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A Wide Band Tetra resonant Kotch Fractal Antenna with Slots for Wireless applications

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Abstract: The design of a tetra band resonant antenna using Koch iteration is presented in this paper. The concept is a fusion technology involving fractal antenna with slots on the radiating patch. Four bands of resonances are optimized by using an FEM based simulator. Koch Fractals are simulated up to iteration two. Circular slots and triangular slots are also etched on the patch to freeze the required spectras. The designed antenna resonates at 2.61, 6.25, 8.21, 14.58 GHz. The gains are found to be adequate in all the bands with Omnidirectional Patterns.

Keywords: Microstrip Patch Antenna, Fractal Antennas, Linear Polarization, Wireless Applications

INTRODUCTION

Metamaterials & Fractals are the two emerging domains in antenna design over the past decade. The term fractals means a fraction; In other words a self similar structure is generated and are analyzed using Fractal electrodynamics. This technology is used popularly by antenna designers nowadays for achieving multiresonances and reconfigurability. The self similar iterations as it gets increased leads to multi resonance. Fractal antenna for various applications and reconfigurability are seen in [1-10]. Many types of fractals are seen For example Koch type fractal is attempted in this paper for multiresonance. The paper is organized in to the following sections; Introduction, Design of proposed antenna, Discussion, Conclusion. The upcoming section deals with design of proposed antenna.

DESIGN OF THE PROPOSED ANTENNA

Koch type Fractal antenna is chosen. The iteration up to stage 2 is carried out. Small triangles are etched at the center of Floral Patch. Further four circles are etched on the Patch. Using the commercial simulator the fractal dimension and triangular, circular slot dimensions, Feed positions are changed to freeze the optimized dimensions that produce the required resonances. The antenna is designed specially with a flexible substrate (RT Duroid) with relative permittivity of 2.2 and a thickness of 62 mils. The top view of the Fractal Patch is as shown in Figure 1, while the dimensions are seen tabulated in Table 1.

DISCUSSIONS

When fed with a coaxial cable ; The antenna resonates at 2.61, 6.25, 8.21, 14.58 GHz with a return loss of -13.816,-11.7988, -16.4278, -11.9455 dB's respectively. The antenna has VSWR value less than 2 (as in commercial specification) i.e. 1.51, 1.69, 1.67, 1.3554.
The Return Loss characteristic is shown in Figure 2. The Polar Plots (Gain) are shown in Figures 3-6.

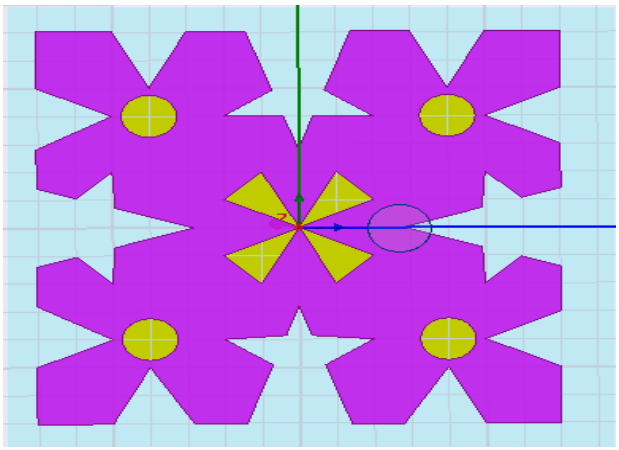

Fig. 1: *Top View of the Proposed Antenna.*

Table 1: *Dimension of the Proposed Antenna.*

Parameters	Size
Substrate	62 mils
Ground	45 X 38 cm
Radius of circle	0.15 cm
Patch Total size	50X50 mm

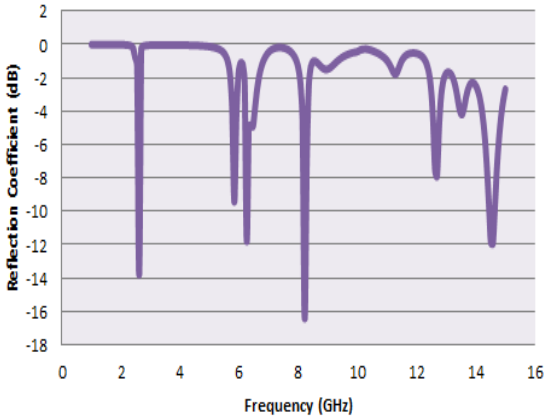

Fig. 2: *Reflection Coefficient of the Proposed Antenna.*

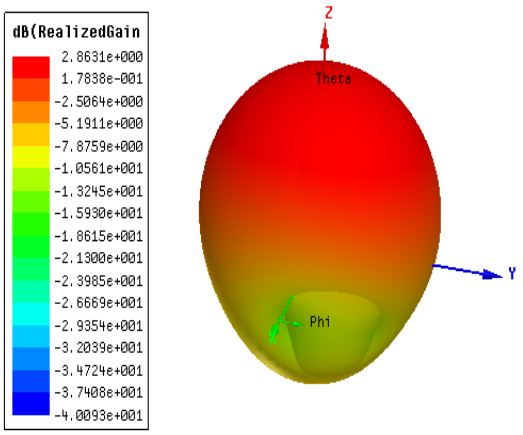

Fig. 3: *Polar Plot (Gain) of the Proposed Antenna.*

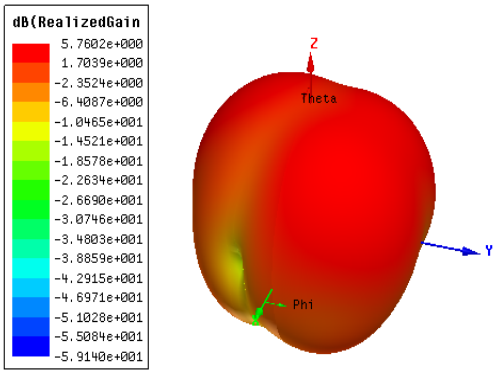

Fig. 4: *Polar Plot (Gain) of the Proposed Antenna.*

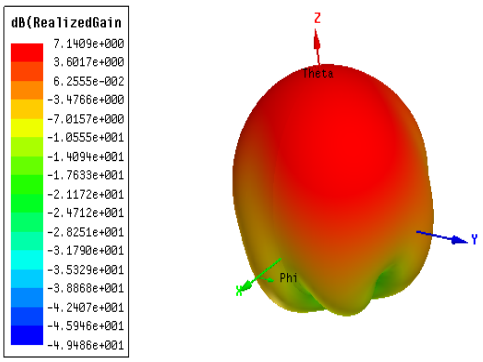

Fig. 5: *Polar Plot (Gain) of the Proposed Antenna.*

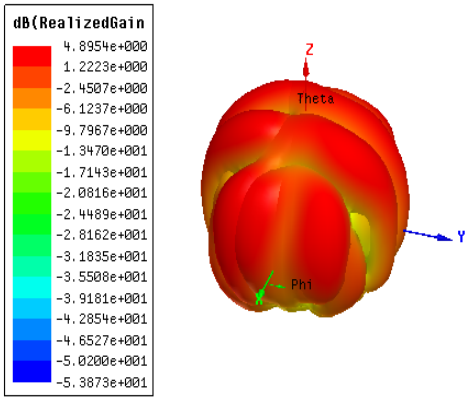

Fig.6: *Polar Plot (Gain) of the Proposed Antenna.*

The Directivity at all the frequencies are shown in Figures 7-10. Miniaturization, Multi bands of resonance is due to repetitive small fractals in the antenna. The Surface Current distribution is shown in Figures 11-14. Radiation patterns are shown in Figures 15-18.

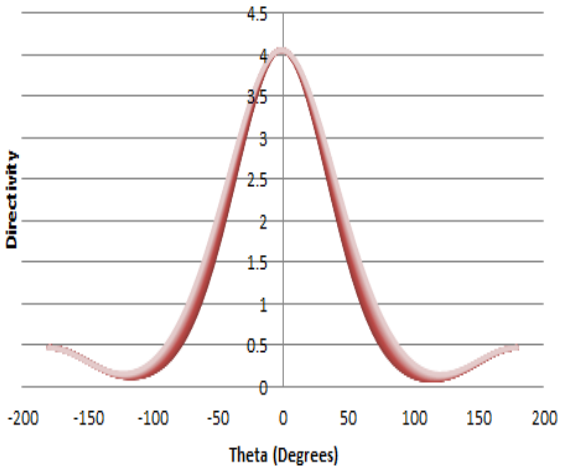

Fig.7: *Directivity of the Proposed Antenna.*

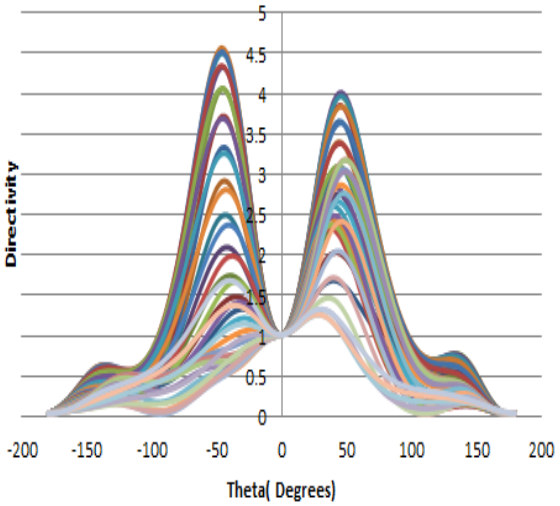

Fig.8: *Directivity of the Proposed Antenna.*

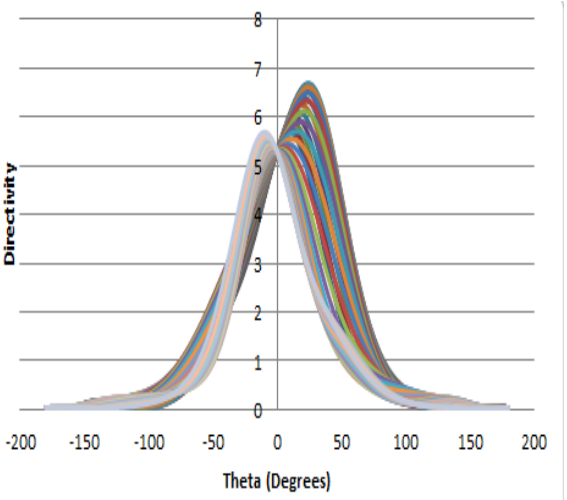

Fig.9: *Directivity of the Proposed Antenna.*

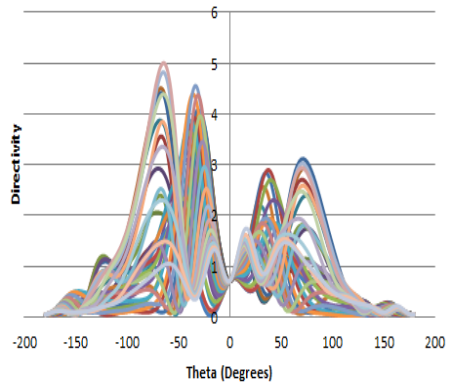

Fig.10: *Directivity of the Proposed Antenna.*

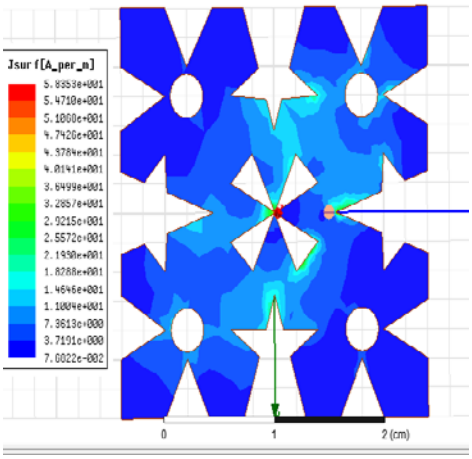

Fig.11: *Surface Current Density of the Proposed Antenna.*

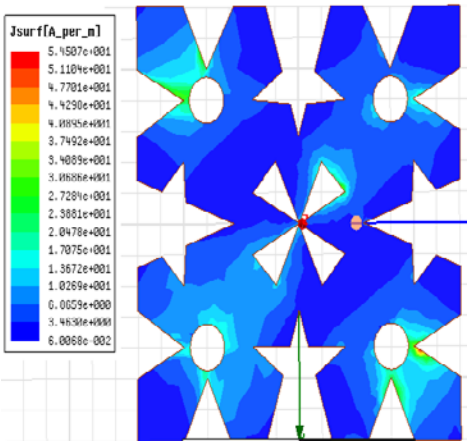

Fig.12: *Surface Current Density of the Proposed Antenna.*

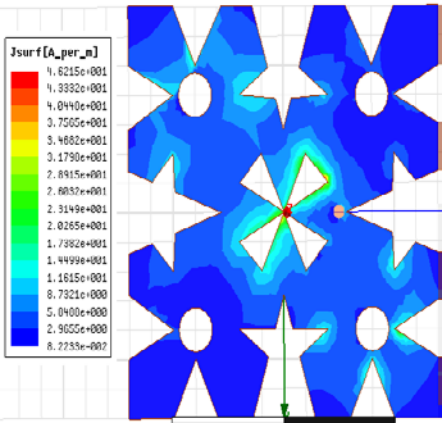

Fig.13: *Surface Current Density of the Proposed Antenna*

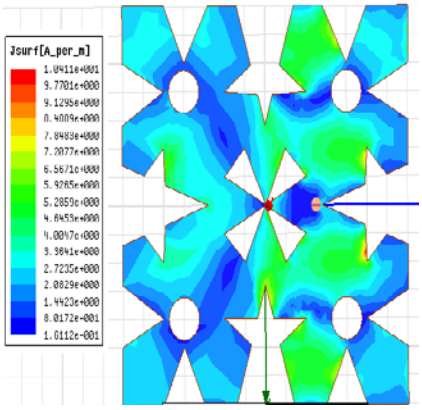

Fig.14: *Surface Current Density of the Proposed Antenna.*

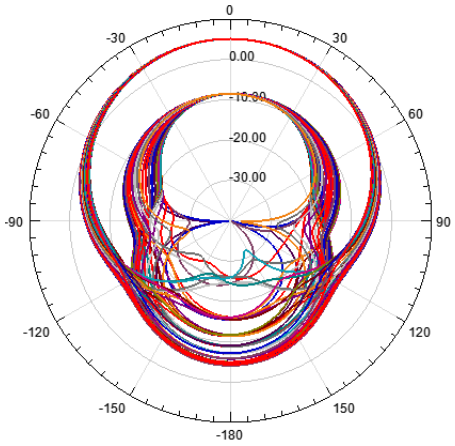

Fig.15: *Radiation Pattern of the Proposed Antenna.*

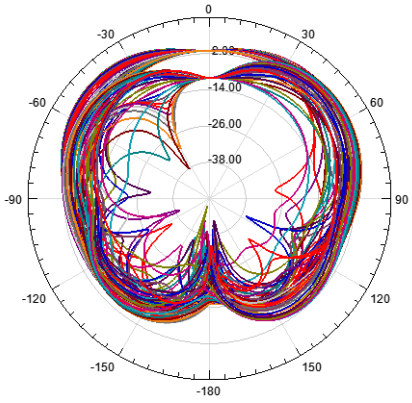

Fig.16: *Radiation Pattern of the Proposed Antenna.*

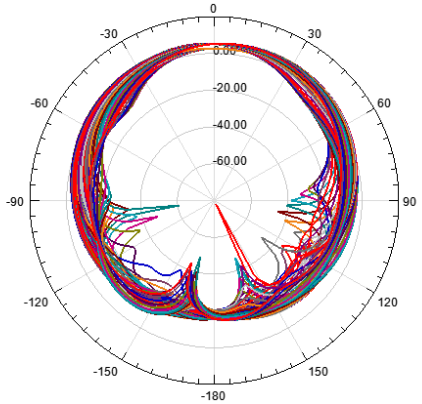

Fig.17: *Radiation Pattern of the Proposed Antenna.*

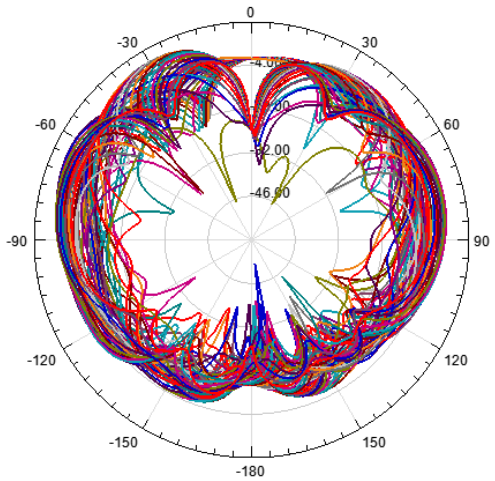

Fig.18: *Radiation Pattern of the Proposed Antenna.*

Table 2: *Simulated Antenna Parameters at 2.61 GHz.*

Quantity	Value
Directivity	4.06
Intensity	0.00254
Gain (dB)	3.23
Efficiency	83
VSWR	1.5119
FBR	8.63

Table 3: *Simulated Antenna Parameters at 6.25GHz.*

Quantity	Value
Directivity	4.5
Intensity	0.002685
Gain (dB)	3.76
Efficiency	89
VSWR	1.6921
FBR	6.5

Table 4: *Simulated Antenna Parameters at 8.21 GHz.*

Quantity	Value
Directivity	6.6
Intensity	0.00407
Gain (dB)	5.1771
Efficiency	96.4
VSWR	1.3554
FBR	98.84

Table 5: *Simulated Antenna Parameters at 14.58 GHz.*

Quantity	Value
Directivity	5.0
Intensity	0.0037
Gain (dB)	4.799
Efficiency	98
VSWR	1.67
FBR	11.317

The details of Simulated Antenna parameters at its four resonances are in Tables 2-5.

CONCLUSION

A Novel fractal antenna resonating at four bands with adequate gain, directivity, VSWR, Co and Cross polarization levels are presented. Future attempts may be for circular polarization. The fusion of slots and fractal antenna resulted in a wide band, compact, Multiresonant, Cheap, Omnidirectional antenna.

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