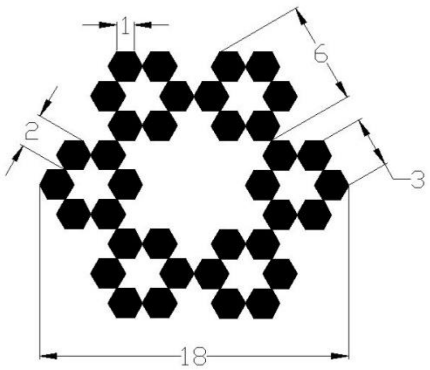

Figure 3: 1st iteration

But these designs are ideal. The actual designs contain overlapping. In actual designs, the side length of smaller hexagon is kept $x \times (11/30)$ and, the centre points of all the hexagons are kept same as that for the ideal hexagons.

The coaxial cable is used to feed the antenna. The coaxial cable is attached 1 mm inwards from the corner of the biggest ideal hexagon.

II. RESULTS

The Figure 2 and Figure 3 designs of hexagonal fractal antenna are simulated using Ansys HFSS. The plot for return loss for both designs is given in Figure 4. The resonant frequencies for base design are 8.15 GHz, 11.3 GHz, 15.25 GHz and, 16.5 GHz. The resonant frequencies for 1st iteration are 7.65 GHz, 10.25 GHz, 15.25 GHz and, 16.4 GHz.

Gain at $\varphi = 90° \,\&\, 270°$ for both the base design and 1st iteration at resonant frequencies is shown in Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11 and, Figure 12.

The gain has maximum value for resonant frequency 15.25 GHz for both the base design and the 1st iteration. Directivity at $\varphi = 90° \,\&\, 270°$ for both the base design and 1st iteration at resonant frequencies is shown in Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, Figure 18, Figure 19 and, Figure 20.

The directivity has maximum value for resonant frequency 15.25 GHz for both the base design and the 1st iteration.

The impedance for both the base design and the 1st iteration is shown in Figure 21 and Figure 22.

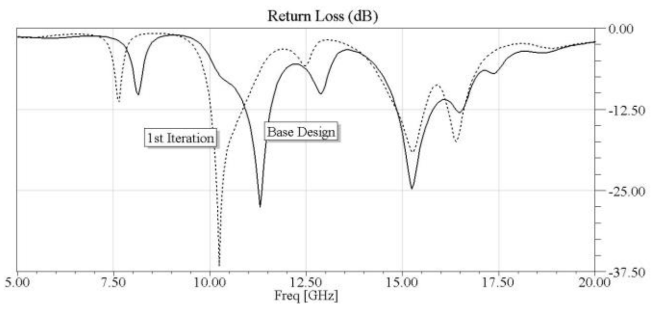

Figure 4

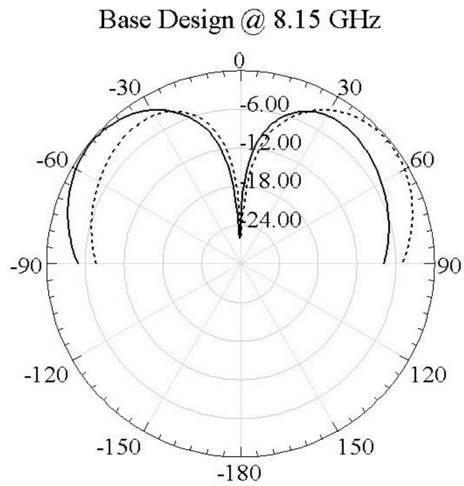

Figure 4

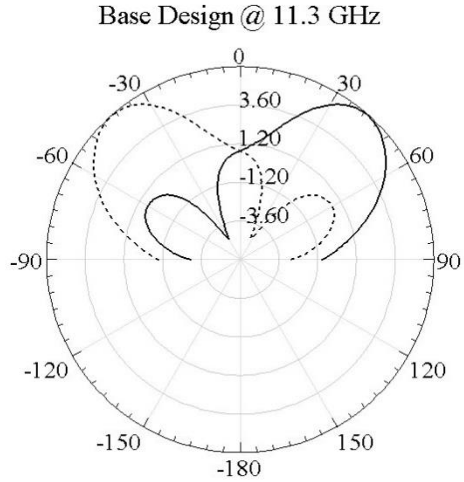

Figure 5

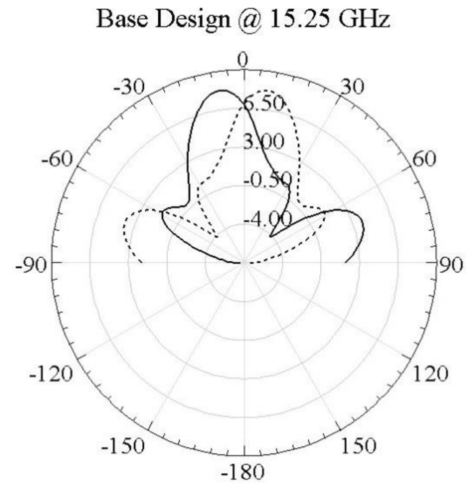

Figure 6

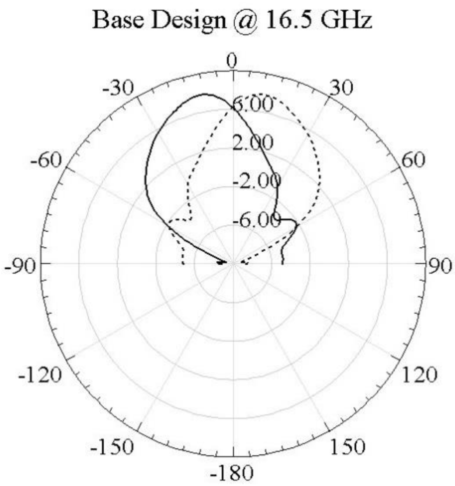

Figure 7

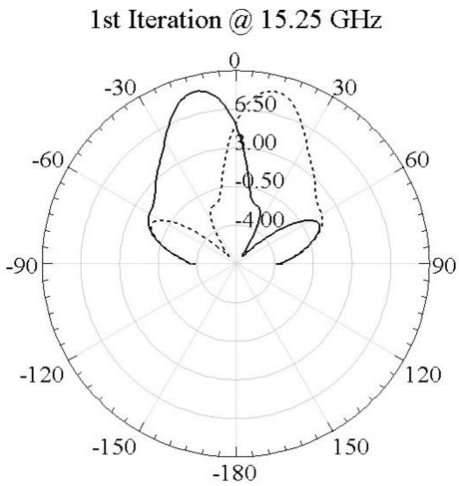

Figure 10

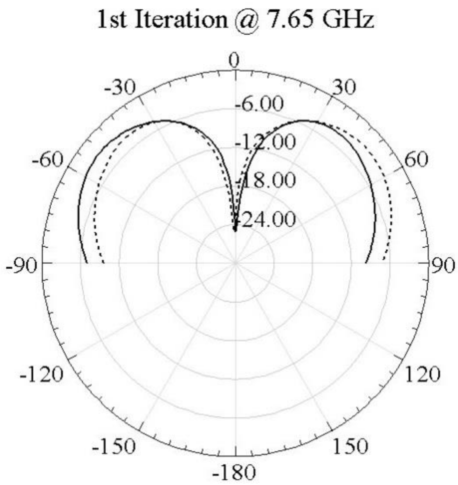

Figure 8

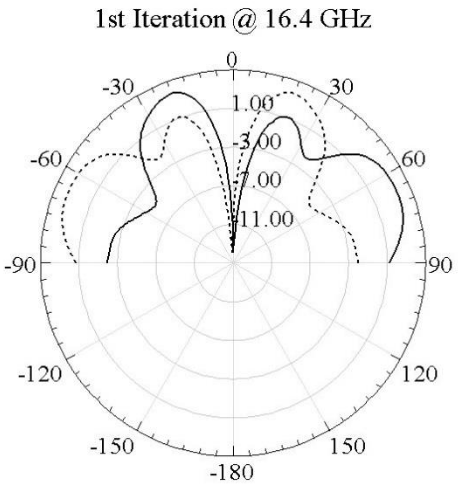

Figure 11

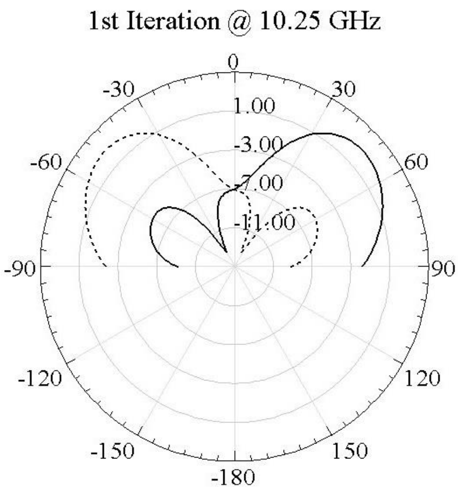

Figure 9

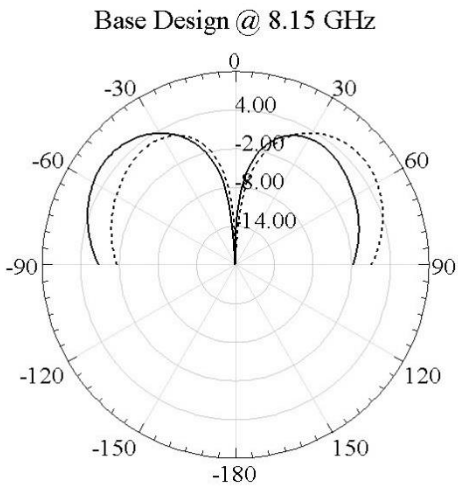

Figure 12

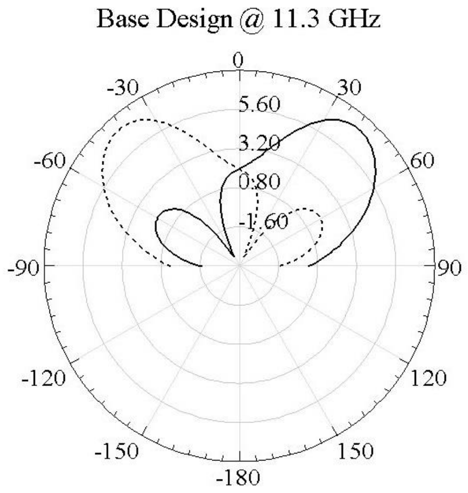

Figure 13

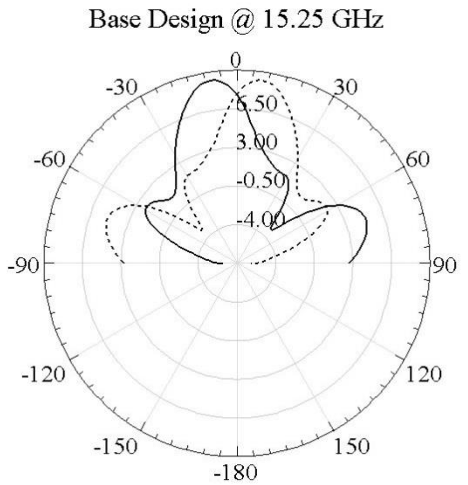

Figure 14

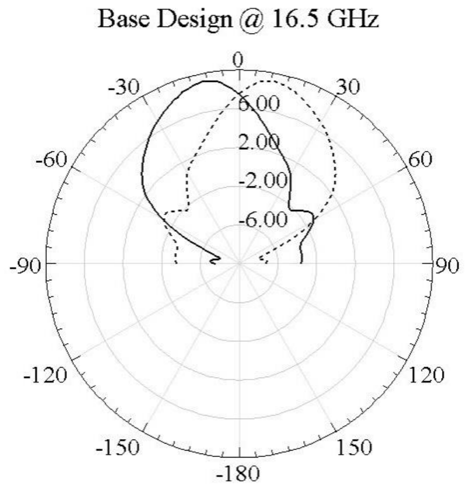

Figure 15

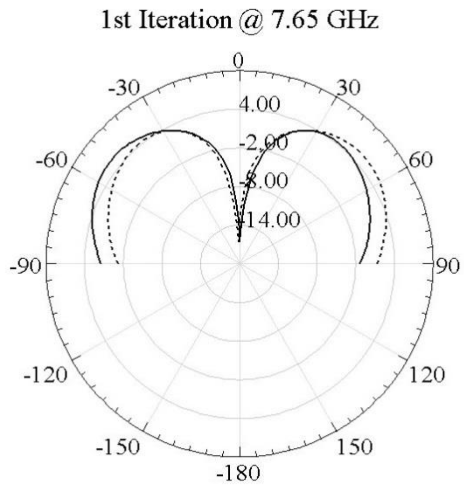

Figure 16

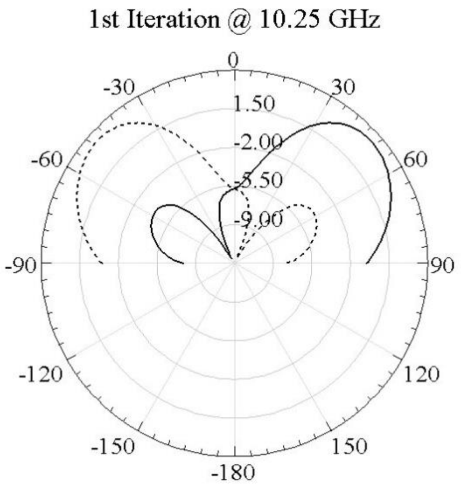

Figure 17

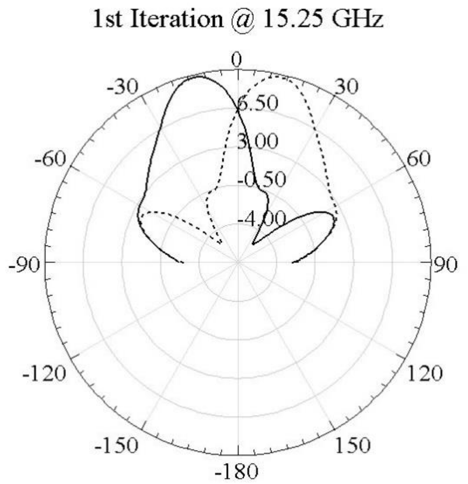

Figure 18

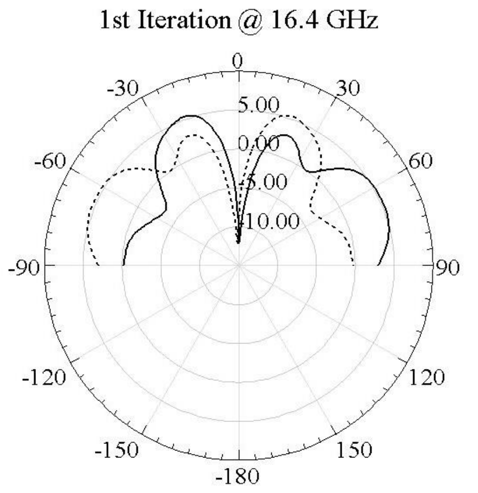

Figure 19

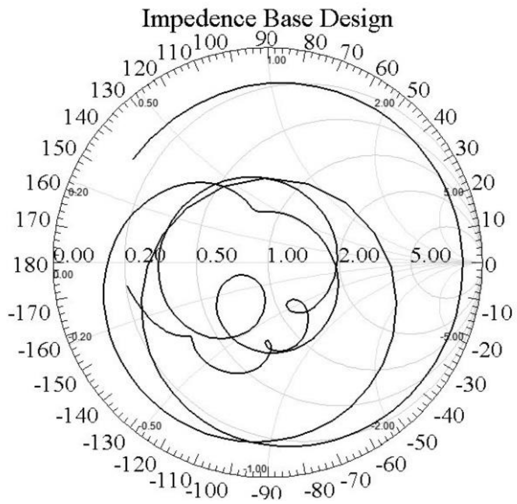

Figure 20

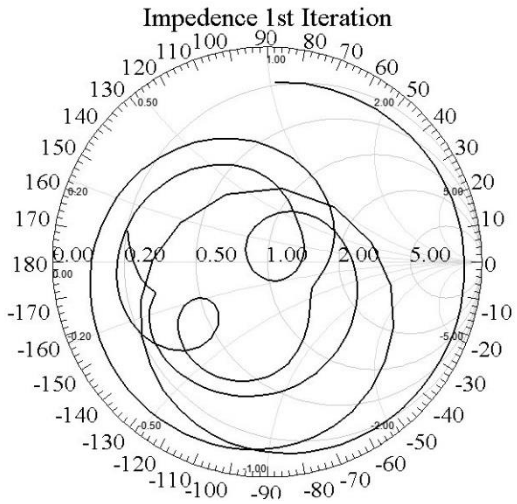

Figure 21

III. CONCLUSION

As the number of iterations is increased, the resonant frequencies move towards the lower side of the frequency band. On increasing number of iterations, the return loss decreases, gain increases and directivity also increase.