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KU Band Fractal MSA for SATCOM

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Abstract: ***This paper presents a rectangular fractalmicrostrip antenna and U slotted fractal microstrip antenna for C band and Ku-band satellite communication applications. The rectangular fractal microstrip antenna and U slotted fractal microstripantenna is designed to cover various applications such as broadcasting, remote sensing and space communication.The simple method and results proposed in this research is compatible with pre reported results.***

Keywords: Rectangular fractal microstrp antenna, U-Slot fractal microstrip antenna, KU band, C band, MSA agent.

I. INTRODUCTION

Traditional microstripantenna[1] –[3] can operate in single or dual frequency band. So a specific antenna is needed to handle multiple application. Moreoverin some applications it may cause space and placeproblem. Therefore a multiband antennacan be used where a single antenna can operate at multiple frequency bands. The technique to construct multiband antenna is generation of fractals into single antenna. Fractals are the most effective way to enlarge the perimeters of ashape, while maintaining same area because it has size reduction ability.

These fractal microstrip or patch antennas can be printed directlyonto a circuit board. Fractal antennas size can be shrunk from two to four times withsurprising good performance over Traditional antenna. Fractal antenna theory uses a modern(fractal) geometry[4] that is a natural extension of Euclidiangeometry. Dual and Triple band Fractal circular micro-stripantennas offers increase in bandwidth and gain at all multibandas well as the size of antenna gets reduced.

fractal antennas and its superset fractalelectrodynamics is a state of affairs for research activity.Fractals are self-similar objects and possessstructure at all scales. Fractal geometries have found anintricate place in science as a representation of some of theunique geometrical features occurring in nature discovered by Benoit Mandelbrot[4], the pioneerof classifying this geometry, first coined the term „fractal" in1975 from the Latin word fractus, which means broken.

This paper deals with thepractical aspect of fractal geometry to improve the functionality ofmodern wireless communication receivers such as cellularhandsets, remote sensing and satellite communication applications. The C band and KU [5] band are identified for satellite communication.

The C band service are better suited for large bandwidth requirement subscribers ranges from 3 to 10 GHz while the KU band services operates with smaller satellite antennas ranges from 10 GHz and above.

This paper proposes a rectangular fractal microstrip antenna and U slotted fractal microstrip antenna for C band and Ku-band satellite communication applications. The MSA Agent tool has been used to find out various results of above said fractal antennas .Further these results are compared with the pre-reportedtheories and analysis.

II. RECTANGULAR FRACTAL MICROSTRIP ANTENNA AND U SLOTTED FRACTAL MICROSTRIP ANTENNA

A fractal is defined as being "derived from the Latin fractus[6] meaning broken, uneven, any of various irregular curves or shapes that repeat themselves at any scale on which they are examined as per Webster's dictionary.

Fractal shaped antenna have already been proved to have some unique characteristics that are link to the geometry of the fractal. Fractal geometry has unique geometrical features occurring in nature. It can be used to describe the branching of tree leaves and plants.

Fractal came into two major variations, first the deterministic fractal and second random fractal.The first category consists of those fractals that are composed of several scales down and rotate copies of it, such as Koch curves. They are called geometrical fractals. Julia set also falls in same category. The whole set can be obtain by applying a non linear iterated map to all arbitrary small section of it. Thus the structure of Julia set is already contain in any small fraction. They are called algebraic fractals.

Since generation requires use of particular mapping or rule which is repeated recursively over and over again. They exhibit the property strict self similarity. The second category (Random fractals) includes those fractals which have an additional element of randomness allowing for simulation natural phenomena, so they exhibit property of statistical self similarity.

The fractals described in this paper are the deterministic fractas. The configuration of rectangular fractals and U-slot fractals has shown in Figure1 and 2 respectively.

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Figure:1Fractals of rectangular patch

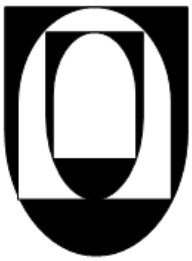

Figure: 2 Fractals of U slots

Fractal shaped antenna have already been proved to havesome unique characteristics that are link to the geometry ofthe fractal. Fractal geometry has unique geometrical featuresoccurring in nature. The above specified antennas can operate on multiple frequencies and gives multiple bandwidth. There are various factors by which the bandwidth can be optimized. In this paper we are optimizing the bandwidth of the above fractal antennas by changing the upper high and lower high frequency of fractal antennas and by changing the permittivity of the stack.

Following results Figure3 shows the optimized bandwidth which were obtained by changing the upper high and lower high frequencies of the fractal in Rectangular and U Slot antennaThe bandwidth is increasing as we are changing the frequency of patch antenna.

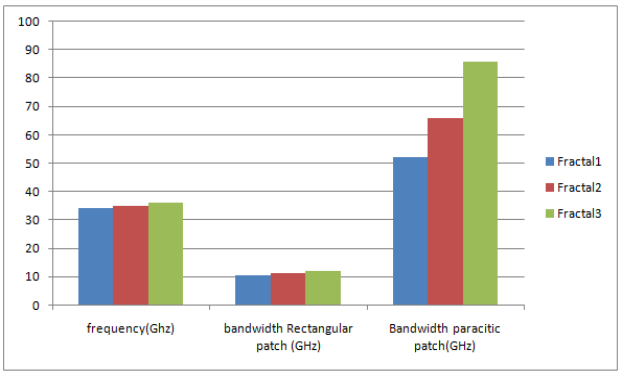

Figure: 3 Bandwidth of Rectangular Fractal and U Slot Fractal Antenna

Figure 4 shows the snapshots of the tool "MSA Agent"[7] which is used to find out the various parameters of rectangular fractal antenna and U Slot fractal antenna.

Figure: 4 Screen shots of MSA Agent to find out bandwidth

If we change the permittivity of fractals the rectangular and U slotted Fractal Patch shows the following results(Figure 5) as shown below:

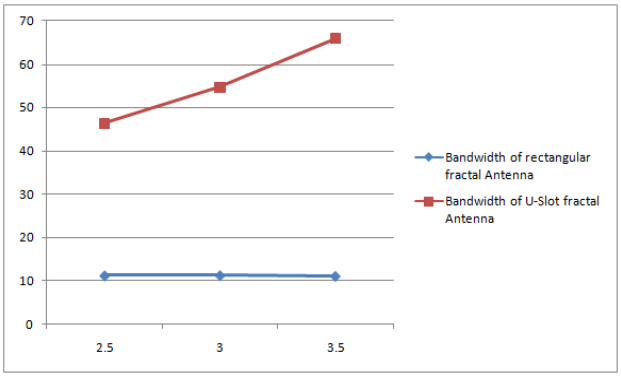

Figure: 5 Bandwidth of Rectangular Fractal Antenna with change of permittivity of stac

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The results clearly shows the optimized multi bandwidth within KU band limitations due to the fractals of rectangular and U-Slotmicrostrip antenna.

III. APPLICATIONS OF FRACTAL RECTANGULAR MICROSTRIP ANTENNA AND FRACTAL U-SLOTMICROSTRIP ANTENNA

The antenna has specially designed for KU Band which is popularly known for broadcasting, remote sensing and satellite communication. There are various types of satellites and sensors available such as imagery satellite, weather satellite, oceanography satellite etc. On each satellite a very-very high resolution cameras and sensors are available as shown in Figure6. The Earth sensor senses the earth and takes the photographs of the Earth's various parts. The proposed antenna is required to receive and send the signal to the earth the satellite data is also capable to find the temperature of a place by using mathematical model in ERDAS imagine software. The Figure 7 shown below is the satellite image of Uttarakhand.

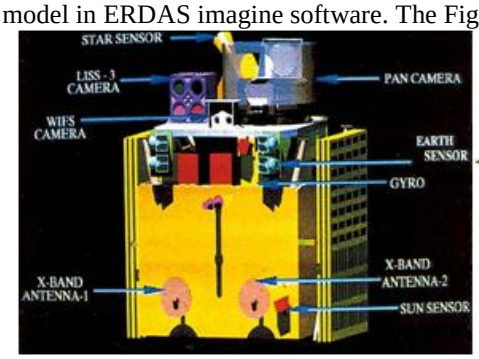

Figure 6IRS Schematic

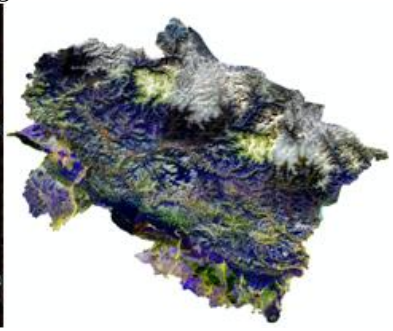

Figure 7 image from space satellite

IV. CONCLUSION

The results discussed in figure 3 shows that rectangular fractal microstrip antenna generates the bandwidth between 10.25 GHz to 11.96 GHz while U-slot fractal microstrip antenna generates 52.12 GHz to 85.97 GHz.The upper high and lower high frequencies of both fractal antenna are ranging from 44 GHz to 46 GHz and 24 GHz to 26 GHz respectively. The di-electric constant is 3.5. The resonant frequency will remain same. While the result shown in Figure 5 shows that by changing the permittivity we can optimize the bandwidth of fractals of rectangular and U-slot antenna.

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