Design and Simulation of Fractal Antenna for UWB Application

Abhishek Kulshrestha[#1]

Electronics & communication, R G P V University
Airport Bypass road, Gandhi Nagar Bhopal
abhi.kulshrestha@gmail.com

[*]**Bhagwat Khakde**
RKDF-IST college Bhopal
2bhagwatkakde@yahoo.co.in

Abstract— **This paper presents the design and simulation of fractal antenna that contributes ultra-wide band characteristics. Fractal technique is adopted to improve the radiation efficiency and other related antenna parameters. The impedance bandwidth of the proposed fractal antenna is 9 GHz ranging from 3.5GHz to 12.5GHz with maximum gain of 6.2dB and efficiency of %. Analysis of antenna is done using CST Microwave Studio.**

Keywords— **Ultra wide Band, Fractal antenna, slot, feed, Relative Band Width.**

I. INTRODUCTION

Development of high data rates wireless communication system has increased the demand for smaller size antenna. This smaller size antenna is an excellent radiator for many applications such as mobile antenna, aircraft and ship antennas, remote sensing, missiles and satellite communications. In recent years several printed planner monopole antennas are developed for UWB range due to their low profile, ease of fabrication and large bandwidth.

In a UWB antenna is designed with the help of rectangular patch consisting two steps and partial ground plane. Feed gap optimization, shaping of ground plane, multiple feed technique, can also be used achieve wide band characteristics. The important point is Radiation characteristics can be improved using fractal technique.

The concept of fractal was first introduced by French Mathematician B. B. Mandelbrot. Fractals have self similarity properties which are helpful in achieving multi band characteristics and hence can be optimized for UWB applications. Also fractal curves introduce discontinuity in terms of bends and cuts to the radiating patch which increases radiation efficiency of antenna. Various UWB fractal antennas

In this paper a circular fractal antenna is developed which covers the UWB range of 3.5 GHz to 12.5 GHz achieving relative bandwidth of 120%. The proposed structure is build and simulated using CST Microwave Studio 2010.

II. FRACTAL CONCEPT AND IMPLIMENT THE DESIGN

'The concept of fractal was first introduced by French Mathematician B. B. Mandelbrot in 1970. Based on his Findings fractal can be defined as the set F such that, F has a fine structure with details on arbitrarily small scales, F cannot be defined by traditional geometry, F poses self-similarity property, can be geometric or statistical, Fractal Dimension of F is greater than topological dimension.

In recent years, fractal concept is frequently used by antenna design engineers for designing smaller antenna. Along with smaller size, fractal also introduces discontinuities, in terms of increased bends and corners, in radiating patch of antenna to achieve higher efficiency.

A Micro strip antenna is very versatile and made for a wide range of resonant frequencies, polarization patterns and impedances. Due to its operational features viz low efficiency, low power, high quality factor, poor polarization purity, poor scan performance and very narrow frequency bandwidth, it is suitable for mobile and government security systems where narrow bandwidth are priority. They are also used on laptops, microcomputers, mobile phones etc. The basic form of circular microstip patch antenna is shown in fig (1)

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Dimension of feed line is calculated transmission line model with characteristics impedance of 50 ohm and found to be (Wfeed –Lfeed) -2.1/2 -2.1/2 length and width -15 to .4, height 1.638 – 1.676. Dimension of ground is -15 to 15 (length), -15 to -15+13.899+.1 (width) (Wfeed- Lfeed) and height is maximum 0.38 mm.

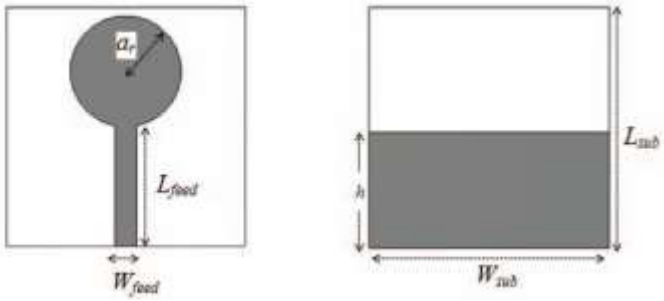

Figure1. (a) Front view (b) back View

III. RESULT AND DISCUSSION OF DESIGN.

With the Calculated Dimensions, circular patch antenna performance is studied using CST Microwave Studio. Initially the effect of ground plane on return loss characteristics is studies.

The design of circular patch antenna is completely shown in figure (2). In this design firstly we design the Base Structure as Ground Wfeed X Lfeed is (-15 X 15) and it's Substrate is (-15X -15+13.899+.1) after that in the design we design the Circle with cutting shape of Square with different- different dimension. And check the accuracy of design after completes the structure of design.

DESIGN AND IT'S SIMULATION: AS per last discussion to be continue in the design we use the feed at the bottom of the structure [W x L] is-15+c at Y location and 1.676 at Z location. We show the result of design at the different frequency to find the better and much better return loss. We find the better return loss at the frequency [0-18 mm].

Figures and Tables: The design of Circular fractal antenna shown in fig. in this diagram a one circular, one feed and one square made. Foer excellent result of return loss we use the iteration method in the design. In four step of iterations of fractal cuve that is introduced on conventional structure. in first iteration is obtained by removing square slot in basic circular patch . in second iteration again follow same step . This process is repeated for iteration.

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Four iteration shown in fig. (2).

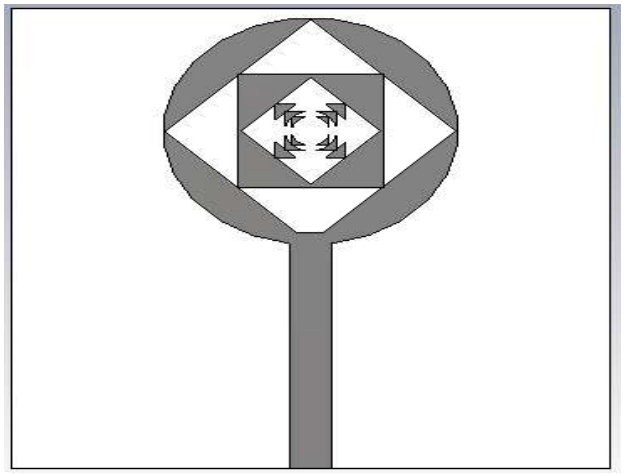

Figure (3) . Proposed structure. Of Circular fractal antenna

The first graph of return loss is shown in fig. In this graph as per analysis we found the actual return loss rage is going to -55mm. And its frequency range is [0-10mm] .but this result is not satisfied to my reference paper result. So now we design the new graph with new frequency range to find better return loss.

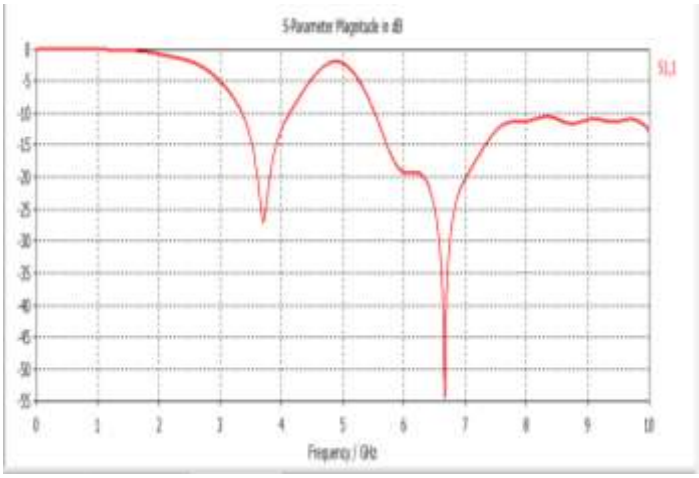

Figure (5)

In the Second Graph shown in below have a better return loss at better frequency range. The frequency range is [0-18 mm] to take a respond the return loss is maximum -70dB .The impedance bandwidth of the proposed fractal antenna is 9.5 GHz ranging from 3.2GHz to 12.7 GHz. With the maximum gain is..... All the analysis is done using the CST Microwave Studio 2010.

Hence we satisfy with this result. Because this result is better than all the other result. Also better than the Reference paper.

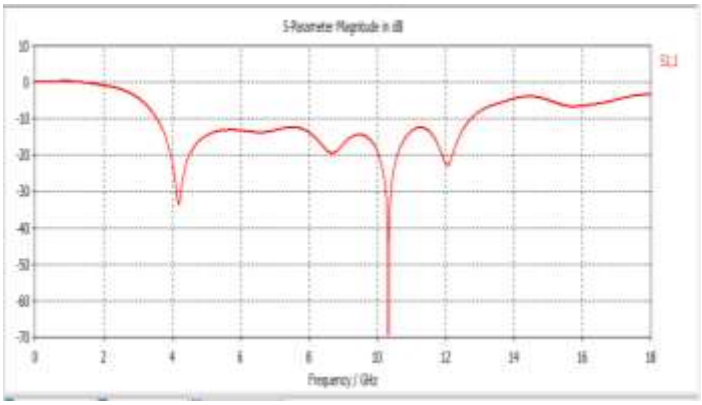

Figure (6) final result of return loss

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Fig. 6 Shows the full design of the Circular fractal antenna . With the help of Circular fractal antenna we find the better Radiation pattern. and find the better Return loss.

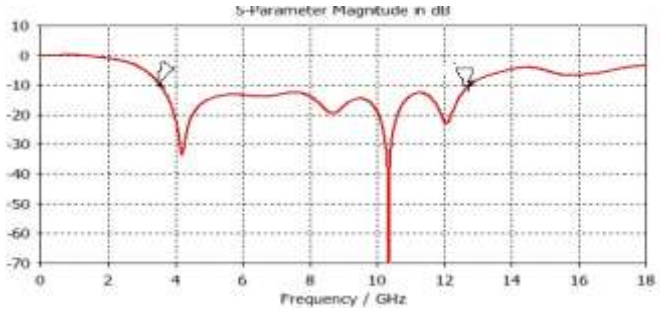


Figure (7) shows the UWB (ultra wide bandwidth) from 3.4 GHz to 12.9GHz. So the impedance bandwidth is 9.5 GHz much better than previous results of design, Hence this is my final result of design of Circular fractal antenna.

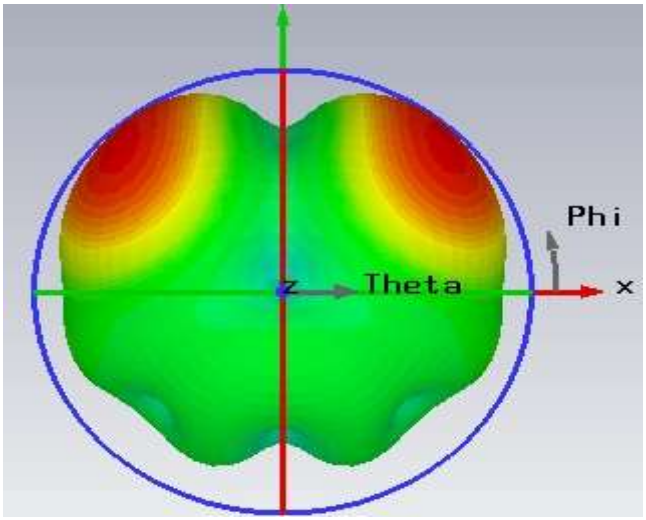


Figure (8) shows the 3D design of structure

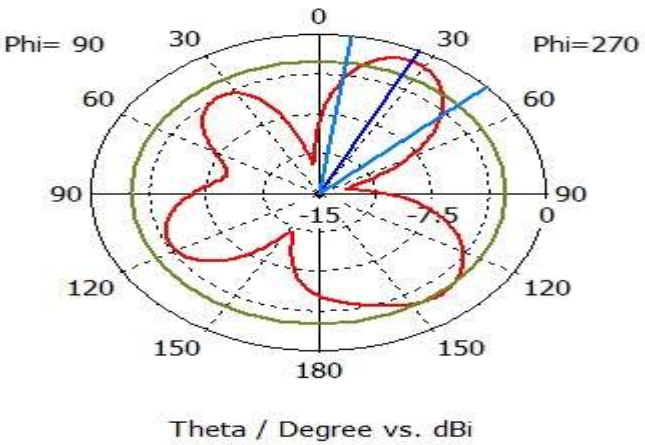
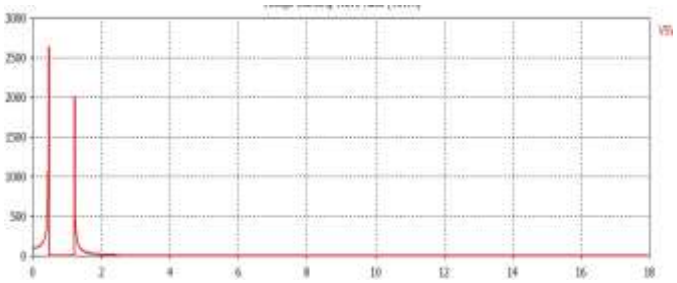


figure (9) Polar plot

CALCULATE VSWR : Figure (10)



CONCLUSION: The proposed structure has better radiation efficiency than the conventional antenna. It also achieves relative bandwidth of 118.50% approximate in UWB range. Thus the making of proposed fractal antenna is lighter in weight. Hence fractal concept can be used in designing small size antenna with higher frequency.

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