# Multi-Fractal Triangular Microstrip Patch Antenna: A Literature Review

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*Abstract*— The antenna radiation characteristic is the important parameter to select the shape of antenna and triangular patch antenna gives the better antenna characteristic as compared to other shape antenna with less geometrical structure. Objective of our work is to enhance the characteristics of triangular patch antenna .In this paper we discussed about some previous applied techniques to improve the parameter described by different researchers.

***Key words:*** Multi-Fractal Antenna, Ultra Wide Band, Koch Fractal, Sierpinski Fractal, Return Loss, Bandwidth

## I. INTRODUCTION

Modern wireless communication systems require low profile, lightweight, high gain and simple structure antennas to assure reliability, mobility, and high efficiency. A microstrip patch antenna is very simple in construction using a conventional microstrip fabrication technique. Microstrip antennas consist of a patch of metallization on a grounded dielectric substrate. They are low profile, lightweight antennas, most suitable for aerospace and mobile applications [1].

The conducting patch can take any shape which is shown in the Fig.1 but rectangular and circular configurations are the most commonly used configurations. Among the shapes that attracted much attention lately is the triangular shaped patch antenna this is due to their small size requirement compared with other shapes like the rectangular and circular patch antennas.

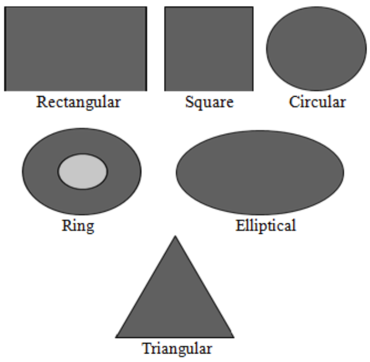


Fig. 1: Different basic patch structure

## II. LITERATURE REVIEW

Triangular patch antenna with fractal geometry is Multi-frequency antenna has been taken more and more attention, with its small volume, light weight, easy and active circuitry integration advantages, especially along with the rapid development of wireless communication.

"A Multi-fractal Antenna for WLAN and Wi-MAX Application", Basil K Jeemon, K Shambavi, Zachariah C Alex 2013. In this paper presents a multi-fractal antenna operating in ultra wide band range for WLAN and WiMAX applications. The novel idea of multi-fractal geometry is introduced into the conventional triangular patch antenna with microstrip feed. The addition of Koch and Sierpinski fractal techniques gives rise to better impedance bandwidth and return loss characteristics. Here the partial ground plane with feed gap optimization technique is used to get better impedance matching and obtaining the maximum relative bandwidth. Here fractal technique is used to get better radiation characteristic because in fractal technique discontinuities introduces in the patch geometry which increases the radiation efficiency with reducing the antenna metal part size and also by application of each fractal iteration it is found to reduce the lower cut-off frequency[2].

"A review Paper on Fractal Antenna Engineeing" Amanpreet Kaur, Gursimranjit singh 2014. This paper represents the types of fractal techniques which is of two types: Deterministic and random. Deterministic, like the Sierpinski gasketand the von Koch snowflake, are constructed by several scaled-down and rotated copies of themselves. Random fractals have elements of randomness which makes it possible to simulate natural phenomena. In Sierpinski gasket the initial few stages involved in the construction of the sierpinski gasket are shown in Fig. 2. The procedure for constructing this geometry of fractal begins with an equilateral triangle contained in the plane. The process is continued by removing the similar triangle from the former triangle. This iterative process is carried out an infinite number of times to form the Sierpinski-gasket fractal.

Fig. 2: Stages in the construction of a Sierpinski gasket fractal.

In the Koch snowflake is generated by adding smaller and smaller triangles to the original structure in an iterative manner. This procedure is clearly demonstrated in Fig.3 where the first three stages involved in the construction of Koch snowflake geometry are shown[3].

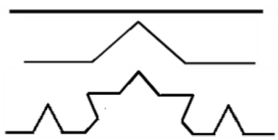

Fig. 3: stages in the construction of a Koch snowflake

"Effect of Partial Ground Plane Removal on the Radiation Characteristics of a Microstrip Antenna"

Hong-Min Lee, Wong-Sang Choi 2012 In this study presents a new, simple method for reducing the back-lobe radiation of a microstrip antenna (MSA) by a partially removed ground plane of the antenna and owing to the suppression of surface wave diffraction from the edges of the conventional MSA ground plane. Here this method is used for impedance matching between patch antenna and feed path structure from various available impedance matching techniques. The stub matching and quarter-wave transformer matching resulted in narrow impedance bandwidth and was not found suitable for the UWB antenna. The binomial transformer matching gave more impedance bandwidth but resulted in poor return loss as the matching technique did not account for imaginary part of characteristic impedance of the antenna. The partial ground plane with feed gap optimization technique was found apt for Ultra wide band operation as it accounted for the compensation of both real and imaginary part of characteristic impedance of the antenna. Further improvement in antenna parameter can be realized by modifying the ground plane by introducing a rectangular slit in ground plane. In Fig.4 dotted line represent the partial ground plane after removing $G_L$ from both sides from the initial ground plane area $S \times S$ [4].

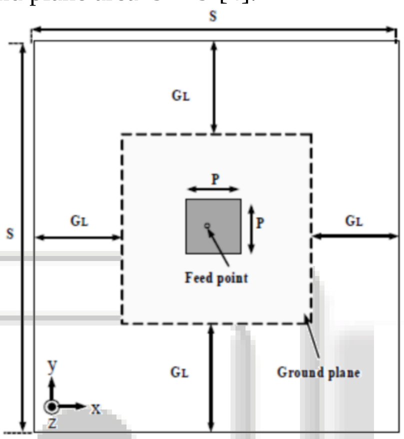


Fig. 4: Partial ground plane structure

"A Novel Approach to Bandwidth Enhancement of Multi -fractal Antenna" Sanjeev Yadav, Pushpanjali Jain, Ajay Dadhich 2014. In this paper, a fractal triangular patch design is proposed which is a combination of Koch and Sierpinski techniques. The proposed design will provide contribution to the ultra-wide band characteristics. To increase the bandwidth of proposed design, a slot is cut in partial ground plane. In this paper a novel koch like curve side sierpinski multi fractal antenna was proposed and simulated. In result part it is shown that as we increase the iteration, return loss and bandwidth is improved. Also after introducing a slot in ground plane, bandwidth is increased up to 20% in compare to conventional triangular patch antenna. The proposed antenna is satisfying the band specification of the WLAN and Wi-MAX and it can be used in higher frequency of S band (2-4GHz) and C band (4-8GHz) applications[5].

"CPW-Fed Koch Fractal Slot Antenna for WLAN WiMAX Applications" Deepti Das Krishna, M. Gopikrishna 2008 This paper indicate about demand for low profile, light weight and low cost broadband antennas has increased in the recent years with the widespread deployment of short distance wireless communications, like the wireless local area networks (WLAN). WLAN's are designed to operate in the 2.4 GHz (2.4–2.48 GHz) and 5 GHz frequency bands (5.15–5.35 GHz and 5.725–5.825 GHz in the United States and 5.15-5.35 GHz and 5.47–5.725 GHz in Europe). Also there is the easily deployable, low cost, broadband wireless access commonly known as WiMAX (Worldwide Interoperability for MicrowaveAccess) which is allocated the 2.5–2.69/3.4–3.69/5.25–5.85 GHz bands[6].

"Equilateral triangular microstrip antenna for circular polarization dual-band operation", Rajesh K Vishwakarma, J A Ansari, M K Meshram 2006. This paper gives the idea about the triangular antenna parameter calculation.

If $f_r$ is resonant frequency of resonating triangular patch antenna in GHz and c is velocity of light in m/sec then it is obtained for various modes by

$$f_r = \frac{ck_{mn}}{2\pi\sqrt{\varepsilon_r}} = \frac{2c}{3a\sqrt{\varepsilon_r}}\sqrt{m^2+mn+n^2} \quad \text{....……(1)}$$

Where $k_{mn}$ is wave number and given by

$$k_{mn} = \frac{4\pi}{3a}\sqrt{m^2+mn+n^2} \quad \text{…………………(2)}$$

The expression for lowest order resonance frequency is

$$f_r = \frac{2c}{3a\sqrt{\varepsilon_r}} \quad \text{…………………...……..………(3)}$$

Here triangular patch length a is calculated in mm.

In this relation effects of fringing fields are not considered. The resonant frequency may be determined with better accuracy, if $\varepsilon_r$ and a in the above equation are replaced by effective dielectric constant $\varepsilon_{eff}$ and $a_{eff}$ which is given by[7].

$$\varepsilon_{eff} = \frac{1}{2}(\varepsilon_r+1) + \frac{1}{4}\frac{(\varepsilon_r-1)}{\sqrt{1+\frac{12h}{a}}} \quad \text{………...….(4)}$$

and

$$a_{eff} = a + \frac{h}{\varepsilon_r} \text{…………………..…..(5)}$$

Respectively, hence

$$f_r = \frac{2c}{3a_{eff}\sqrt{\varepsilon_r}} \text{……………………….…..(6)}$$

## III. CONCLUSION

The triangular patch antenna is basic structure which gives some advantage over other shape antenna characteristics and by using multi fractal techniques it further improved by some extent. This paper present some techniques for enhancing the different characteristic as radiation pattern, bandwidth, return loss, V.S.W.R etc. of triangular patch antenna by using partial ground concept, multi fractal technique to alternate the triangular shape structure, introducing a slit on the ground plane. Here we concluded that by introducing higher order fractal, the antenna characteristics can be further be improved. So there is a future scope in the higher order fractal techniques to improve characteristic of triangular patch antenna.

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