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Novel Sierpinski Carpet Fractal Antenna for Multiband Wireless Applications

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Abstract: A Sierpinski carpet fractal antenna is proposed for multiband wireless applications. It consists of two-stage Sierpinski carpet fractal geometry as the radiating element. The proposed antenna has compact dimension of 59.06×47.16×1.6 mm^3. The multiband characteristic for a return loss less than 10dB is achieved. The proposed antenna is considered a good candidate for Multiband Wireless applications.

Keywords: Sierpinski carpet fractal antenna, multiband, wireless.

I. INTRODUCTION

To meet the current trends in the field of communication systems, it is essential to design a compact antenna which suits for different wireless applications. Fractal antennas [2-3] are the best suitable radiating structures. Fractal is a new class of geometry that was proposed by “Mandelbrot”. The physical construction of the fractal is not possible only objects with a limited number of iterations can be built. These objects are usually referred to as pre fractals. These fractals increase the electrical length of the antenna without affecting the radiation characteristic of conventional antenna [4]. Fractal antennas play a vital role in developing new types of antennas with notable characteristics such as multiband, miniature and high directive elements [5]. Another prominent benefit that has been derived from using fractal geometries has been to design antenna with multiple resonances [1].

Self-similarity and Space filling properties of fractal antennas are utilized in the design of antennas with notable characteristics like multiband behaviour and miniaturization. Self-similarity means that an object is built of sub units and sub units on multiple levels which try to figure out the structure of entire object. Space filling means it uses long electrical length into small dimensions [6-8]. In this paper, we propose a microstrip patch antenna embedded with a Sierpinski fractal geometry, which exhibits a large size reduction. The size reduction is achieved by increasing the electrical length of the antennas. Two-stage Sierpinski carpet fractal geometry is introduced as a radiating element. The patch is fed by a microstrip feed line, and this antenna has a good matching at 50 ohms at the frequency of multiband systems. The results show that the proposed design provides sufficient antenna performances such as wide impedance bandwidth and omnidirectional radiation pattern

II. ANTENNA GEOMETRY AND SIMULATION RESULTS

The Sierpinski is one of the mathematicians who has proposed the Sierpinski triangle in 1961. The proposed Sierpinski carpet antenna for multiband application is shown

in Fig.1. Classical Sierpinski triangle is having the scale factors as given in (1)

$$\delta = h_n / h_n + 1 \qquad (1$$

Where n represents the iteration and h represents the height. The antenna is printed on a 1.6 mm thick substrate, dielectric $\varepsilon_r = 4.4$, with the size 59.06×47.16 mm^2, the radiating element consists of a two-stage modified Sierpinski fractal geometry. The parameter dimensions are L=59.06 mm, L_1= 47.68 mm, L_2= 10.18 mm, w=47.16 mm, g = 0.6 mm, f = 3mm and R = 28

The recursive procedure of the proposed antenna is shown in Fig. 2 for different iterations. Fig. 3 shows the simulated return loss of the proposed antenna for different iteration levels. The proposed antenna provides reasonable impedance matching at 2.4 GHz for Bluetooth, UHF-RFID, 3.62 GHz for WiMAX, and at 5.24 GHz for Wi-Fi. Omni directional radiation patterns are often required for multiband antennas. For the antenna two principal planes are selected to present the radiation patterns.

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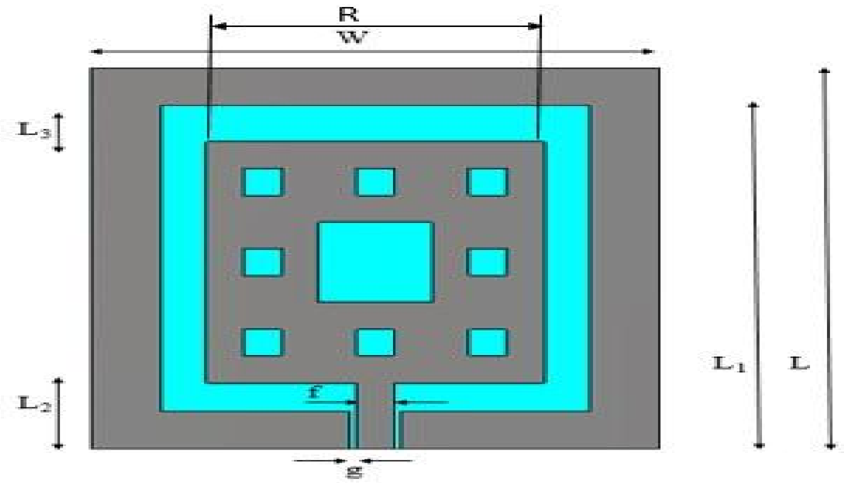


Fig. 1 Geometry of proposed fractal

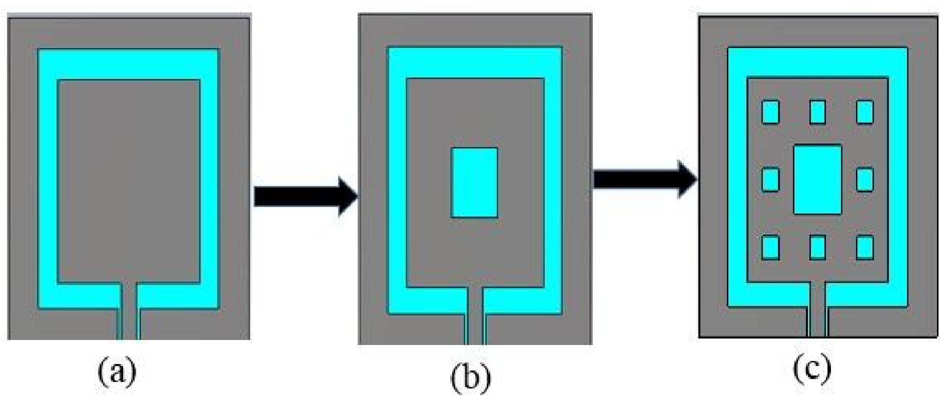


Fig.2. Recursive procedure of proposed antenna (a) Basic geometry, (b)First Iteration (c) Second Iteration

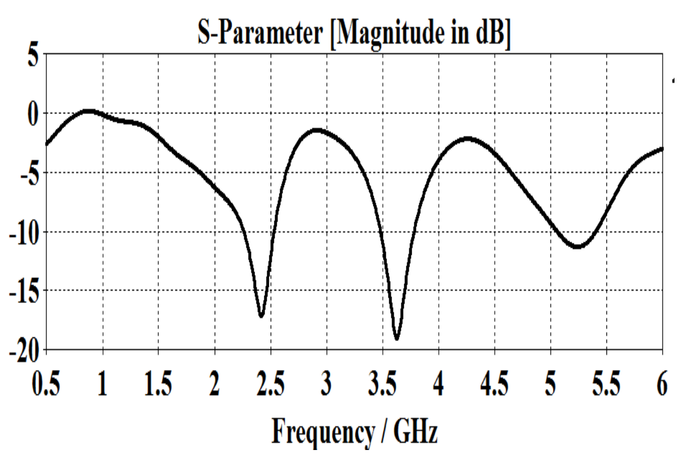


Fig.3. Simulated return loss curve for the proposed geometry

Surface current distribution is an essential parameter to control the radiation pattern of an antenna. By introducing slots we can control the distribution of surface current. Surface current distribution at, 2.4 GHz, 3.62GHz and 5.24 GHz is shown in figure 4

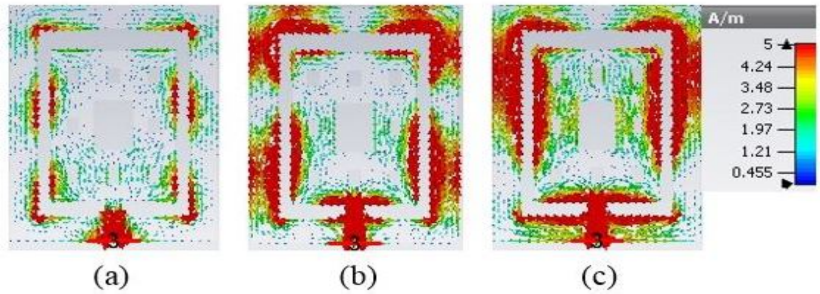


Fig.4.Surface Current distribution at (a) 2.4 GHz, (b) 3.62 GHz, (c) 5.24 GHz.

These are referred to as the x-y plane (E plane) and y-z plane (H plane). Fig.6 shows the plots of the simulated radiation patterns in the E-plane and H-plane at resonant frequencies. As the frequency, the number of lobes associated with them also increases. This type of behavior is seen in multiband antenna. The antenna gain in broadside direction is plotted in Fig.3. When the antenna is used for multiband application, the impedance mismatch must be taken in to account for defining its characteristics especially while calculating antenna gain. It is observed from fig.3. That the proposed antenna gain lies between 1dB to 5dB with maximum gain of 5.2 dBi.

III.CONCLUSION

The proposed model is a good candidate on the behaviour of the Sierpinski carpet antenna, with two iterations levels. It is very useful for reducing the volume of the antenna and for multiband operation. The proposed antenna is having approximates omnidirectional radiation pattern. Therefore the proposed antenna is useful for low profile, low-cost and supporting multiband operation such as GSM, Bluetooth, WLAN applications.

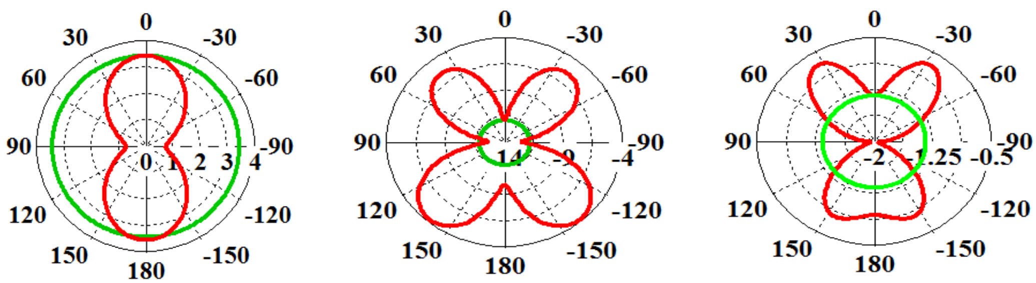


Fig. 5 Simulated radiation patterns of proposed multiband antenna at (a) 2.4 (b) 3.62 GHz (c) 5.24GHz

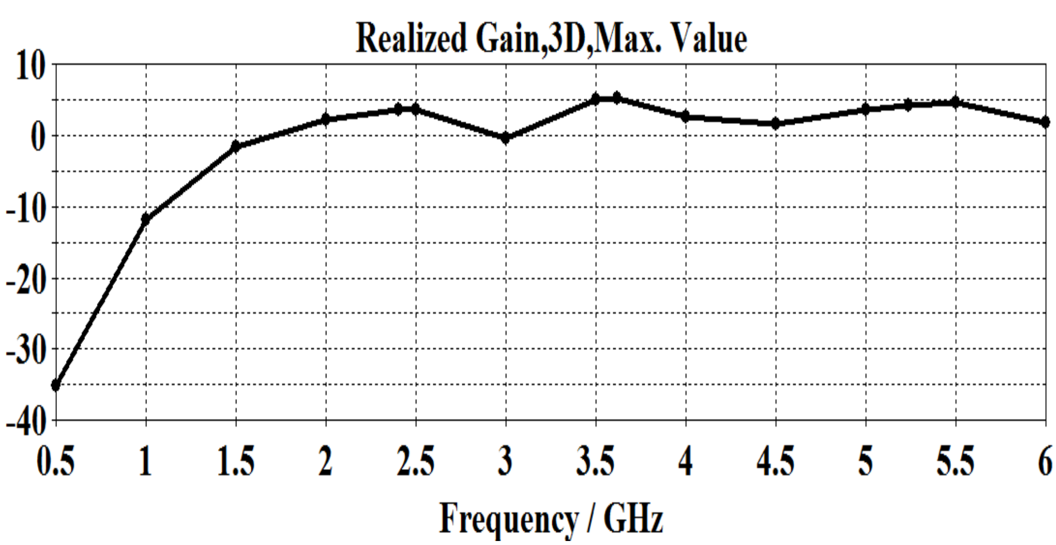
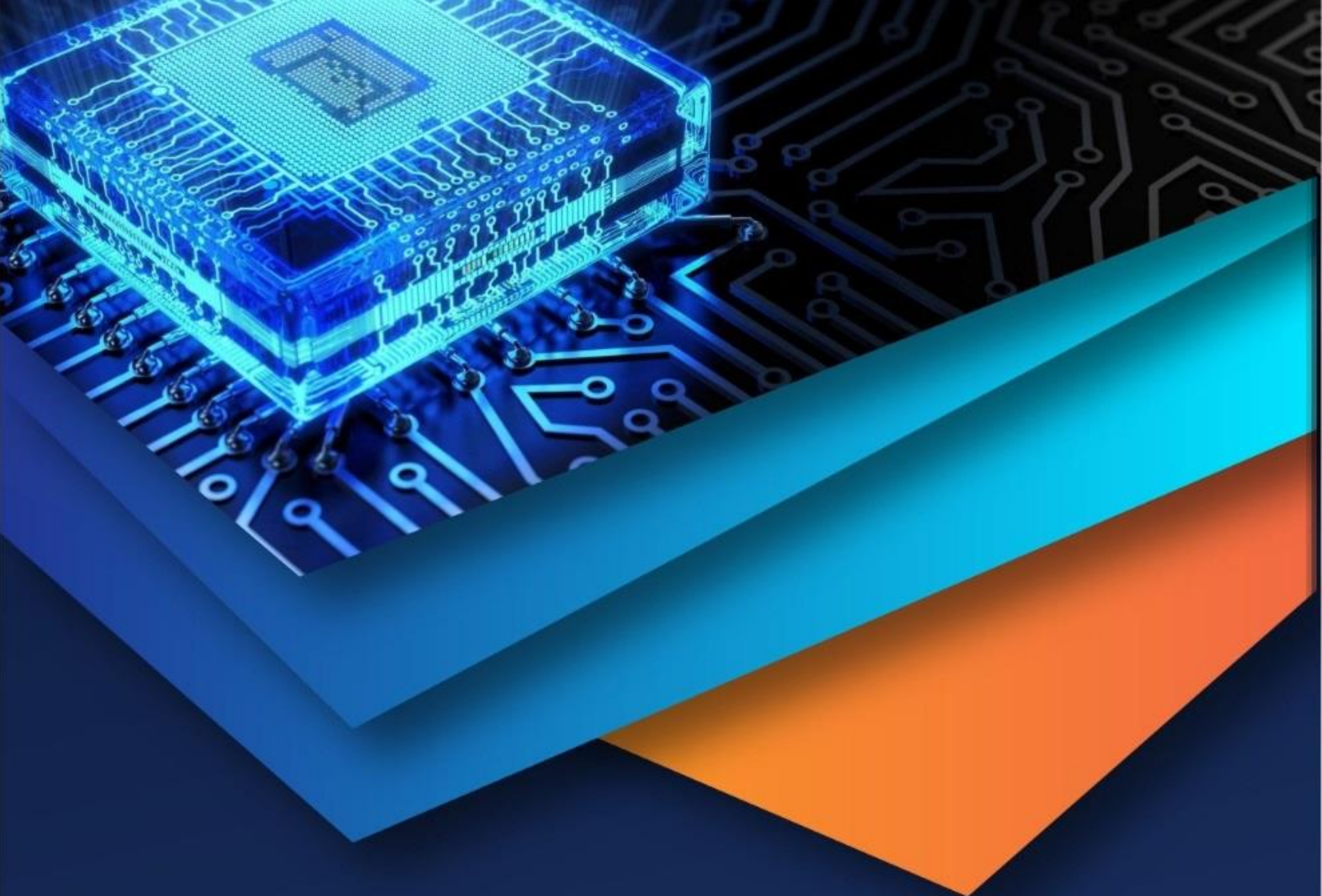


Fig.6.Simulated gain vs Frequency curve of the proposed antenna

REFERENCES

[1] N. Naresh Kumar, S. K. Behera “Compact Modified Sierpinski Fractal Monopole Antenna for Multiband Wireless Applications”, IEEE international conference on communication and signal processing (ICCSP 2014), ChennaiJ..
[2] P.Gianvittorio and Y. Rahmat-Samii , “Fractal antennas: A novel antenna miniaturization technique, and applications,” IEEE Antennas and Propagation,Mag., Vol.44, no 1, pp.20-36, 2002.M.
[3] Y.J.Sung, “Bandwidth Enhancement of a Wide Slot using Fractal Shaped Sierpinski,” IEEE Transactions on Antenna and Wave Propagation, vol.56, no.12, 2009.
[4] http://www.fractenna.com
[5] J.L. Sanchez and L.de.Haro, “Experiences on multibrand fractal antennas,” Antennas and Propagation Society International Symposiu, IEEE Trans., vol.4, pp.58-61, 2001
[6] J. L. Vehel, E. Lutton and C. Tricot, “Fractals in engineering,” Springe- Verlag, London, pp.222-236, 1997.
[7] ChakkritKamtongdee and NantakanWongkasem, “A Novel Design of Compact 2.4 GHz Microstrip Antennas,” IEEE Transactions on Antenna and Wave Propagation, vol.56, no.12, 2009.
[8] Abdul M.F. Ja’afar A.S., “Sierpinsky Carpet Fractal Antenna,” Proceedings of the 2007 Asia-Pacific Conference on applied electromagnetics, Melaka.



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