Fractal Based Microstrip Patch Antenna in wireless Communication

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***Abstract*: in this review paper, we developed a rectangular shape Microstrip patch antenna for the application of wireless communication. Here Microstrip patch antenna is being simulated using HFSS (High Frequency Structure Simulator). The radiation pattern and gain of the designed antenna make it perfect for the applications of various wireless communications. In this review paper the effect of changing the permittivity of the substrate has also taken into account. It shows that how the performance of Microstrip patch antenna varies with the dielectric constant. All design and simulation are done on HFSS software.**

***Keywords:* rectangular shape microstrip patch antenna, radiation pattern wireless communicatin, HFSS software.**

I. INTRODUCTION

Due to fast advancement in wireless communication technology, use of small size antenna has rapidily increased. Microstrip patch antennas are very useful in modern wireless communications systems. Not only the size of antenna its cost,performance,ease of installation everything have been taken care while designing the antenna.To meet this entire requirement rectangular shape microstrip patch antenna is designed. Microstrip antennas are largely used in many wireless communication systems such as aircrafts, space crafts, satellites and missile applications because of their low cost and light weight. Inspite of having a number of advantages like low cost, good radiation pattern , light weight, it has some drawbacks also like narrow bandwidth[2]. This problem can be overcome by applying various technique such as increasing of substrate thickness. These antennas are suitable for both planner and nonplanner type of surfaces, simple and not much expensive manufacture using model printed circuit technology. This antenna is found very versatile in term of resonant frequency. When the perticular patch shape and mode are selected. The current designs of antenna is very popular and comfortable for wireless local area network (WLAN) application and worldwide interoperation for microwave access. These antennas provide diversity function in operating frequency, radiation pattern and polarization to mobile communication .

II. DESIGN AND SPECIFICATION OF ANTENNA

Some parameter are needed to design or to simulate the antenna such as- dielectric constant, resonant requency, substrate dimension. Using some specific formulas we can calculate the patch width, length, effective length, dielectric constant etc.

A. WIDTH OF METALLIC PATCH (W)

$$W = \frac{C}{2f_0\sqrt{\frac{(\varepsilon_r+1)}{2}}}$$

Where,
c = free space velocity of light
ε_r= Dielectric constant of substrate

B. LENGTH OF METALLIC PATCH (L)

$$L = L_{eff} - 2\Delta L$$

Where, ΔL - Length Extension

$$L_{eff} = \frac{C}{2f_0\sqrt{\varepsilon_{reff}}}$$

Where,
ε_{reff} - Effective Dielectric Constant

C. EFFECTIVE DIELECTRIC CONSTANT

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\sqrt{1+12\frac{h}{w}}$$

D. LENGTH EXTENSION

$$\Delta L = 0.412h\frac{(\varepsilon_{reff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{w}{h}+0.8\right)}$$

III.TECHNIQUES OF FEEDING

Microstrip patch antenna can be feed by using various methods. These methods categorised into two- contacting and non-contacting. In the contacting method, the RF(Radio Frequency) power fed dirctly to the radiating patch using microstrip line which is a cnnecting element. In non contacting method, power transfer between the radiating patch and microstrip line by using and electromegnatic field coupling. Four most popular techniques are widely used, they are- (i) microstrip line (ii) coaxial line (iii) proximity coupling (iv) aperture coupling. Microstrip line and coaxial line are contacting method while the aperture coupling proximity coupling are non contacting methods[6].

IV. STRUCTURE OF THE ANTENNAS

Fig1.shows the Microstrip patch antenna configuration. The basic frame of antenna is rectangular patch shape. For the purpose of practical applications, Microstrip rectangular patch antenna is most suitable. Rectangular patch antenna consists of a radiating patch on one side of dielectric substrate and has a ground plane on other side[1]. A rectangular shape patch antenna can be depicted by array of two radiating narrow apertures, each of height h, width W, disunited by a distance L. The fields at the edges of the patch undergo fringing because of the finite dimensions (length and width). Radiation extends the effective open circuit beyond the edge. This radiation will occur from the fringing field.

The patch is electrically little bit larger than it actual physical length due to fringing field. This difference between physical and electrical length depends on the dielectric constant of the material used and height[5].

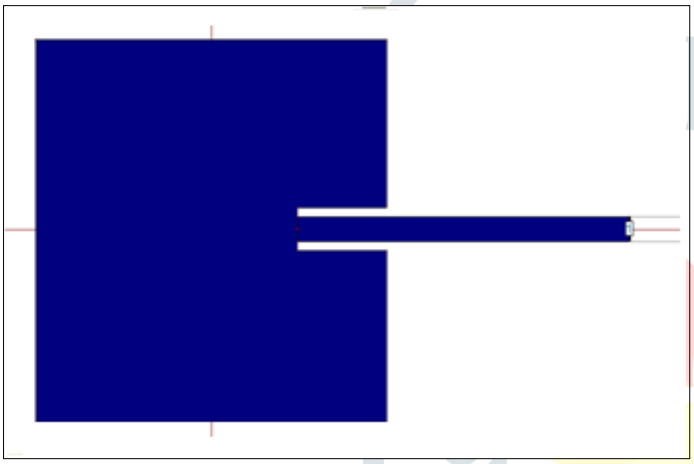

Figure 1: Rectangular Microstrip patch Antenna

V. SIMULATION AND ANALYSIS

In this work, a traditional rectangular patch antenna with inset feed using transmission-line model is simulated. This is directed to be a standard for antenna succinct study in terms of radiation properties and size. A conventional rectangular patch was contemplated and designed as performance standard solving the equation mention in section II[7]. The aimed resonance frequency is 7.3 GHz with centre frequency of 3.68 GHz band. Fig.-1 shows the dimension of the fundamental conventional antenna. To ensure the performance of simulated antenna, the radiation pattern with ideal radiator is analyzed.

Profile	Thin
Shape	rectangular
Size	111mm2
Band Width	1.29GHz
Resonance Frequency	3.68GHz
Gain	0.3dB
Return Loss	-26dB
Directivity	7dB

Table 1: Simulation Parameter

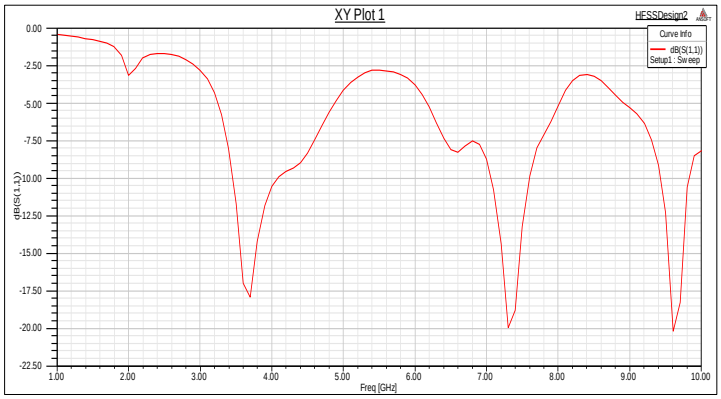

Figure 2: Return loss of normal rectangular Microstrip Patch Antenna

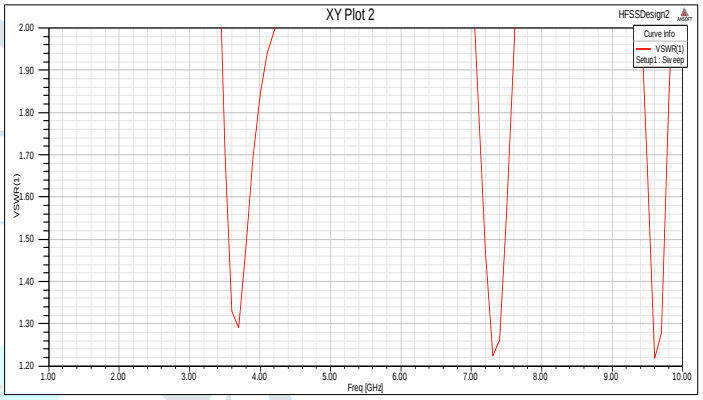

Figure 3: VSWR of rectangular Patch Microstrip Antenna

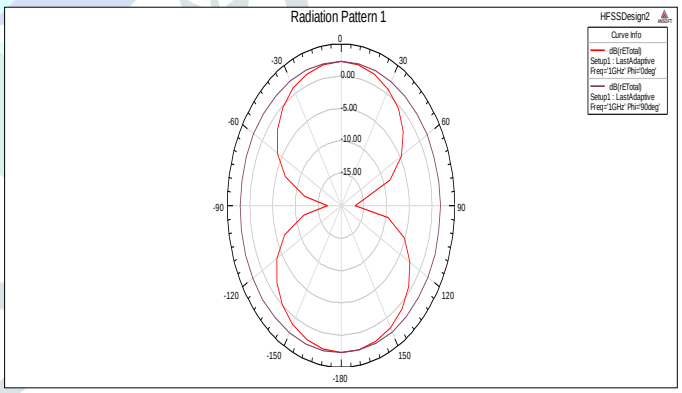

Fig. 4: Directivity of fractal Microstrip Patch Antenna

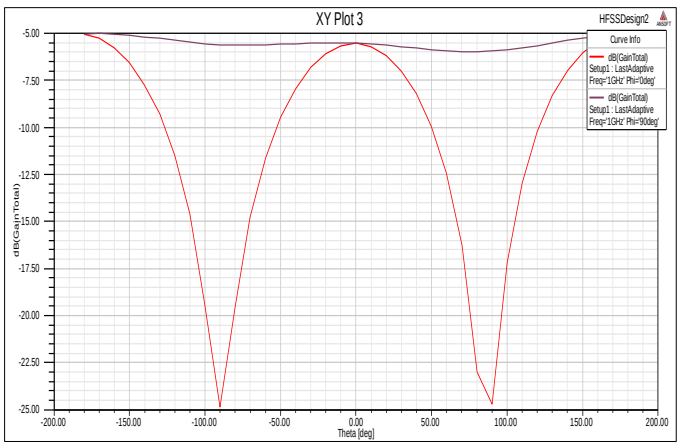

Fig.5 Antenna gain of Microstrip patch antenna

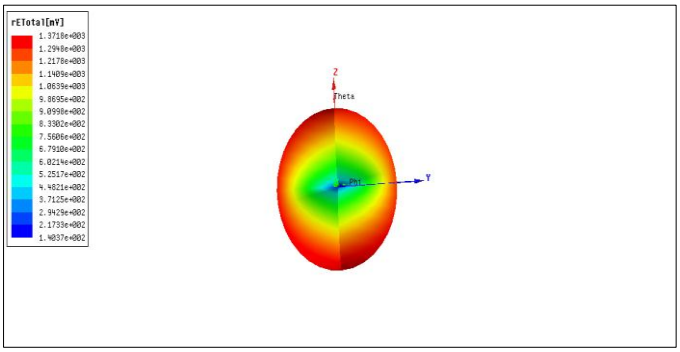

Fig.6 3D Polar Plot of the Microstrip antenna

Radiation pattern:-

The radiation pattern is presented with the body of the antenna so as to represent the major and minor lobe clearly. The values of the different antenna parameters obtained after the simulation has been done.

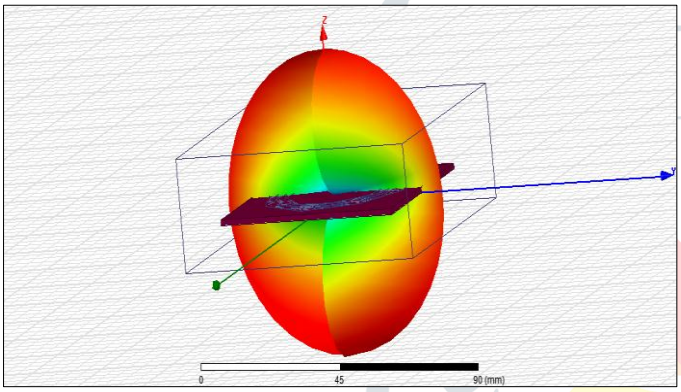

Fig. 7: Represent the 3D plot of the radiation pattern

VI. RESULT

Simulated Microstrip patch antenna operates in the desired frequency range and its return loss is also recorded. The return loss has analyzed, the positioning and quantity were returned to improve the size and reduce inductive effects. The antenna size is half of conventional patch. Fig.-4 and Fig.-5 shows the simulated result of rectangular Microstrip patch antenna with trapezium cut shape. It exhibits the return loss -26dB at 3.68 GHz frequency and at the same frequency normal. It is also noticed that the impedance bandwidth of the simulated of the simulated antenna at 3.68 dB is 1.8%. The supporting plots for other parameters like smith chart are also shown here which shows the performance and quality of simulated antenna using Meta material structure.

VII. CONCLUSION

In this paper, novel, compact and low cost rectangular Microstrip patch antenna is being proposed for wireless communications devices applications and designed is being simulated using ANSOFT HFSS (High Frequency structural simulator) Version 13 software. This new antenna allows flexibility in matching multiband operations for which a larger frequency separation is required. Hence it can be used in wireless sensor networks, cellular and microwave applications. With the parametric study it shows that the simulated antenna is operated at 3.68GHz centre frequency. Making some variations in parameter (such as increasing the thickness of substrate), gain and bandwidth can be improved up to but some practical limitations should be taken care while simulation the antenna on ANSOFT HFSS software, when we use the substrate from the ceramic family it gives the low microwave loss and good insulation at high temperature.

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