

# Design of a Novel Triangular Shaped Fractal Antenna for Wireless Communication

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**ABSTRACT :** In this paper a compact fractal monopole antenna for ultra wideband application is proposed with microstrip feed technique. This paper describes the design and simulation of novel triangular shape fractal antenna using Ansoft Designer. The fractal structure generates multiple frequencies and increases the bandwidth of the patch antenna. Fractal antenna gives better performance in terms of return loss, efficiency and directivity. The proposed antenna is designed on an inexpensive FR4 Epoxy substrate of thickness 1 mm and a dielectric constant of 4.4. Theoretical analysis done by Ansoft Designer reveals that the structure resonates at 7.6 GHz and has an Ultra wide bandwidth of 4.21 GHz

**Keywords -** Fractal Antenna, Microstrip Feed, Microstrip Patch, Return Loss, Ultra Wide Band

## I. INTRODUCTION

The basic structure of a patch antenna consists of a ground plane in the underside with a dielectric region separating the ground and the radiating patch. The electromagnetic waves fringes from the radiating patch into the substrate and are reflected by the ground plane into air. The length of the patch determines the operating frequency whereas the width controls the input impedance. Patch width regulates the bandwidth as well as the radiation pattern of the antenna. For example an increase in the width of the patch increases the bandwidth of the antenna [1].

Microstrip patch antennas have various attractive features such as light weight, low profile, planar configuration, low cost, high efficiency, simple to fabricate and easy to integrate [2]. Major operational disadvantages of the microstrip antennas include low efficiency, low power gain, high quality factor (sometimes in excess of 100), poor polarization purity, poor scan performance, spurious feed radiation and very narrow frequency bandwidth. A lot of investigations have been done to increase the bandwidth of these antennas in recent years. Some of these techniques include utilization of thick substrates with low dielectric constants [3] and introduction of slots in the patch. There are many ways of feeding the designed antennas. The CPW, microstrip, slotline, coaxial probe are some feed methods. The main advantage

of using microstrip transmission line feeding is that it is very easy to fabricate and simple to match by controlling the inset position and relatively simple to model.

Only if the dimension of the antenna is greater than a quarter of its wavelength then the antenna is efficient because the radiation resistance, gain and bandwidth of the antenna is increased and the antenna size is less [4]. A good solution to this problem is the introduction of fractal geometry to the patch. In recent years the increasing demand for operation in multiple bands have been addressed by antenna design engineers to adopt the space filling, self similar geometrical fractal structures [5]. Ultra Wideband Antennas have found a lot of important applications in military and commercial systems. . For example the UWB antenna is widely used in radar systems due to its high speed data rate and immunity to multi-path interference [6].

In this paper an effort has been made by the author to design an UWB antenna by introducing triangular fractal shapes in the patch which can be used for high speed data transfer in Wi-Fi systems.

## II. ANTENNA DESIGN

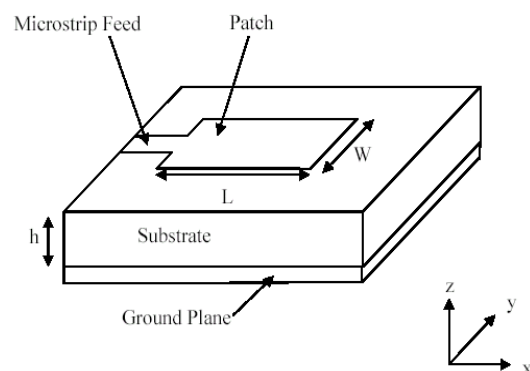


Fig 1: Microstrip line feed Patch Antenna

The proposed antenna was designed on an inexpensive FR4 Epoxy substrate of dielectric constant 4.4 and thickness of 1 mm which separates the ground plane of dimensions 40 X 40 mm and the metallic patch. The microstrip line feed technique is used to feed the input signal. Some

fractal slots resembling right angled triangles are introduced in the patch which is expected to enhance the bandwidth of the antenna as compared to a conventional patch antenna.

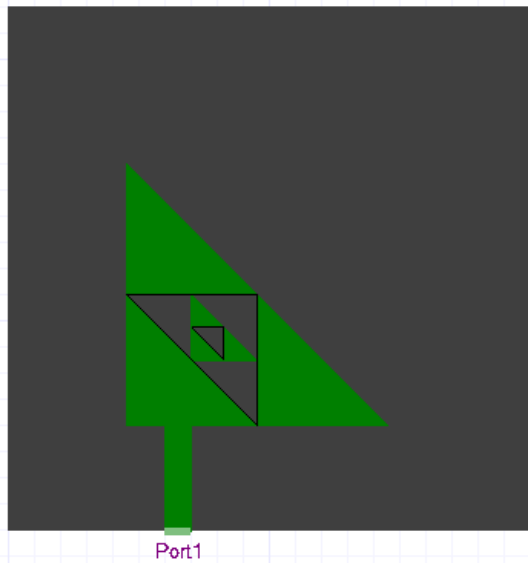


Fig2: Proposed Patch Antenna

The dimensions of the Ground Plane and the Patch are labelled as shown in the Fig. 3.

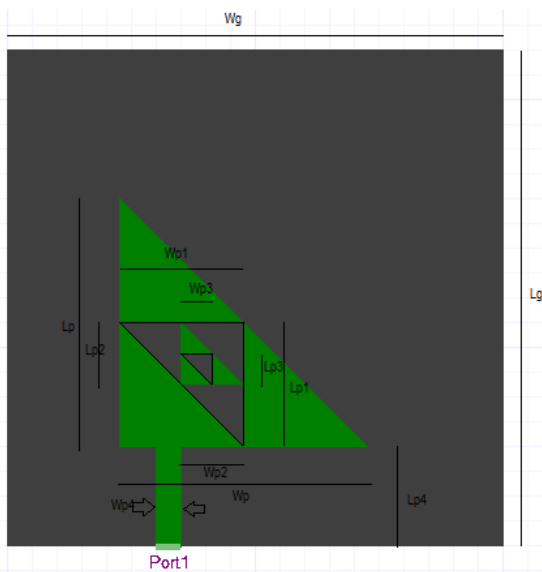


Fig3: Proposed Patch Antenna dimensions

TABLE 1: Dimensions of the Ground Plane and Patch

Sl. No	Ground Plane Dimension	Length (mm)	Patch Dimensions	Length (mm)
1	$W_g$	20	$W_p$	10
2	$L_g$	20	$W_{p1}$	5
3			$W_{p2}$	2.5
4			$W_{p3}$	1.25
5			$W_{p4}$	1
6			$L_p$	10
7			$L_{p1}$	5
8			$L_{p2}$	2.5
9			$L_{p3}$	1.25
10			$L_{p4}$	4.06

### III. RESULTS

Return Loss vs. Frequency, VSWR, the Radiation Pattern and the 3D Gain Plots of the proposed antenna are shown. The proposed antenna has an upper cut off frequency (-10 dB frequency) at 8.54 GHz and a lower cut off frequency (-10 dB frequency) at 4.33 GHz with a resonant frequency of 7.6 GHz. Thus a wide bandwidth of 4.21 GHz is attained using this simple structure which is useful for ultra wideband applications. The percentage bandwidth attained by this antenna structure is approximately 55%.

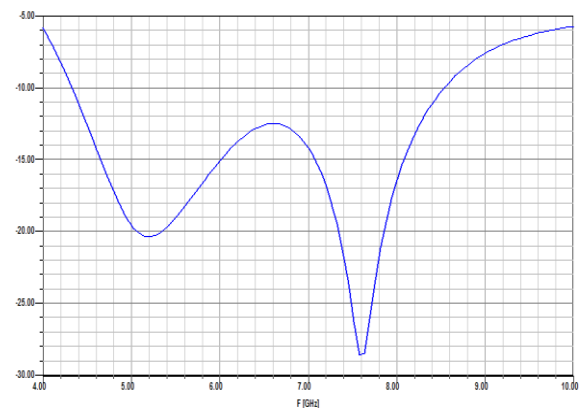


Fig 5: Return Loss Vs Frequency

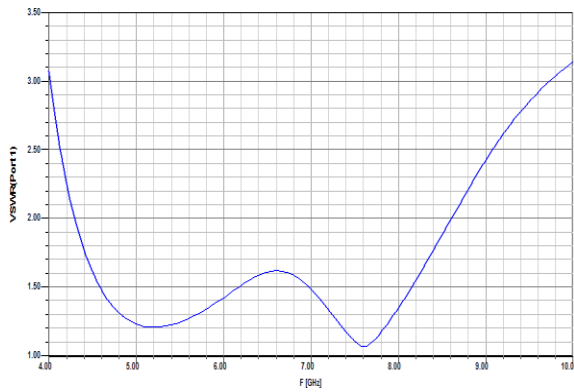


Fig 6: VSWR Vs Frequency

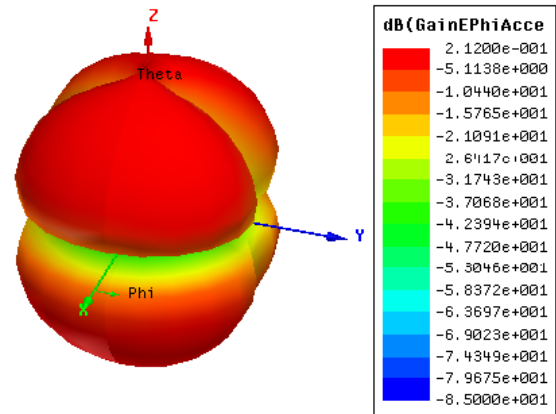


Fig 8: 3D Gain Plots of the Antenna

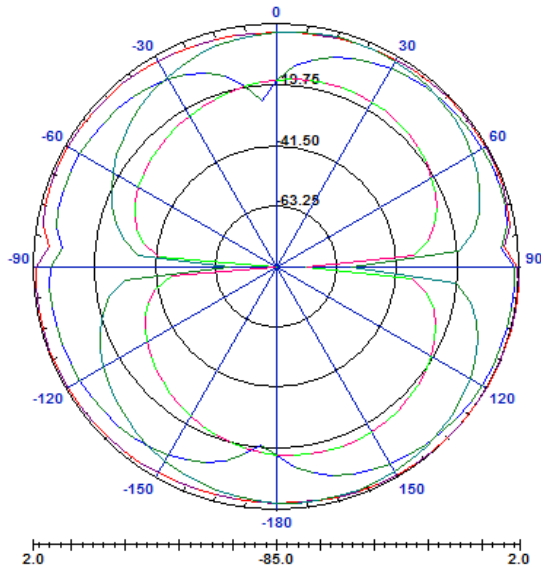
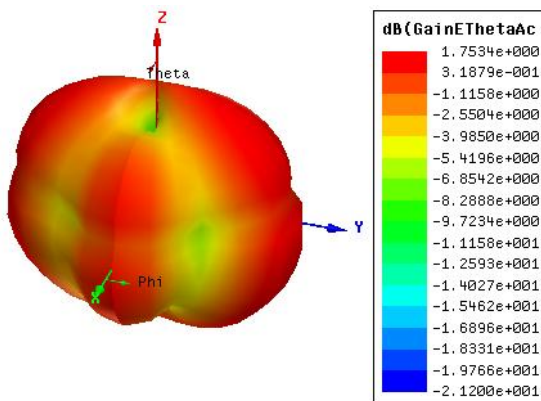


Fig 7: Radiation Pattern of the Antenna



#### IV. CONCLUSION

In this paper a compact monopole fractal patch antenna has been designed which can be used for Ultra wideband Wi-Fi applications. Ansoft Designer was employed for simulating the results. A large bandwidth is obtained by incorporating fractal slots in the patch. It is expected that this antenna will find applications for high speed data transfer for wireless communication networks and personal communications service.

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