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Modified Microstrip Antenna for Wireless Application

Mr. Praveen Kumar
M.Tech, (Student)
ECE, MMU Mullana, Ambala
India

Er. Geeta Kaushik
Assoc. Prof.
ECE, MMU Mullana, Ambala
India

Abstract- In Modern wireless communication system and incising of the wireless application, wider bandwidth, multiband and low profile anteenas are in great demand.The microstrip antennas are preferred due to small size, light weight and easy installation. A square microstrip antenna is described in this paper. The use of microstrip pattern in this paper provides a simple and efficient method for obtaining the compactness. A auspicious based microstrip antenna is designed for 4.2 GHz and 9.51 GHz. The gain of the antenna at resonant frequencies is 1.2 dBi, 5.5dBi. The directivity of the antenna is 8 dBi and the VSWR is between 1 and 2. The bandwidth of the antenna is 500 MHz, 700 MHz and 1000 MHz for 4.9 GHz, 9.51 GHz, 14.1 GHz bands respectively. In term of wavelength (λ) the length of the antenna is 42λ.

Keywords-Microstrip, Multiband patch antenna, Auspicious

I. INTRODUCTION

Antenna design in this miniaturized world has become a challenging task for engineering and science as it needs to be compact as well as efficient to meets the required conditions. The microstrip patch antenna (MPA) has attracted wide interest due to its important features, such as light weight, low profile, low cost, simple to manufacture and easy to integrate with RF devices. For reducing the size of antenna, microstrip geometries have been introduced. The main objective is to design a square shaped microstrip antenna which will be small in size and multiband performance. A microstrip is "a rough or fragmented geometric shape" that is generated by starting with a very simple pattern that grows through the application of rules. In many cases the rules to make the figure grow from one stage to next involve taking the original figure and modifying it or adding to it.

The process can be repeated recursively an infinite number of times. For reducing the size of antenna, microstrip geometries have been introduced in the design of antenna. Microstrip geometries have two common properties: Self-similar property, Space filling property. The self-similarity property of certain fractals results in a multiband behaviour. Using the self-similarity properties a microstrip antenna can be designed to receive and transmit over a wide range of frequencies. While using space filling properties, a microstrip make reduce antenna size. Microstrip antenna engineering is the field, which utilizes microstrip geometries for antenna design. It has become one of the growing fields of antenna engineering due to its advantages over conventional antenna design.

II. ANTENNA DESIGN

The proposed antenna is designed by using concept of Auspicious microstrip structure, which originates from the plane square patch and subsequent microstrip antenna. Auspicious iterations produce a cross-like microstrip patch with even more fine details at the edges. The antenna is designed by using the square patch and iterating first iteration at the center of each side. Iterated polygons (indentation) in the shape of rectangle are created. The square patch microstrip antenna is based on auspicious square shaped. For designing this microstrip antenna IE3D software is used which is based on method of moment (MoM). The FR-4 material is used as substrate. The thickness of the substrate is 1.575 mm. The dielectric constant (ε_r) of the antenna is 4.3. In decomposition algorithm for rectangular shape is cut down from each side of the square patch antenna which shows the 1st iteration and generates two resonance frequencies. To design the microstrip antenna a square shape structure is designed on the simulator. Rectangular indentation is cut down from the each side of the square. The side length of square patch microstrip antenna is 30 mm (without iteration) and after iteration 'indentation' size is 2 mm×8 mm and square size is 14 mm. This square patch microstrip antenna has scale factor

$$\delta = \frac{h_n}{h_{n+1}} \quad (1)$$

Where h represents the side length of the square patch microstrip antenna and n is a natural number represents the number of iteration. The length of the antenna is L (initially) and the geometrical object obtained at the first iteration. For determining the dimension of self-similar deterministic structure, like the geometries in this article, the self-similar dimension provides an intuitive approach. The dimension,D, is a solution to the following equation:

$$k_1\left(\frac{1}{h_1}\right)^D + k_1\left(\frac{1}{h_2}\right)^D + ...k_n\left(\frac{1}{h_n}\right)^D = 1 \qquad (2)$$

Where K_n , is the number of copies of the initiator scaled by *hn* and *D* is the width of the indentation is given by

$$D = \frac{-\ln(k_1)}{\ln\left(\frac{1}{h_1}\right)} \qquad (3)$$

After iteration in the proposed antenna it consists of four copies of itself, each scaled down by a factor of two

$$D = \frac{-\ln(4)}{\ln\left(\frac{1}{2}\right)} = 2 \qquad (4)$$

After 1st iteration the microstrip antenna has four squares of same size.

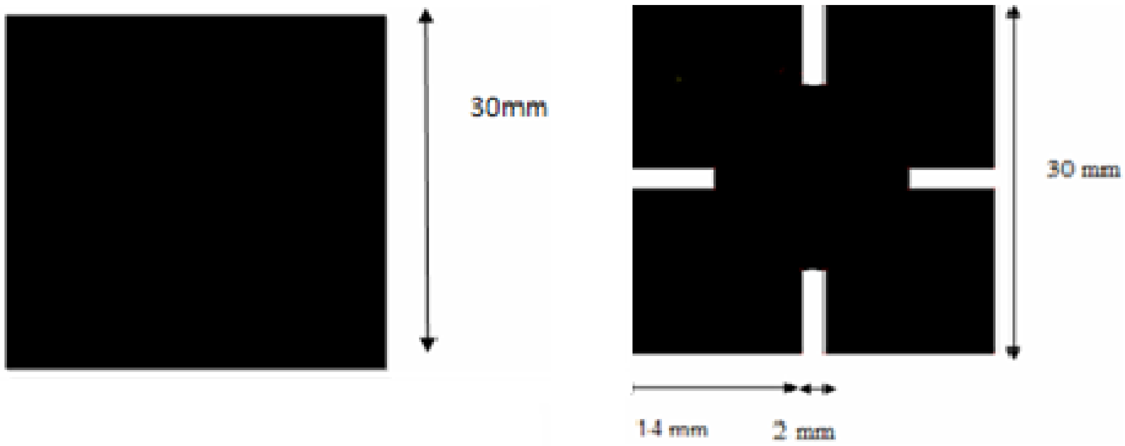

Fig. 1 proposed antenna with zero, first

III. RESULT AND DISCUSSION

The simulated results of input return loss for 1st iteration are shown in fig.2. The return losses are -14 dBi and -17dBi for the resonance frequencies 4.9 GHz and 9.5 GHz respectively. The bandwidth of the antenna is 500 MHz and 650 MHz for two band respectively.

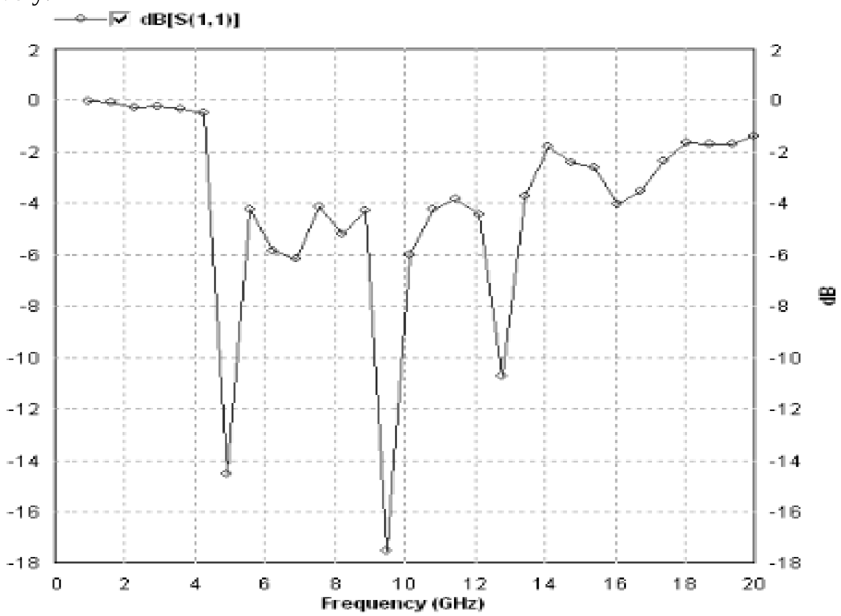

Fig. 2 Return loss (S_{11}) Characteristics of the antenna (1st iteration)

The gain of the antenna is 4 dBi and 5 dBi for the resonance frequencies 4.9 GHz and 9.5 respectively. The gain characteristics of the antenna are shown in fig.3.

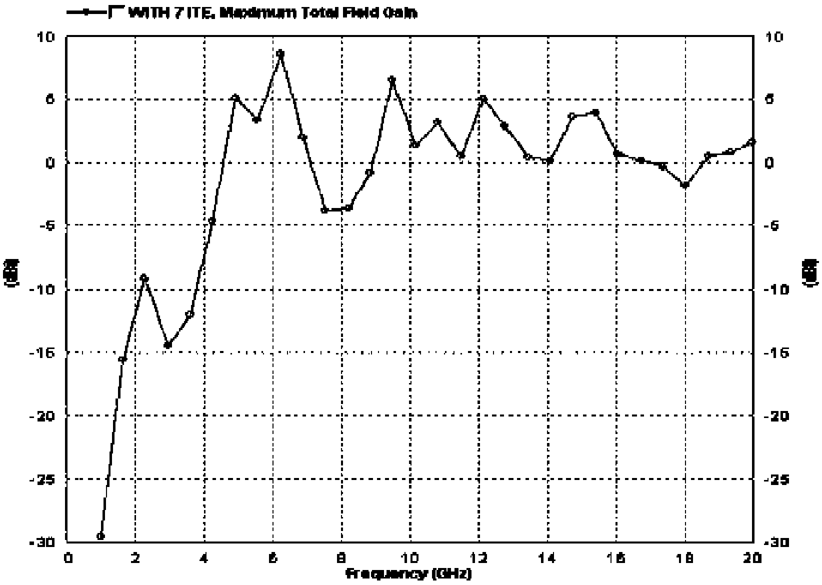

Fig. 3 Gain characteristic of the antenna (1st iteration)

In fig. 3, gain of the antenna is 3 dBi, which is suitable for radiation for resonant frequency 4.9 GHz.

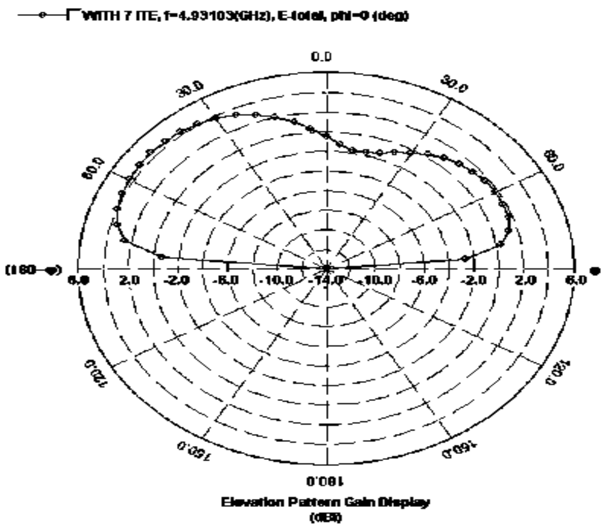

Fig.4 Elevation radiation pattern for 4.9 GHz (1st iteration)

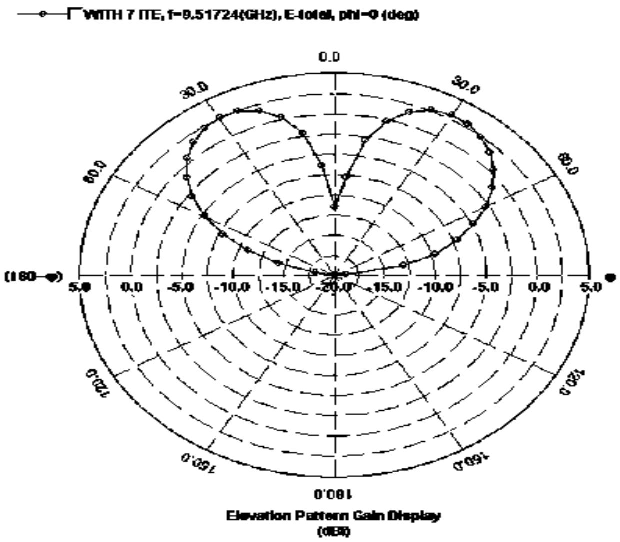

Fig.5 Elevation radiation pattern for 9.5 GHz (1st iteration)

The azimuth radiation pattern of the proposed antenna are presented in fig. 4 and 5.

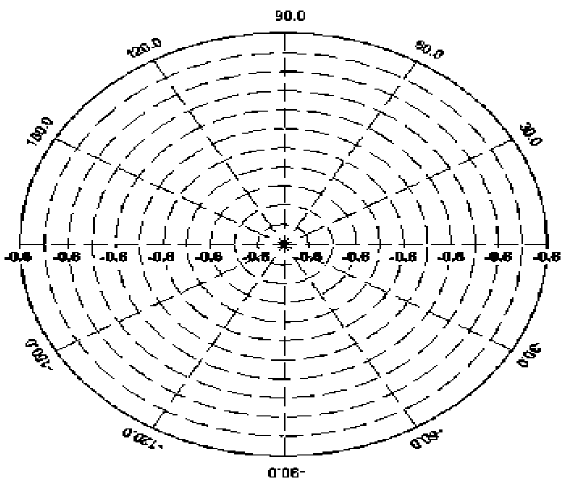

Fig.8 Azimuth Radiation pattern for 3.6 GHz (1st iteration)

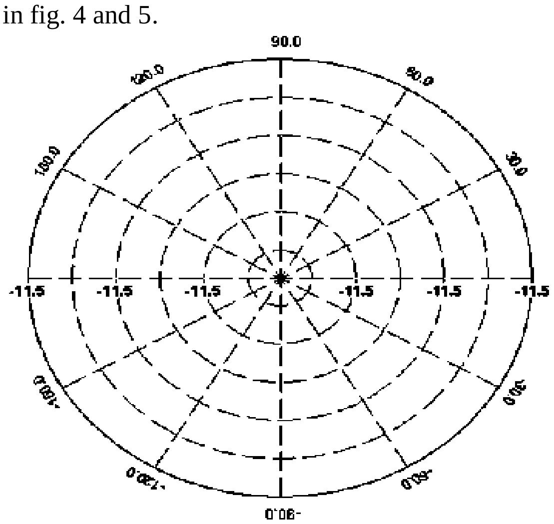

Fig.9 Azimuth Radiation pattern for 9.5 GHz (1st iteration)

The VSWR is the voltage standing wave ratio should be leis between 1.2 to 2.
The VSWR is between 1.2 & 2 for both resonance frequencies of the proposed antenna.

$$VSWR = \frac{1+S_{11}}{1-S_{11}} \tag{5}$$

I V. CONCLUSION

The resonance behaviour and space filling capabilities of the auspicious based square patch fractal antenna have been investigated. It is found that this structure with an indentation in the border length offers considerable miniaturisation compared with a conventional square patch antenna (zero iteration). For this iteration the resonance frequencies decrease to lower side which indicates size reduction as compare to non microstrip structure. The simulation results show the modified Auspicious microstrip antenna. The frequency bands of the antenna lies between 2-4 GHz.

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