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Design of Circular Shaped Fractal Antenna for the Application of Satelite Communication

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***Abstract*— In this manuscript circular shaped fractal antenna is proposed for the use of satellite communication. Antenna is implemented and simulated by using RogersRT5880 substrate the design is fractal antenna with modified ground structure. The fractal antennas are used due to its reduced size in shape and its multiband characteristics. The antenna has been implemented to operate at frequency resonance of X band K band and Ku band which is used in satellite communication. The antenna is designed and simulated using CST studio suite version 2016. The results are given in terms of VSWR, reflection coefficients, gain and directivity. According to results the antenna at 3rd iteration has a good gain and VSWR with reduced area of patch. The antenna is made more effective by applying the concept of fractal geometry .**

Keywords*— Satellite communicattion; Patch antenna; Reflection coefficient; VSWR; FractalAntenna

I. INTRODUCTION

As wireless communication plays a major role in our day to day life, antennas are required to produce more gain, higher performance, multiband support, wider bandwidth. This lead to the further development of the micro strip antenna. Circular patch antenna is one among the micro strip antenna categories which are more advantageous than the conventional antenna kind such as light weight, tiny size and easy to manufacture and installation further the micro strip patch antenna can be enhanced using fractal geometry[2]. The fractal term is derived from Latin word “fractus” which means irregular iterative and it was determined by Benoit B. Mandelbrot who is a French mathematician [3]. The one who proposed the method for increased bandwidth by using fractal geometry which gave rise to fractal antenna. The fractal antenna is antennas that are of similar or irregular shapes which are created in an antenna and subtracted from the main antenna so that it can maximize effective length and reduce the area size of material that can receive or transmit electromagnetic radiation [4]. A fractal is rough and it’s of different geometric shapes which are different from the conventional geometry which is created by using formulas. Fractals are generally self-similar and independent of scale. There are many e.g., Mandelbrot set, Cantor’s comb, vonKoch’s, snowflake, Sierpinski’s gasket, the Lorenz attractor etc...[5] The benefits of fractalizing an antenna depend on reducing the total area size of the antenna, it produces an acceptable range of gain and the physical constraints of the antenna are made simple. In general, however, the fractal parts produce “fractal loading” and allow the creation of smaller antennas for the given frequency. These antennas are used in shrinkage of antennas by 50-70.Fractal antennas also provide many versatile capabilities. Based on the background, it will designed and realized the antenna is circular shape fractal antenna with 3iteration using the Rogers RT5880 thus antenna will work on frequency band of X,K and Ku band which is used for satellite communication each with width of 0.2GHz, 1.089GHz and 0.796GHz respectively on SWR<1.3. The antenna parameters are measured using micro strip line technique

II. ANTENNA DESIGN SPECIFICATIONS

Circular patch antenna is one of the famous antennas among the micro strip antenna. The frequency range for a circular patch antenna is a multiband range of frequencies. The radius of patch is only degree of freedom to control the antenna. The dimension of antenna radius (a) are calculated from the equation

$$a = \frac{8.791}{f_o\sqrt{\varepsilon_o}} - \frac{h}{\sqrt{\varepsilon_r}} \quad (1)$$

$$\varepsilon_e = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + \frac{12h}{w}\right]^{-1/2} \quad (2)$$

h = thickness of subtracts.

w = width of subtract (w=4a)

ε_r = relative permittivity.

a = radius of match.

The length and width of substrate are taken as 68.56mm*68.56mm. The antenna is fabricated on Rogers RT 5880 material having dielectric constant of 2.2 and height of subtract is 1.6mm. The radius of circular antenna is taken as 17.14mm. Micro strip feed line is used for feeding. The simulation results show that the antenna fulfils the frequency range of X, K, Ku band respectively. Ground plane with same dimensions of substrate is used. Creating a port at the

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bottom of the feed line the simulation results are obtained which is done to improvement in the return loss. The design and simulation of antenna is carried out using CST microwave studio simulation software

Table.1.Antenna value description

PARAMETER	DESCRIPTION	VALUE (mm)
L_s	Length of substrate	68.56
W_s	Width of substrate	68.56
h	Height of substrate	1.6
a	Radius of Patch	17.14
L_f	Length of feed line	18.14
W_f	Width of feed line	3
L_g	Length of ground plane	68.56
W_g	Width of ground plane	68.56

III. ANTENNA DESIGN METHODS

In this manuscript circular patch has been taken as base shape circular patch is further subtracted with smaller circular patch with concept of fractal geometry to reduce the overall size. The construction of our design begins with designing a patch (a = 17.14mm) and in 0^{th} iteration circular shape is created.

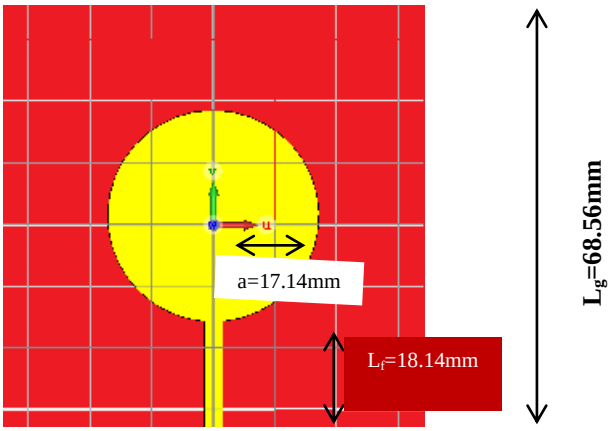

Fig.1.0^{th} iteration

In the 1^{st} iteration a smaller circular with reduced radius (a = 5mm) is drawn inside the patch and subtracted. In the 2^{nd} case around the smaller subtracted circle another four circle are drawn each with radius (a = 2.5mm) and subtracted then in final iteration another 16 more circle with radius (a = 1mm) is being subtracted from another circular patch i.e. four circles surrounding the 2^{nd} case circular patch thus creating fractal geometry (fig2).

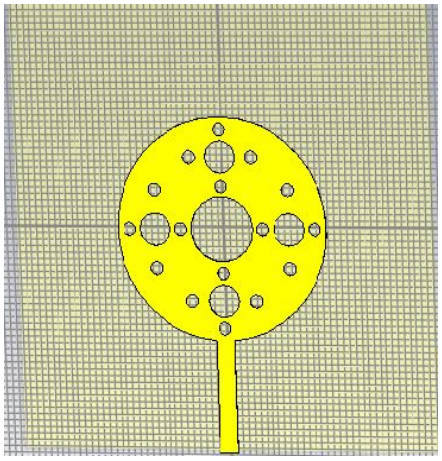

Fig.2. Final iteration

The ground plane is of with length and breadth 68.56mm*68.56mm

IV. SIMULATION RESULTS

The s11 vs. frequency curve with optimized values is shown below. The return loss curve has shown a minimum s11 of three values 18.87db at 8.675GHz 35db at 17.789 and 32db at 20.026 which are known as X band, K band, Ku band respectively which can be used for satellite Communication (fig3).

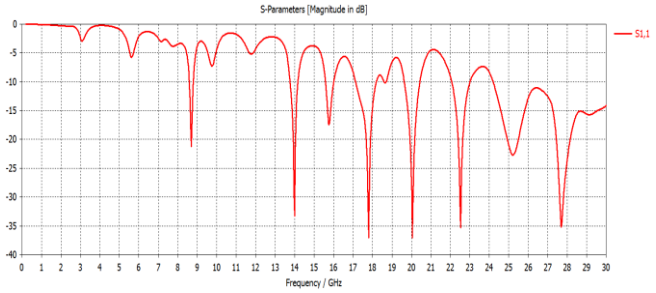

Fig.3.Return loss vs. Frequency curve

The VSWR vs. the frequency curve for the antenna with optimized parameters is shown below. The VSWR for the given circular shaped fractal antenna is 1.12dB at 8.178GHz, 1.038dB at 17.789GHz, 1.052dB at 20.026GHz that resemble the ideal value of VSWR(fig4).

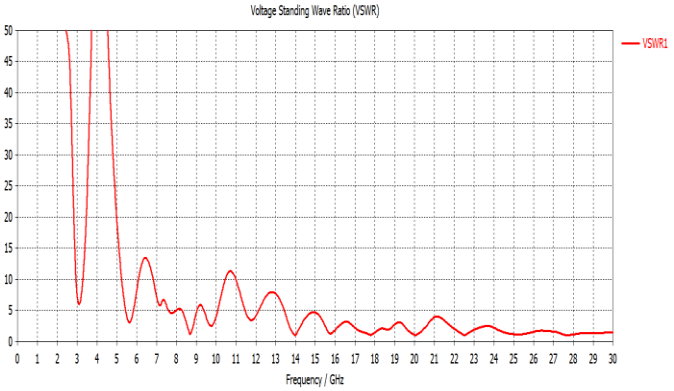

Fig.4.VSWR vs. Frequency curve

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Maximum gains over frequency for the antennas with optimized parameters are shown below (fig5).

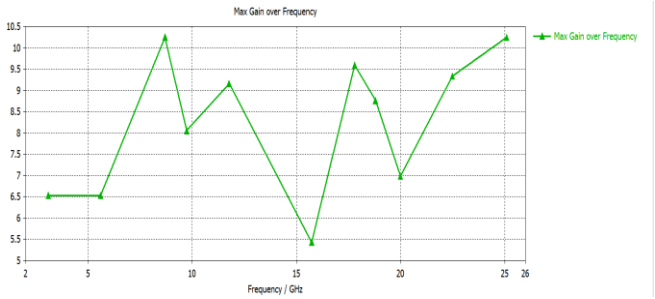

Fig.5.Maximum gain over frequency

V. CONCLUSION

In this manuscript circular patch antenna with fractal geometry has been determined and optimized for the application of satellite communication. The antenna exhibits good performance at three different bands like X, K and Ku band other than satellite communication they can be used for military and weather for casting and several other application due to its wide range of frequencies. The antenna is of reduced cost, small with good efficiency and stable radiation pattern which can be suitable for multiband wireless communication. The antenna has been simulated by using CST microwave studio. Thus by further iteration can determine more range of frequencies can be obtained and validated using CST.

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VII. REFERENCES

[1] Fractal Antenna for Wireless Applications Gursimranjit Singh Fractal Antenna for Wireless Applications M.Tech Thesis. 2014.

[2] Saxena and et al, "A compact micro strip fed dual polarized multiband antenna for IEEE 802.11 a/b/g/n/ac/ax applications," international journals of electronics and communications, pp. 95-103, 2017.

[3] Dheeraj Kalra, A thesis on "Antenna Miniaturization Using Fractals"

[4] YogeshBhomia, S.V.A.V. Prasad, Pradeep Kumar, "Sierpinski and crown square fractal shapes slotted micro strip patch antenna", International Journal of Electronics and Comp. Sci. Engineering, Vol. 3, No. 1, pp. 26-30.

[5] I. Acharya and D. Upadhyay, "A novel ultra wideband antenna with dual band notches for wireless applications," International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015.