International Conference on Systems, Science, Control, Communication, Engineering and Technology 2015 [ICSSCCET 2015]

ISBN	978-81-929866-1-6
Website	icssccet.org
Received	10 - July - 2015
Article ID	ICSSCCET026

VOL	01
eMail	icssccet@asdf.res.in
Accepted	31- July - 2015
eAID	ICSSCCET.2015.026

A Compact Multiband Fractal Antenna(CMFA) For Wireless Applications

A Manikandan[1], Dr S Uma Maheswari[2]
[1]Assistant Professor, Department of ECE,
Karpagam Institute of Technology, Coimbatore, Tamilnadu, India.
[2]Associate Professor, Department of ECE,
Coimbatore Institute of Technology, Coimbatore, Tamilnadu, India.

Abstract: In this paper, A compact Fractal antenna is designed and examining novel self-similar fractal geometry to reduce the size and to resonate for multiband frequencies. This antenna is microstrip line fed and its structure is based on fractal geometrics. . Design and Analysis of fractal antenna is done by using Software ADS (Advanced Design System). The proposed antenna exhibits multiband characteristics with a small return loss and high efficiency at design frequency of 2.2GHz. The ultimate aim of implementing self-similar fractal concept in antenna design makes it flexible in controlling the resonance and bandwidth. . It is very flexible, compact and has very small return loss at this design frequency. It covers WLAN IEEE 802.11b and IEEE802.15, PCS(1900), GSM lower band, GSM higher band DCS(1800), IMT(2000), UMTS(2100), Wi-Fi, DARS(digital audio radio service),WLAN and wireless applications.

Keywords: self similar geometry, ADS, return loss

I INTRODUCTION

Fractal is a rough or fragmented geometric shape that can be subdivided in parts, each of which is (at least approximately) a reduced- size copy of the whole. Fractals are generally self-similar and independent of scale. There are many mathematical structures that are fractals; e.g. Sierpinski gasket, Cantors comb, von Koch curves. Fractals also describe many real- world objects, such as clouds, mountains, turbulence, and coastlines that do not correspond to simple geometric shapes. As we see fractals have been studied for about a hundred years and antennas have been in use for as long.
Fractal antennas are new on the scene. That is, the antenna should keep similar radiation parameters through several bands. Second, because the space-filling properties of some fractal shapes (the fractal dimension) might allow fractal shaped small antennas to better take advantage of the small surrounding space These geometries have been used to characterize structures in nature that were difficult to define with Euclidean geometries. Examples include the length of a coastline, the density of clouds, and the branching of trees.

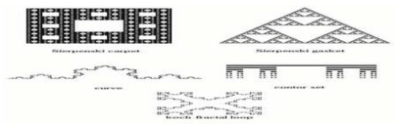

Fig.1 Examples of fractal antenna patte

Cite this article as: A Manikandan, Dr S Uma Maheswari. "A Compact Multiband Fractal Antenna(CMFA) For Wireless Applications." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 128-131. Print.

These geometries have been used to characterize structures in nature that were difficult to define with Euclidean geometries. Examples include the length of a coastline, the density of clouds, and the branching of trees.

II ANTENNA DESIGN

The self-affine fractal structure in this project is constructed by scaling a rectangle as shown in Fig.1a. The initiator S0 by a factor of two along its width and two along its length, which leads to four rectangles of equal dimension, is presented. The upper topmost corner region is eliminated there by their retaining the remaining regions as shown in Fig.1b. ie. 75% of the total area is

Retained and 25% is eliminated. First, the initiator S0 is made to resonate at design frequency 2.4GHz by adopting coaxial feed technique. This process is a repetitive procedure and is continued up to nth iteration. The width of the Microstrip patch antenna is given by

$$W = \frac{C}{2 f_o \sqrt{(\varepsilon_r+1)/2}}$$

- $c = 3x10^8$ m/s
- $\varepsilon_r = 4.4$
- $f_o = 2.2$ GHz

We calculated the width and it came out to be **W=41.5mm**

CALCULATION OF THE LENGTH

The formula for the Effective length is given as

$$L_{eff} = \frac{C}{2 f_o \sqrt{\varepsilon_{reff}}}$$

$L_{eff} = 32.6$ mm

SELF SIMILAR:

The phrase "self-similar" means that it looks same for all iterations and is super imposed of too many iterations and it portrays the self affinity property of fractal geometry. When the fractal iteration increases, then the original patch

reduces by 45% in size, thereby maintaining a radiation pattern comparable to that of a normal patch . A self similar structure is one in which the length and the width are scaled down by itself to a maximum number of possible iterations (n), through which the size of the geometry shrinks by maintaining its individuality. A Self-affine concept has been implemented in designing a low profile antenna which provides flexibility in obtaining a miniaturized antenna. By proper selection of scaling factor and optimization of the feed position, the antenna resonates for multiband covering the near bands

FRACTAL STRUCTURE

Cite this article as: A Manikandan, Dr S Uma Maheswari. "A Compact Multiband Fractal Antenna(CMFA) For Wireless Applications." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 128-131. Print.

Fig 2.Self-Similar fractal structure

The self-affine fractal structure in this project isconstructed by scaling a rectangle as shown in Fig.1a. The initiator S0 by a factor of two along its width and two along its length, which leads to four rectangles of equal dimension, is presented. The upper topmost corner region is eliminated there by there retaining the remaining regions as shown in Fig.1b. ie., 75% of the total area is retained and 25% is eliminated. First, the initiator S0 is made to resonate at design frequency 2.4GHz by adopting coaxial feed technique. This process is a repetitive procedure and is continued upto nth iteration. Figures.1c. to 1d. shows that the number of iterations undergone by the initiator S0.

III RESULT AND DISCUSSIONS

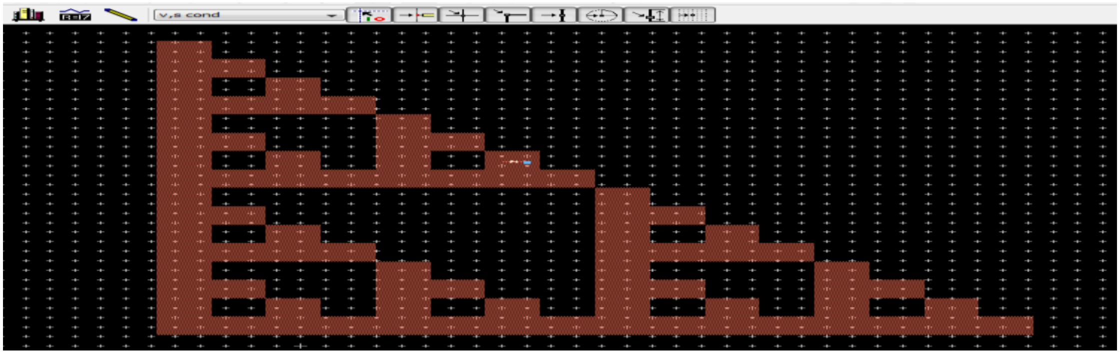

Fig3:Layout structure

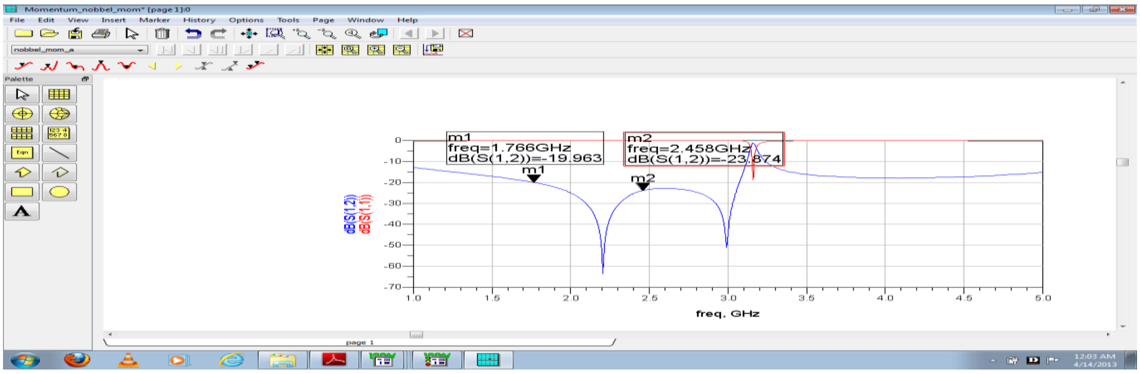

Fig.4 Simulated return loss against frequency for the proposed antenna.

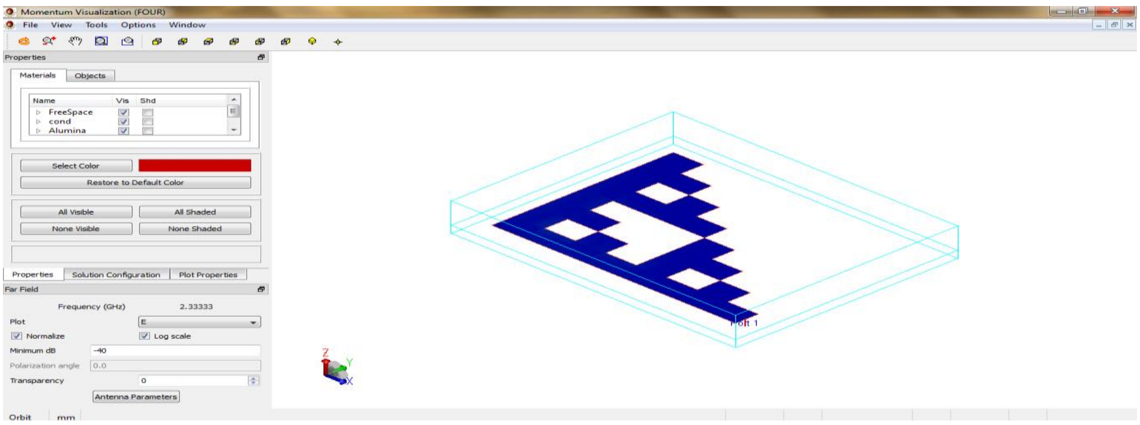

Fig.5 current distribution for the proposed antenna.

Cite this article as: A Manikandan, Dr S Uma Maheswari. "A Compact Multiband Fractal Antenna(CMFA) For Wireless Applications." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 128-131. Print.

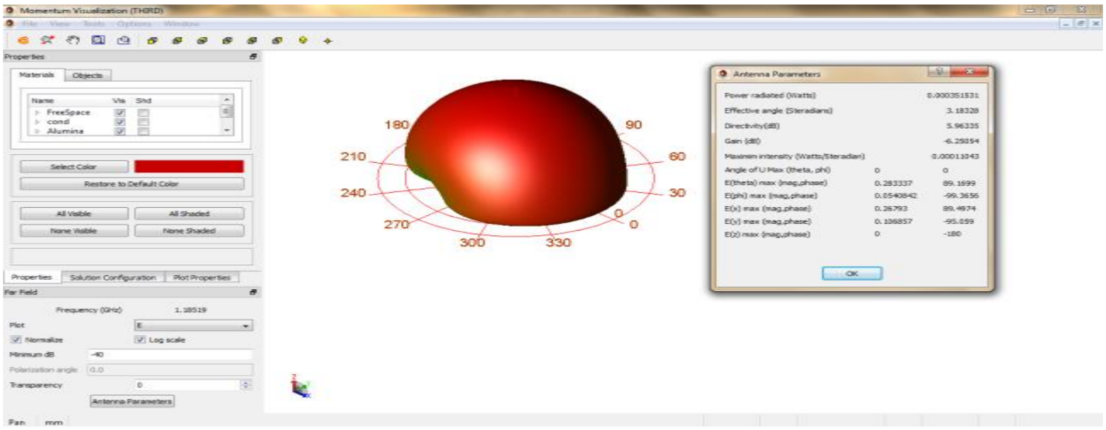

Fig.6 Radiation pattern and parameters of proposed antenna

IV CONCLUSION

A novel compact fractal antenna is proposed. Almost constant group delay is achieved. The good impedance matching characteristic, constant gain, and Omni directional radiation patterns over the entire operating bandwidth of 1.7GHz–2.4GHz (0.7GHz), 2.5 GHz-3GHz(0.5GHz) make this antenna a good candidate for wireless applications and systems. Return loss is -10 to -25 db and VSWR – 1-2 and impedance- 48 to 50 ohm. Microstrip line feeding is provided to proposed antenna which is simple and suitable for this.

V REFERENCES

[1].Neetu, Savina Bansal, R K Bansal, "Design and Analysis of Fractal Antennas based on Koch and Sierpinski Fractal Geometries." IJAREEIE Vol. 2, Issue 6, pp. 2110-2116, June 2013.

[2]. P. J. Soh, G. A. E. Vandenbosch, S. L. Ooi, and M. R. N. Husna, "Wearable dual-band Sierpinski fractal PIFA using conductive fabric," *Electronics Letters,* vol. 47, pp. 365-367, 2011.

[3] Yogesh Kumar Choukiker, S.K. Behera, "Design of Wideband Fractal Antenna with Combination of Fractal Geometries." ICICS, 2011.

[4] A. Ismahayati, P.J. Soh, R. Hadibah, G.A.E Vandenbosch, " Design and Analysis of a Multiband Koch Fractal Monopole Antenna." IEEE International RF and Microwave Confrence. pp. 58-62, 12th -14th December 2011.

[5] P. J. Soh, G. A. E. Vandenbosch, S. L. Ooi, and M. R. N. Husna, "Wearable dual-band Sierpinski fractal PIFA using conductive fabric," *Electronics Letters,* vol. 47, pp. 365-367, 2011.

[6].Amer Basim Shaalan, "Design of Fractal Quadratic Koch Antenna." International Multi- Conference on Systems, Signals and Devices, 2010.

[7] S. N. Shafie, I. Adam, and P. J. Soh, "Design and Simulation of a Modified Minkowski Fractal Antenna for Tri-Band Application," in *Mathematical/Analytical Modelling and Computer Simulation (AMS), 2010 Fourth Asia International Conference on*, 2010, pp. 567-570.

[8].D.D. Krishna, M. Gopikrishna, C.K. Aanandan, P. Mohanan, and K. Vasudevan, " Compact wideband Koac Fractal Printed slot antenna." IET Micro waves, Antennas and Propagation, Vol3, No. 5, pp. 782-789, 2009.

[9] N. A. Saidatul, A. A. H. Azremi, R. B. Ahmad, P. J. Soh, and F. Malek, "Multiband fractal planar inverted F antenna (F-PIFA) for mobile phone application," *Progress in lectromagnetic Research (PIER),* vol. 14, pp. 127-148, 2009.

[10] N. Abdullah, M. A. Arshad, E. Mohd, S. A. Hamzah, "Design of Minskowsi Fractal for Dual Band Application." IEEE, pp. 352-355, May 13-15, 2008.

[11] Raj Kumar, Yogesh B. Thakare and M. Bhattacharya, "Novel Design of Star Shaped Circular Fractal Antenna." IEEE, pp. 239-241, 2008.

[12] B.L. Ooi, "A modified contour integral analysis for Sierpinski fractal carpet antennas with and without electromagnetic band gap ground plane," IEEE Trans. Antennas Propag., Vol.52, pp. 1286-1293, May 2004.

[13] Introduction to antenna and near-field simulation in CST Microwave Studio Software By Jorge R.Costa Jerzy Guterman.

[14] Vinoy, K. J., "Fractal shaped antenna elements for wide and multi-band wireless applications," Thesis, Pennsylvania, Aug. 2002.

[15] Constantine A. Balanis, Antenna Theory Analysis & Design, John Wiley & Sons, 1997.

Cite this article as: A Manikandan, Dr S Uma Maheswari. "A Compact Multiband Fractal Antenna(CMFA) For Wireless Applications." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 128-131. Print.