

Fractal Dual Band Antenna for WLAN Applications

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Abstract— Fractal antenna, as name concerns, uses fractal i.e. structure does not change and repeat it when large focus has created upon it. This repetition feature of this antenna provides a great flexibility that it can be designed and can used in different frequencies. These antennas gives a finite area of coverage but the diameter of perimeter becomes infinite. Fractal antenna is used in most of the traditional and innovative applications today. In antenna engineering fractal geometry is very useful for performance improvement, in terms of gain and other things. Fractal antenna gives high performance with high variation in the size of its structure. This paper demonstrates an optimized and compact printed dual band fractal antenna suitable for WLAN applications. The proposed antenna works on 2.4GHz and 5.2 GHz. Simulation results show that the proposed design gives improved performance in terms of return loss and gain.

Index Terms— Microstrip patch antenna; fractal geometry; WLAN;

I. INTRODUCTION

Wireless communication becoming popular day by day and also developing rapidly. In a professional field and also in the home applications the use of wireless network is increasing for its easy to use properties. To satisfy increasing demands of users, IEEE has introduced various frequency bands for WLAN applications. IEEE 802.11 WLAN standards specify two operating frequencies, i.e. 2.4 (2400-2484 MHz) and 5.2 GHz (5150-5350 MHz). So in order to satisfy these standards, dual band antennas are required, which can be easily printed on a circuit board and size of which will be small to be fitted on a circuit board. Because of simplicity in design and fabrication many researches are exploring this field. furthermore fractal geometry has been introduced to propose microstrip patch antennas. The proposed antenna is suitable for wireless local area network (WLAN) with operating frequency ranges from 2.12 to 2.62GHz with a return loss of -16.62dB at 2.4 GHz and 4.75 to 5.67 GHz with a return loss

of -44.14dB at 5.2 GHz. The antenna has also shown an acceptable gain and directivity. Fractal antenna inherits the feature of Euclidean antenna. The use of fractal in Fractal antenna by two ways. In the first way, antenna elements are becoming discrete to end Application's users and in the second way, a blueprint antenna is proposed which uses self-structure geometry so that resultant antenna can work on different frequencies. The fractal design has been introduced to increase the return loss of the antenna. The proposed antenna is suitable for use in laptop like devices.

II. RELATED WORK

Various modified works have been done in the antenna design field using fractal geometry. One of these types of work is by using a dual-Koch loop structure, a wideband vertical patch antenna (VPA) was designed [3]. In [4] techniques to reduce the size of microstrip patch antennas is proposed. Paper [5] shows the reduction of the size of the antenna by 50% for using fractal geometry approach. In [6] authors demonstrated details of fractal geometries developed to get multiband behaviour of the patch resonator antenna. In [7] novel type of miniature microstrip patch antenna has been demonstrated based on fractal geometry. In [8] new cell of UC- PBG structures for microstrip antennas is adopted to reduce the surface waves and improve the radiation patterns. Koch curve fractal geometry is also a popular choice for the miniaturization of antenna [13]. [9-18] have shown improved performance for antennas. [19] The topology used for making microstrip patch antenna is U-shaped, which is a single narrowband patch antenna. [20] The E-shaped microstrip patch antenna is used for WLAN applications. [21] While, Dual wideband stacked patch antenna is used for both WLAN and WIMAX applications [22]. Due to these properties [23], the microstrip patch antenna has become very popular in many applications such as in WiMAX communication system and mobile applications.

III. PROPOSED WORK

In this paper, we are implementing Fractal Dual band Antenna, which is used efficiently for wireless local area network. The antenna which is used in Wi-Fi/WLAN should contain high gain with directional or omnidirectional features. Directional antenna radiates signal with beam width consideration of few range, but omnidirectional antenna radiates or transmitted signal in all directions with having center radiator node property. The designer of antenna can use directional or Omnidirectional according to their requirement set up. Fractal antenna has unique features that it can contain many geometries with properties of fractal as well as the reason for considering fractal antenna in WLAN applications is, Fractal contains so many advantages when applied to antenna and used for wireless communication. If the fractal antenna is used in WLAN then the size of the antenna will reduce with great performance and antenna can perform in various resonance frequencies. For achieving Wideband performance, infinite Complexity combined with self-similarity i.e. repetition. Compact size of Fractal antenna provides higher gain with great efficiency and this feature make them more suitable to use them in wireless communication applications. Our implemented fractal used 2.4GHz and 5.2 GHz.

A. ANTENNA GEOMETRY

This antenna consists of a 50Ω microstrip feed line with waveguide feeding mechanism. The antenna has been printed on FR – 4 (lossy) substrate material with permittivity 4.3 and thickness of 1.5 mm. Ground plane of length 7.5 mm and the same width as the substrate has been used in the opposite side of the patch in the same end of the feed line. Copper has been used as antenna material. The total volume of the antenna is 45x35x1.5 mm³.

The antenna has given away agreeable end result by simulation. Following Fig 1 shows the geometry of proposed Fractal antenna.

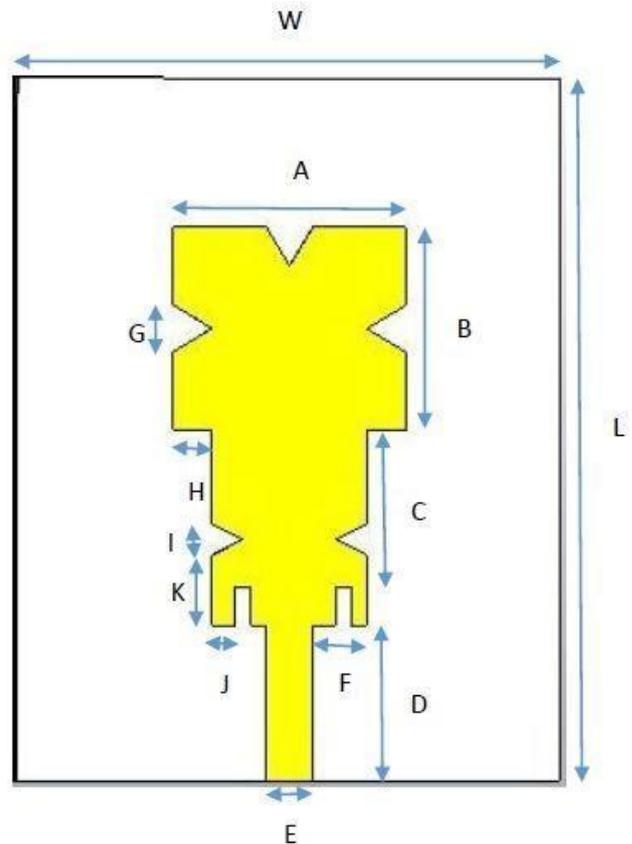


Fig1. Structure of the proposed antenna

B. DESIGN SPECIFICATIONS

The proposed antenna has been simulated on transient solver in CST Microwave Studio simulation tool. This Antenna design simulator CST is installed on windows 7 very easily. listing of parameters used in the intend of Fractal antenna is specified below within table 1.

Parameter	Value(mm)
A	13
B	13
C	10
D	10
E	3

F	3.5
G	3
H	2.5
I	2
J	1.5
K	4.5
L	45
W	35

TABLE 1. Parameters of proposed Antenna

IV. RESULTS AND DISCUSSION

Simulation of the proposed antenna has been done in transient solver in the CST Microwave Studio. The performance of the WLAN applications depends on convined parameters such as gain, radiation pattern, and return loss. These parameters depend on the simulation recital and design methodology of the fractal antenna. These results proved by simulation and the corresponding results have been shown below.

A. RETURN LOSS

The antenna has shown a return loss better than -10 dB and are -16.62dB at 2.4 GHz and 4.75 to 5.67 GHz and -44.14dB at 5.2 GHz. Fig.2 shows the return loss of the proposed antenna in both the frequency.

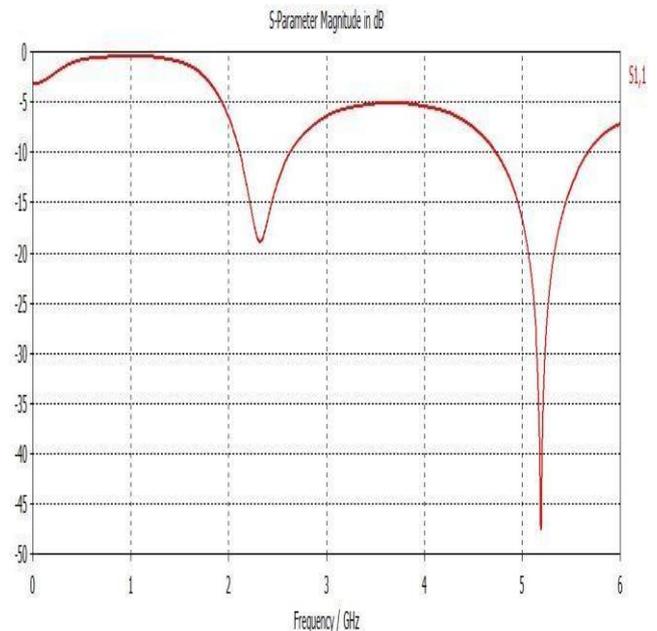


Fig2. Return loss plot of the proposed fractal antenna

Since the value of S parameter is less than -10 dB as indicated in fig 2 which henceforth results in very less.

B. VOLTAGE STANDING WAVE RATIO (VSWR)

Voltage Standing Wave Ratio (VSWR) of the anticipated antenna is not as much of 2 and is 1.35 with consideration of frequency 2.4 GHz and 1.01 with consideration of frequency 5.2 GHz, which is satisfactory and acceptable. Plot of VSWR of proposed antenna is publicized in Figure 3.

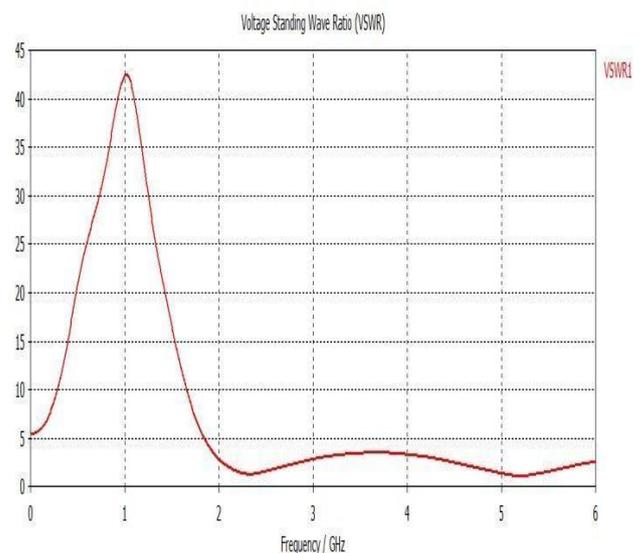


Fig3. VSWR plot of the anticipated antenna

In figure 3, The VSWR is for eternity a real and positive number for antenna which is simulated and developed. According to the work reported in [15] the less significant the VSWR is, the superior the antenna is coordinated to the transmission line and the supplementary power is delivered to the antenna.

C. RADIATION PATTERNS

"A radiation pattern defines the variation of the power radiated by an antenna as a function of the direction away from the antenna. This power variation as a function of the arrival angle is observed in the antenna's far field." [16, 24]. The gain of an antenna is described as the intensity of radiation of the antenna in a particular direction, which relates the concept of directivity and electrical efficiency of the antenna. The [25-28] Radiation pattern is the representation of obtaining gain, including direction as a function. The radiation patterns have been simulated and shown in Fig.4 and Fig.5.

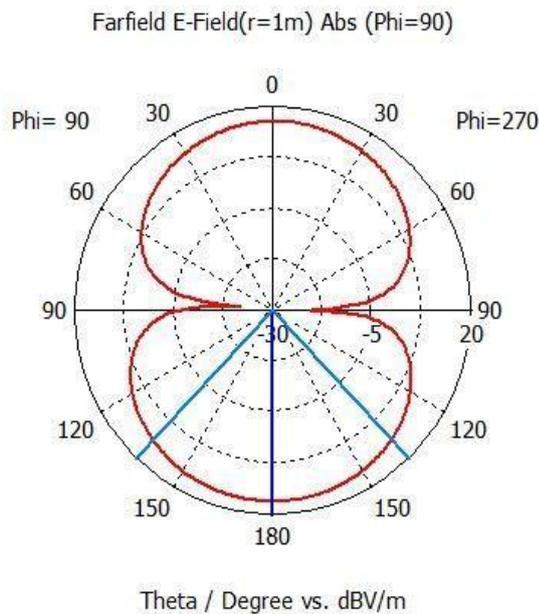


Fig. 3. Radiation pattern for E Plane with consideration of frequency 2.4 GHz

Figure 3 depicts the radiation pattern which refers to the directional (angular) dependence of the strength of the radio waves from the antenna proposed for E Plane 2.4 GHz.

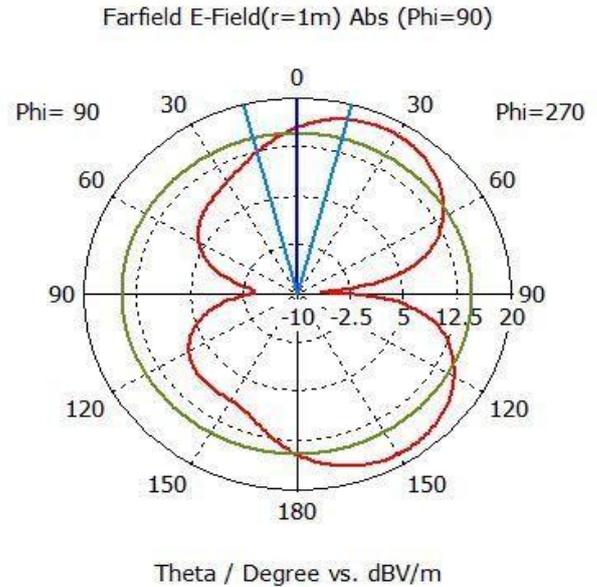


Fig. 4. Radiation pattern for E Plane with consideration of frequency 5.2 GHz

Figure 4 depicts the radiation pattern which refers to the directional (angular) dependence of the strength of the radio waves from the antenna proposed for E Plane 5.2 GHz.

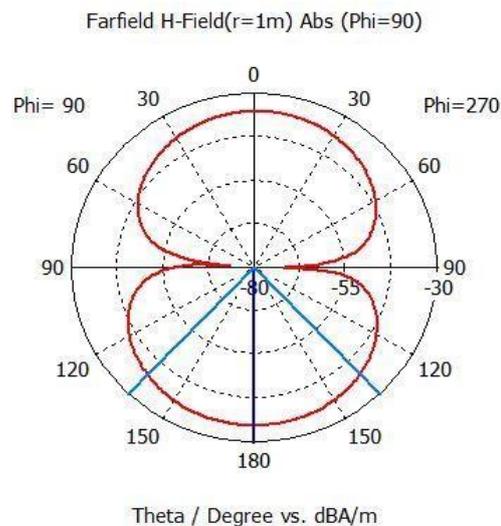


Fig. 5. Radiation pattern for E Plane with consideration of frequency 5.2 GHz

Figure 5 depicts the radiation pattern which refers to the directional (angular) dependence of the strength of the radio waves from the antenna proposed for E Plane 5.2 GHz.

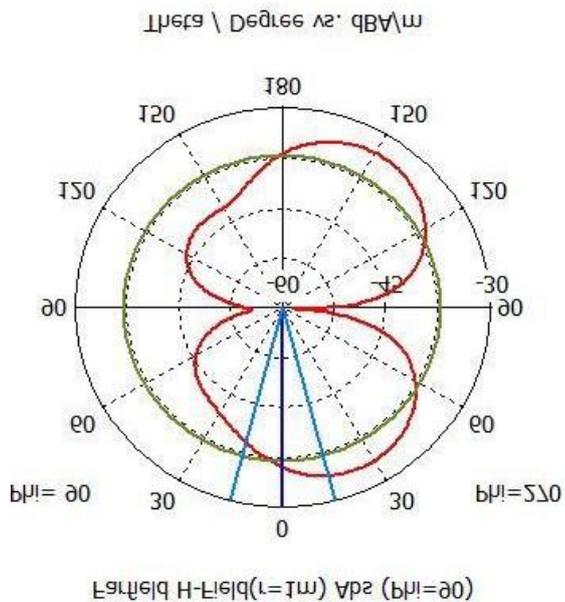


Fig. 6. Radiation pattern for E Plane with consideration of frequency 5.2 GHz

Figure 6 depicts the radiation pattern which refers to the directional (angular) dependence of the strength of the radio waves from the antenna proposed for E Plane 5.2 GHz.

V. CONCLUSION

The proposed simple dual band fractal printed antenna which has operating frequencies of 2.4 GHz and 5.2 GHz has shown an acceptable return loss and gain. The antenna has a gain of 2.109 dB with consideration of frequency at 2.4 GHz and 3.44 dB with consideration of frequency 5.2 GHz. So, it can be concluded that the proposed antenna is appropriate for applications concerning to WLAN.

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