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Multiband Fractal Antenna for Wi-Max Technology

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Abstract: **-- This paper presents a modified a Fractal antenna to implement the applications like Wi-Max. Fractal Antenna is used to design the system with high capacity. The fractal antenna is having the Iterations. As the number of iterations increase, the capacity of the antenna is also increased. The Co- Planer Waveguide is used to decide the circular patterns of the antenna. In this paper, the two iterations are shown. These two iterations decide to describe the increased capacity of the antenna. Due to fractal technology, the sham and compact antennas are used to handle higher frequency bands with small size. The frequency used is 2.4 GHz centralized frequency. The limitations of first iterations are overcome by second iterations.**

Index terms: Fractal, CPW, Wi-Max, IE3D.

I. INTRODUCTION

There are so many several researchers have devoted large efforts to develop antennas that satisfy demands of the wireless communication industry for improving performances, especially in term of multiband operations and miniaturization. As a matter of fact, the design and development of a single antenna working in two or more frequency bands, such as in wireless local area network (WLAN) or WIFI and Worldwide Interoperability for Microwave Access (WIMAX) is generally not an easy task. The CPW feed also helps the antenna to achieve the bandwidth in the ratio of 6:1.Though it is difficult to construct a CPW feed for an antenna, but it exhibits wider bandwidth. Monopole fractal antenna and implemented to effectively support mobile worldwide interoperability for microwave access (Mobile Wi-MAX), and Wi-MAX which operate in the 2.3/2.5 ghz (2.305–2.360 ghz/2.5–2.69) ghz The Wimax forum has published three licenses spectrum profiles, namely the 2.3 (2.3-2.4 ghz), 2.5 ghz (2.495-2.69 ghz) and 3.5 ghz (3.5-3.6 ghz) varying country to country.

Second most important work in this thesis is designing and simulating with IE3D. IE3D is a full-wave, method-of-moments based electromagnetic simulator solving the current distribution on 3D and multilayer structures of general shape.

The software used to perform all simulations is Zealand Inc's IE3D. IE3D is a full-wave electromagnetic simulator based on the method of moments. It analyzes 3D and multilayer structures of general shapes. It has been widely used in the design of mics, rfics, patch antennas, wire antennas, and other RF/wireless antennas. It can be used to calculate and plot the S parameters, VSWR, current distributions as well as the radiation patterns. Some of IE3D's features are

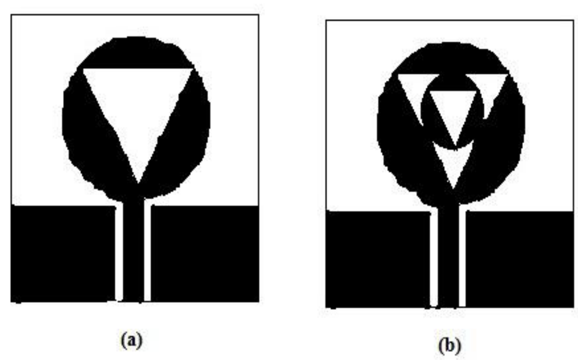

Figure 1: First and Second Iterations of CPW Antenna

II. ANTENNA MANUFACTURING

The first step in designing micro strip antenna is to choose the suitable substrate. There are various types of substrate available in market that provides considerable flexibility in the choice of a substrate for particular applications.
In most cases, considerations in substrate characteristics involved the dielectric constant and loss tangent and their variation with temperature and frequency, dimensional stability with processing, homogeneity and isotropicity. In order to provide support and protection for the patch elements, the dielectric substrate must be strong and able to endure high temperature during soldering process and has high resistant towards chemicals that are used in fabrication process.

Conducting materials: They are the most widely used to build antennas. In principle, all conductive materials can be employed, but the antenna efficiency is closely linked to the conductivity of the material: the higher the conductivity, the higher the efficiency. Thus, in practice, we only choose

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materials with very good conductivity. As a result, copper, brass (an alloy of copper and zinc), bronze (an alloy of copper and tin) and aluminum are widely used to make antennas. So considering above parameters copper is used. The Performance of the micro strip antenna depends on its dimension. Depending on the dimension the operating frequency, return loss and other related parameters are also influenced.

Design specifications:

Frequency of operation: 2.4ghz

Height of dielectric substrate:1.6mm

Dielectric constant: 4.4

Practical width of patch cord w is given as

$$w = \frac{1}{2fr\sqrt{\mu\epsilon}} \times \sqrt{\frac{2}{\epsilon r+1}}$$

= 39mm

Length of the antenna becomes L

$$L = \frac{1}{2fr\sqrt{\epsilon eff}\sqrt{\epsilon\mu}} - 2\Delta L \qquad = 43mm$$

Length Extension :

$$\Delta L = 0.41h\frac{\epsilon eff+0.3}{\epsilon eff-0.258} + \frac{(\frac{w}{h}+0.264)}{(\frac{w}{h}+0.8)}$$

=0.707mm

Effective dielectric constant

$$\epsilon\ eff = \frac{\epsilon r+1}{2} + \frac{\epsilon r-1}{2\sqrt{1+12\frac{h}{w}}} \qquad = 4.1$$

1ST ITERATION

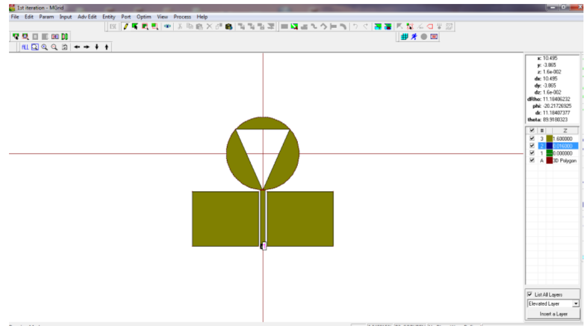

Figure : 2 The CPW Antenna 1 st Iteration

Hardware of 1st Iteration:

Figure : 3 The Hardware of 1st Iteration

Simulation Results of 1st Iteration:

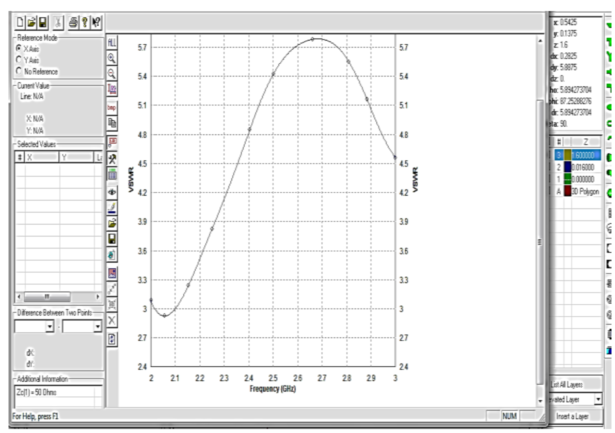

Figure :4 The Simulation result of 1st Iteration

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2nd ITERATION

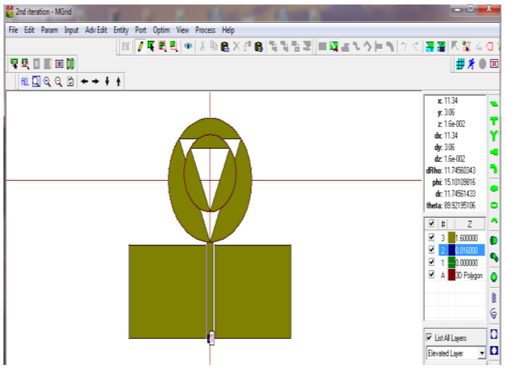

Figure : 5 The CPW Antenna 2nd Iteration

Hardware of 2nd Iteration:

Figure : 6 The Hardware of 1st Iteration

Simulation Results of 2nd Iteration:

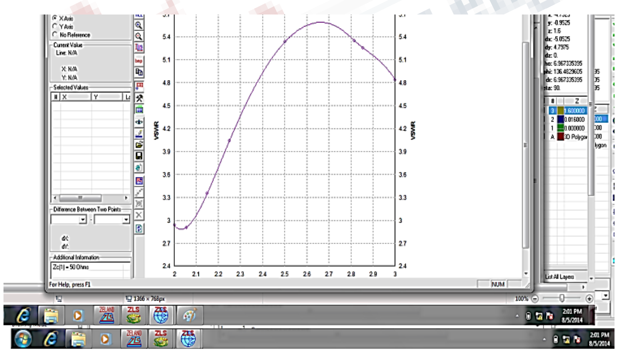

Figure :7 The Simulation result of 1st Iteration

TESTING AND RESULTS

Return Loss:

The circular antenna is used to design Microstrip antenna. he center frequencies are selected as the one at which the return loss is minimum. Results and practical results. Return loss values according to simulated results obtained at 2.4ghz Simulated and Practically are -15.8db,-11.5db respectively.

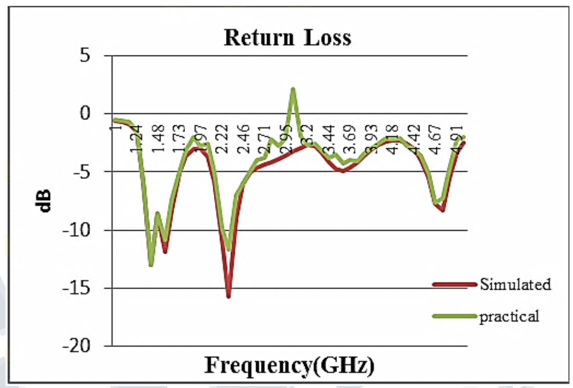

Figure :8 Return Loss Comparison

Effect of parameters on antenna performance

- Antenna substrate dielectric constant:- This parameter affects the bandwidth of the antenna directly. Lower the permittivity of the antenna substrate wider the impedance bandwidth.
- Antenna substrate thickness: - This parameter directly affects the bandwidth and coupling level of the antenna. Thicker the substrates better the impedance bandwidth but lesser the coupling level.
- Micro strip patch length:- This decides the resonant frequency of the micro strip patch antenna.
- Micro strip patch width: - The width of the antenna affects the resonant resistance of the antenna. Wider the patch lowers the resistance.
- Slot width: - This parameter affects the coupling level from the feed lines to the patch.
- Slot length: - Coupling level is primarily decided by the slot length.

By considering above factors the optimizations are made.

CONCLUSION

In this paper, the fractal structure is intended to reduce the patch antenna size. Thus make it possible to yield a lower resonant frequency than the basic structure. The resonant frequency had decreased as the iteration number increased. IE3D simulator's simulated result exhibit the resonant band of frequency with different antenna parameters like Return Loss and Impedance.

It is observed that the resultant antenna is simple to design. The proposed antenna is operating in multiband range with acceptable S11<-10 db (VSWR<2). The new compact Multi-Band antenna has been presented and implemented successfully by fractal technology. like Wi-MAX, mobile wimax applications.

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