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# Analysis of Circular Fractal Antenna

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***Abstract*-**In high perfrmance satellite and missile applications where performance, size, weight and ease of installation, low profile antenna arerequired.This type of antenna are low profile, simple and inexpensive tomanufacture using modern PCB technology. In this, circular shaped fractal antenna is proposed for the use of satellite communication. Antenna is implemented and simulated by using FR4 Epoxy substrate with dielectric 4.4 and height 1.6, 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. We have designed this using High Frequency Simulation Software(HFSS/ANSYS) at a frequency of **5 GHz.**

***Keywords*-FractalAntenna,Directivity,Feedline,VSWR, Return Loss**

## 1. INTRODUCTION

The fractal An antenna that uses a fractal, self-similar design.which increases to Maximize the effective length or increase the perimeter of material and Also referred to as multilevel and space filling curves.It is very compact, multiband or wideband.This type of antenna mainly use in cellular telephone and microwave [1].The term fractal means broken or irregular fragments to describe a family of complex shapes that possess an inherent self- similarity or self affinity in their geometrical structures.Fractals have been successfully used to model complex natural objects such as galaxies,cloud boundaries, mountain ranges and much more. Traditional approaches to the analysis and design of antenna systems use Euclidean geometry but on applying fractal geometric concepts the new research is called fractal antenna engineering [6]. Fractals are generally selfsimilar and independent of scale. It is an antenna that uses a fractal design to maximize the length or increases the perimeter (on inside sections or the outer structure) of material that can receive or transmit electromagnetic waves within a given total surface area or volume [7].ANNs are one of the popular intelligent techniques in solving engineering and mathematical problems. An ANN consists of a few types of many, simple nonlinear functional blocks, which are called neurons.Neurons are organized into layers, which are mutually connected by highly parallel synaptic weights. The ANN exhibits a learning ability,synaptic weights can be strengthened or weakened during the learning process and in this way, information can be stored in the neural network [8, 9]. In ANN model, no formula is necessary to design microstrip antenna due to its empirical nature, based on the observation of physical phenomenon. Neural networks can be used for the applications of wireless communications. In area of microwave applications, ANNs have been used to design Rectangular Microstrip Patch Antenna (RMPA) [10–13] and CMPAs [14, 15]. These can also be used to calculate different parameters such as feed position [16], resonant resistance [17], input impedance [18], radiation efficiency [19], resonant frequencies of triangular and RMPAs [20]. Similarly, ANNs have been used for calculating different parameters such as resonant frequency [21], directivity [22] and input impedance [23] of CMPAs. In case of fractal antenna design, the ANN has not been explored extensively. In this paper the concept of fractal has been applied to the geometry of CMPA in a modified way to obtain proposed CFA with multi-band frequency operations and then ANN has been used for design and analysis of proposed CFA.

In this paper we using Circular shape fractal antenna using HFSS. To excite the antennas microstrip line feed technique(Direct Contact Method) is used. Directivity of antenna is an antenna parameter which measures to what extent the antenna is able to concentrate it's radiation pattern in a particulardirection.Thebasicstructure of Circular fractalantenna isasshownbelow.

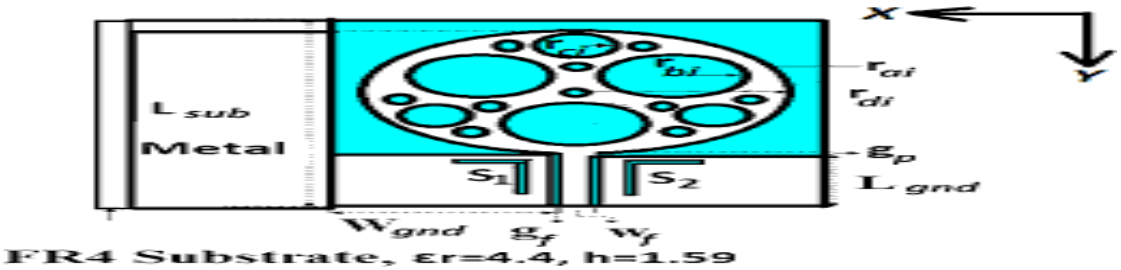


Fig.1Circular FractalAntennastructur

## 2. DESIGNINGFORMULASUSED

Thefrequency of resonant is find through this formula,

$$a_e = a\left\{1 + \frac{2h}{\pi a \varepsilon_r}\left[\ln\left(\frac{\pi a}{2h}\right) + 1.7726\right]\right\}^{\frac{1}{2}}$$

$$f_r = \frac{1.8412c}{2\pi a_e \sqrt{\varepsilon_r}}$$

Where,
a=Actualradiusofthis antenna
C=light Velocity in free space
$F_r$=frequency of resonant
h=Height of Substrate

Steps for design of different iterations of CFA are described below:
Step-1: Radius of base circular geometry is calculated usingEquations (1) and (2).
Step-2: Draw a square whose sides must be equal to 1/3rd ofdiameter of base geometry and diagonals intersect at center ofbase circular geometry.
Step-3: Cut a circle by taking A (vertex of square) as center andhaving radius 1/3rd of radius of base geometry to get 1st iterationgeometry.
Step-4: Cut another three circles on the remaining vertices of square,by taking these as the center of circles andhaving their radius equal to 1/9th of radius of base geometry circleto get 2nd iteration geometry.
Step-5: Draw three more squares with one side of each square is equalto 1/9th of diameter of circle of base geometry and one vertex ofeach square coincide with centers of correspondingcircle.
Step-6: With similar process cut 9 more circles at each remainingvertex of small square, having radius of each circle 1/27th of radiusof base geometry circle to get 3rd iteration geometry of CFA
Step-7: This process can be repeated to get infinite number ofiteration geometries of CFA.

## 3. ANTENNAGEOMETRY

*a).Circular Fractal Antenna:*

TheantennadesignofthisFractalantennashown below.

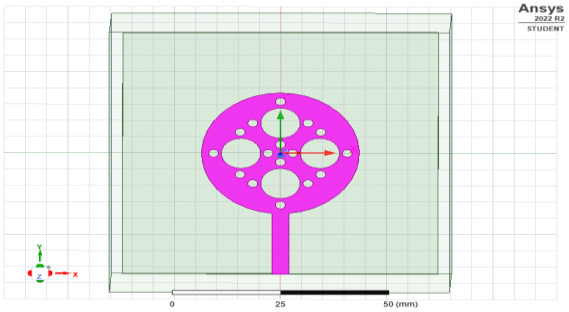


Fig.2Geometryof Circular Fractal antennainHFSS

ThedimensionsofallcomponentsofCircular FractalAntennagivenintable1below.

| Parameter | DESCRIPTION | Value(in mm) |
|---|---|---|
| $L_s$ | Length of Substrate | 33.52 |
| $W_s$ | Width of Substrate | 33.52 |
| h | Height of Subsrate | 1.6 |
| a | Radius of Patch | 8.38 |
| $L_f$ | Length of Feed Line | 8.38 |
| $W_f$ | Width of Feed Line | 2.9995 |
| $L_g$ | Length of Ground Plane | 33.52 |
| $W_g$ | Width of Ground Plane | 33.52 |

Table1ParametersofthisCircular FractalAntenn

Maximum gains over frequency for the antennas with optimized parameters are shown below

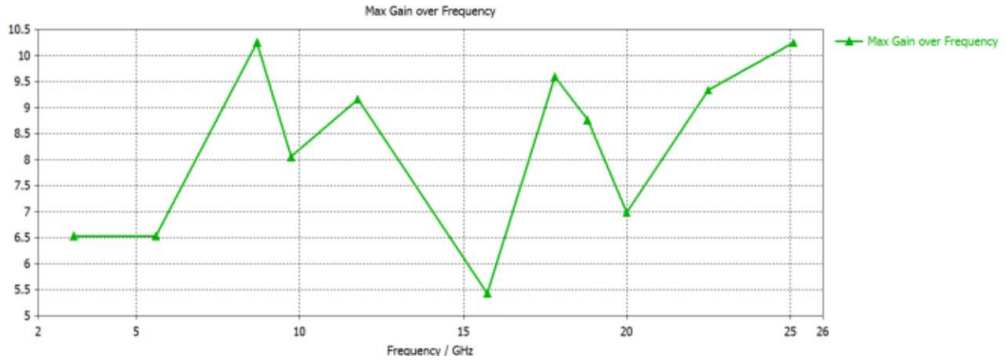


Fig.3(a)Maximum gains over frequency ofCircular Fractal Antenna

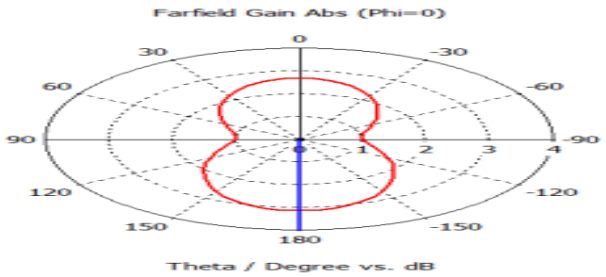


Fig.3(b)radiation pattern for Circular Fractal Antenna

## 3. CONCLUSION

This type of fractal antenna is suitable for satellite communication.The fractal antenna gives the good response with low frequency and used for several types of application due to their wide range.this type of antenna small size so their cost is also less.so,this type of suitable antenna used for large range and it's also gives the stable radition pattern.this antenna simulation done by HFSS Software and this type of antenna suitable for multiband wireless communication.

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