Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2015/01/jls.htm
2015 Vol.5 (S1), pp. 1877-1883/Roholamin et al.
Research Article

DESIGN DUAL FREQUENCY ANTENNA WITH CIRCULAR POLARIZATION

*** Seyed Roholamin Ahmadi, Omid mahdiyar and Jasem Jamali**
Department of Electrical, Kazeroun Branch, Islamic Azad University, Kazeroun, Iran
**Author for Correspondence*

ABSTRACT

In this paper, a dual frequency micro strip antenna with circular polarization has been designed which makes resonance in the frequencies of 1.8 GHZ (mobile band) and 5.8 GHZ (special to Wimax Systems). Both of these frequencies are used in the phone Santeral systems. This antenna uses fractal structure and it is for the first time which has been presented. Its structure is in the form of hexagons composing bigger hexagon with each other, and finally, all replications constitute a big hexagon. The antenna dimensions are too small, showing a good gain for these applications. The performance of this antenna is more improved than similar antennas. To demonstrate the performance of proposed design, it has been used HFSS software. Finally, it is compared with a similar two-frequency antenna in IEEE Journals, and the advantage of proposed antenna than it will be expressed.

***Keywords**: Circular Polarization, Microstrip Antenna, Fractal, Size Reduction*

INTRODUCTION

Considering that a great advancement has been achieved in transmission systems and need to small devices and systems, we are following antennas with small size and also extensive bandwidth and/or multi-frequency.

There are several methods for size reduction and making multi-frequency of antennas. But these methods are so complex or they are not economic.

Due to structure and properties, the fractals can reduce the size of antennas in a good manner and also increase the bandwidth extremely. Using fractal structures is cheaply and well, and it has little complexity to design antenna.

We know that Rumsey, 1957 could demonstrate an antenna is independent from frequency, provided that it will be designed only based on angle. But, Nanthan Cohen, 1999 with the aid of Maxwell equations that this is only one of needed conditions, and in other words, it is a kind of subset for a more overall principle.

He proved that the requisite for an antenna to be independent from frequency is that the antenna itself be "homologous".

And off course, the structure dimension should not be integer, which its mathematics and features were offered several years before Nathan Cohen (1982) by Mandelbert. Using of fractals in antennas cause size reduction of antennas and also the increase of being multi-frequency. Hitherto, there have been introduced many fractal forms and they have been used in many kinds of antennas.

Also, it has been used fractals to design antenna with circular polarization in many times. Our purpose is that, by presenting a new structure would reduce the size of micro strip antenna and design it to use in frequencies of 1.8GHZ and 5.8 GHZ.

Description of Fractal Structure and Antenna

The proposed fractal structure has been shown in figure 1. This structure consisted of hexagons regularly arranged beside each other, and as it is observed in figure 2, we assumed that every pert of structure forms bigger hexagons and the structure entirely constitutes a big hexagon.

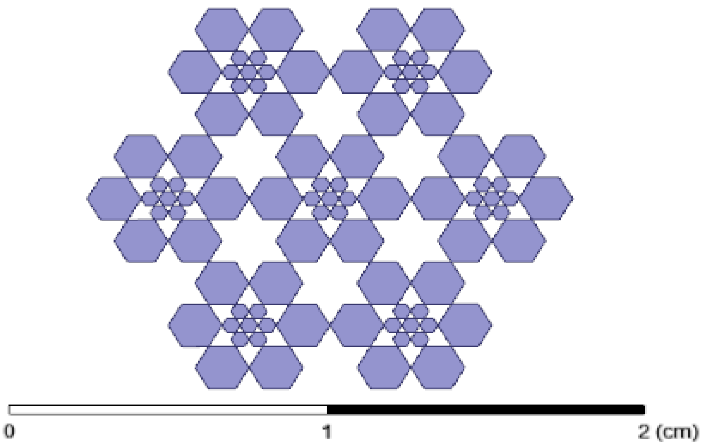

Figure 1: The proposed fractal structure

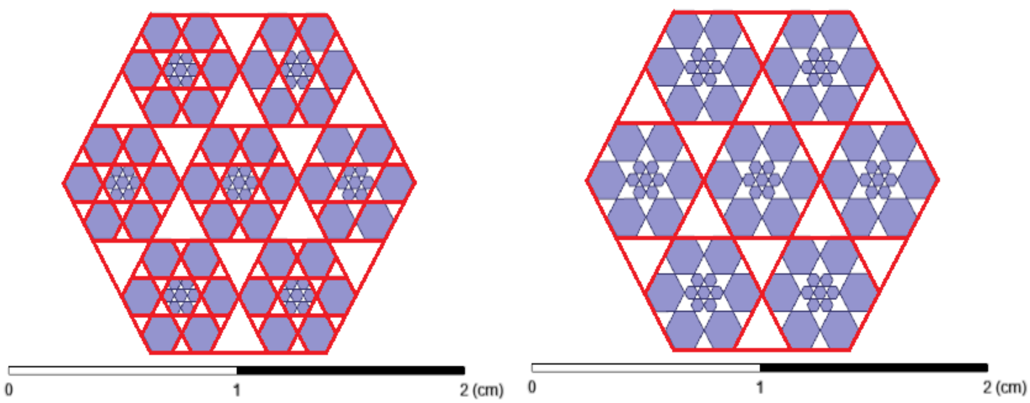

Figure 2: The mode of creating fractal structure

The dimensions of this structure have been expressed in in figure 3, indicating its small dimensions. The small hexagons are one-third of bigger hexagons meaning that it has the fractal of scale coefficient. The dimension of this structure is equal to 1.77 which has given in (1), where K is scale coefficient and N is the number of replications.

$$D = \log_k N = \log_3 7 = 1.77 \quad (1)$$

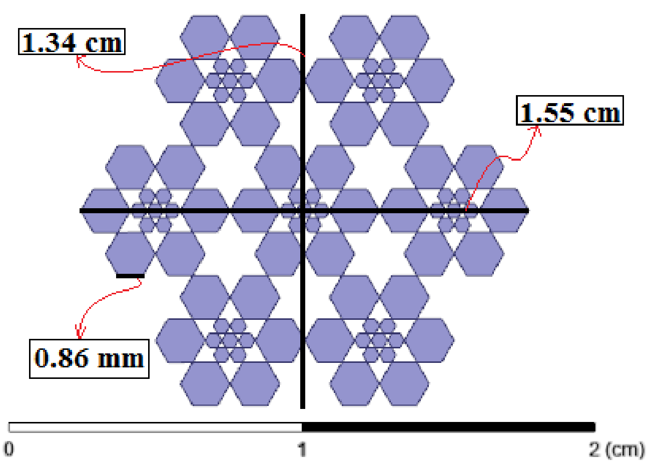

Figure 3: The fractal structure dimensions

This structure is used as microstrip antenna patch.

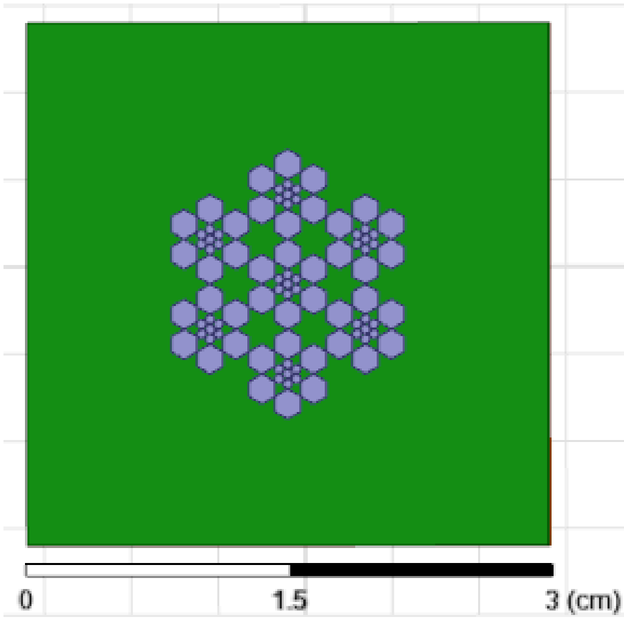

Figure 4: The designed antenna

The feeding style is proximity coupling, and it has been used two dielectrics with the thickness of 1.6mm. The upper substrate is from the kind of Rogers RT/duroid 5880 ™ (constant dielectric=2.2 and loss tangent=0.0009) and the inferior dielectric is from the kind of Rogers RT/duroid4003 ™ (dielectric constant=3.55 and loss tangent=0.0027). The length of feeding line is 0.163 and its width is 4.2cm.

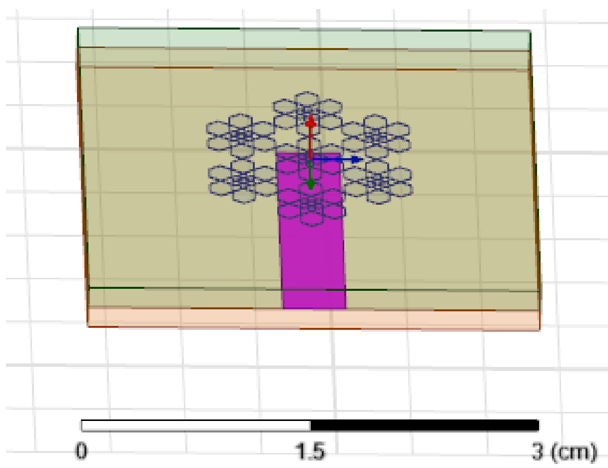

Figure 5: The feeding line and substrate placement way

In diagram 6, this is cleared that the antenna resonates in the 1.8 and 5.8 GHZ frequencies, which in the 1.8 GHZ frequency is about -19db and in 5.8 GHZ has almost -27db loss.
In Fig.7 the two-and three-dimensional radiation patterns as well as the gain in $\theta=0$ are observable. The patterns are very symmetrical and have nice gain.
In Fig. 8 the axial ratio has been drawn under graph, showing throughout working bandwidth they are below 3dB; so, the antenna in its resonance frequencies has circular polarization. This antenna, due to its patch structure has circular polarization, making this possibility to send and receive more information.

Research Article

The bandwidth for frequency of 1.8Ghz is continued from 1.772GHZ to 1.847GHZ and for frequency of 5.8 GHZ, it is continued from 5.630 GHZ to 5.953 GHZ.

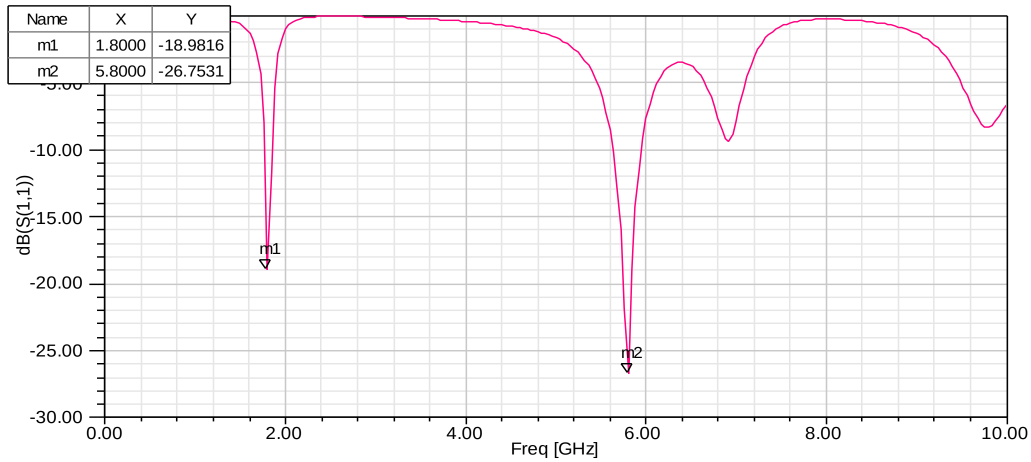

Figure 6: Diagram S11

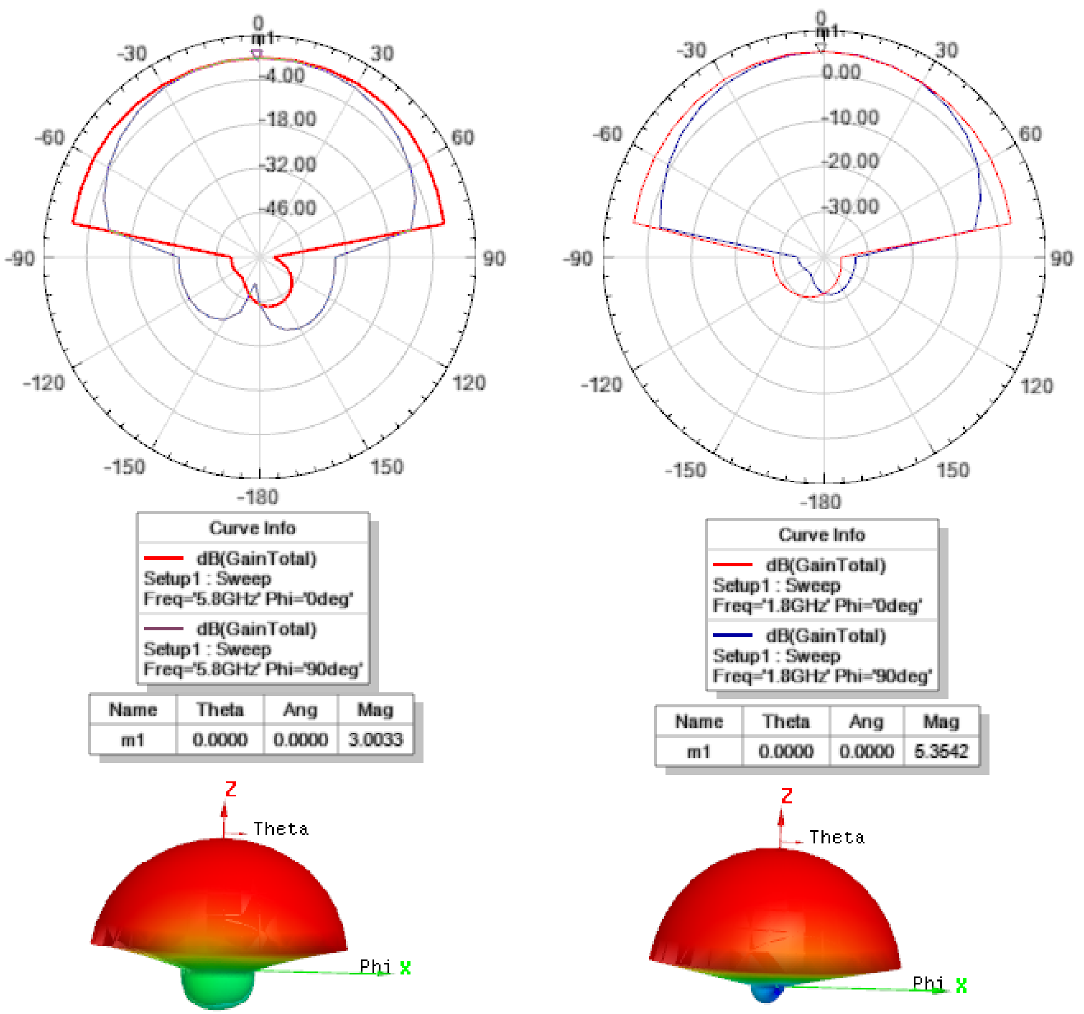

Figure 7: Two- and three frequency pattern. a) Frequency of 1.8 GHZ. b) Frequency of 5.8 GHZ.

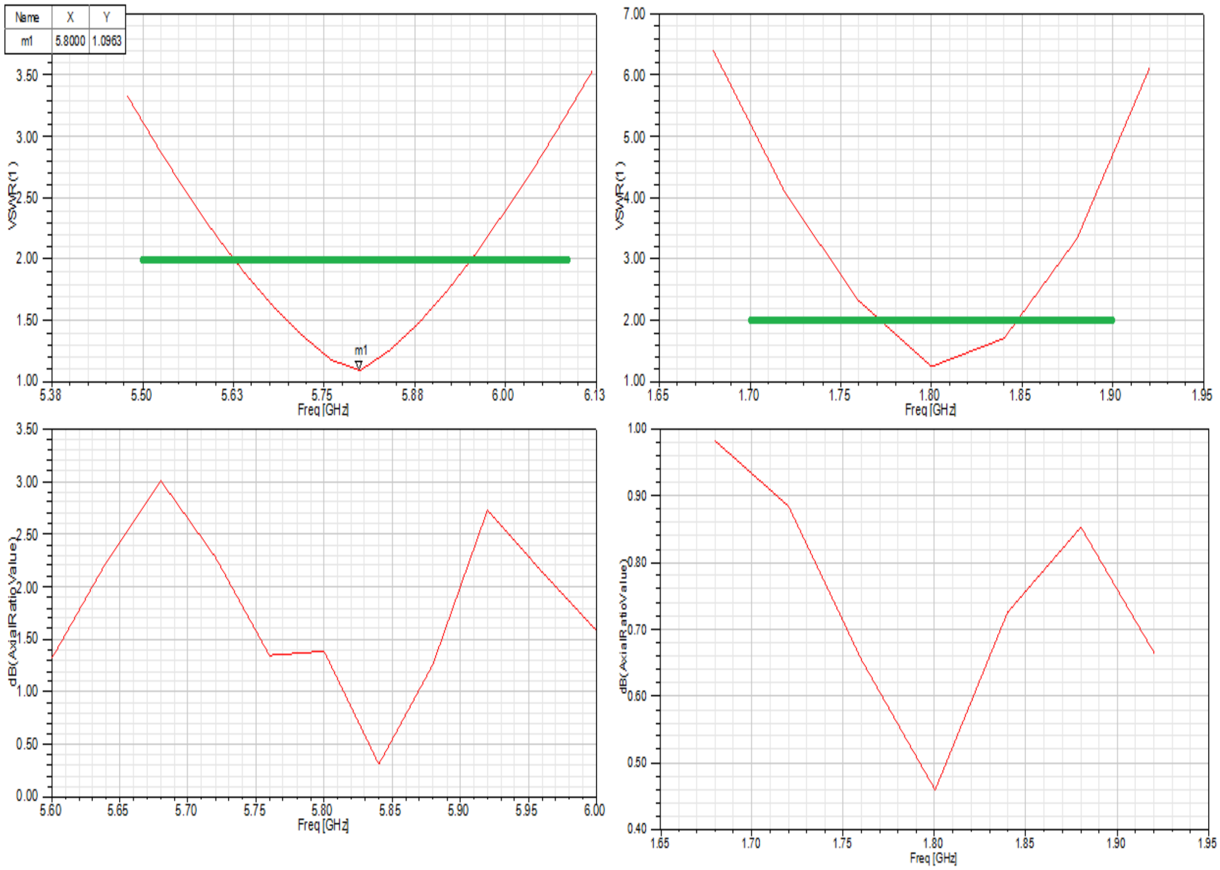

Figure 8: Axial ratio diagram

In fig.8 the VSWR graph is observed and antenna bandwidth is perfectly clear on ih. The green line indicates that the graph is under antenna bandwidth.
In this section, the proposed antenna is compared with the antenna design by Abdulkarim (2013). In the article by Abdulkarim (2013), he provides a microstrip antenna with fractal structure resonating in two frequencies and it is suitable for WiMAX applications. The picture of this antenna is shown in Fig. 9.

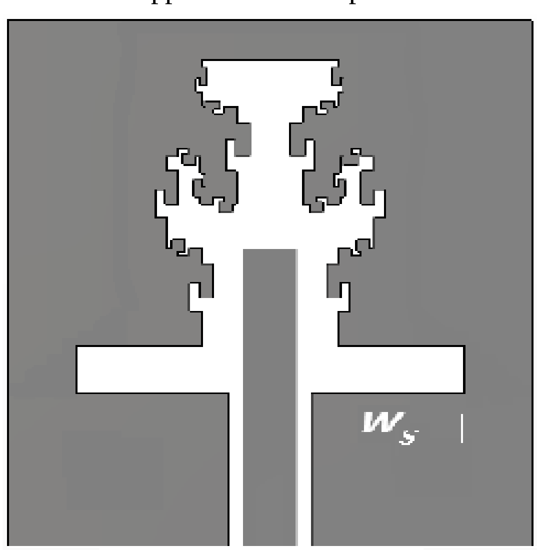

Figure 9: Structure of Abdulkarim's (2013) antenna

The first frequency resonates in 2.5 GHZ and the second frequency in 5.2GHZ, respectively.
The dimensions of this antenna are 4.5×3.6 which they are bigger than our antenna. More importantly, our proposed antenna resonates in smaller frequency, showing our antenna has done size reduction much better.
The gain of this antenna is 2.58db and 3.7db in frequencies of 2.5 GHZ and 5.2GHZ, respectively. The antenna which we have provided in present study in frequency of 1.8 GHZ is 535 db and in frequency of 5.8GHZ is about 3db, indicating our proposed antenna is better. Another point is that our proposed antenna has circular polarization but other antenna lacks this capability. The only advantage of Abdulkarim (2013) antenna is that it has bigger bandwidth; considering that our antenna is for specific applications, its bandwidth is enough. The comparison of these two antennas has been provided in the following table:

Table 1: The comparison between proposed with Abdulkarim (2013) antennas

antennas	Resonance frequencies	General dimension of antenna	gain	Polarization
Proposed antenna	f1=1.8 GHz	L=3cm	G1=5.35dB	circular
	f2=5.8 GHz	W=3cm	G2=3dB	
Abdulkarim (2013) antenna	f1=2.5 GHz	L=4.5cm	G1=2.58dB	linear
	f2=5.2 GHz	W=3.6cm	G2=3.7dB	

CONCLUSION

By using a new structure, it was designed an antenna which applies in mobile frequency, WiMAX systems as well as phone centrals. The suitable gain and pattern shows the good quality of proposed antenna. From the main advantages of this antenna is its circular polarization which this feature is maintained over both frequencies range. The first and second bandwidths are about 75 MHz and 320 MHz, respectively. It can be seen that the proposed antenna has small dimensions and is highly functional.

REFERENCES

Abdulkarim SF, Salim AJ, Ali JK, Hammoodi AI, Yassen MT and Hassan MR (2013). A Compact Peano-Type Fractal Based Printed Slot Antenna for Dual-band Wireless Applications. *IEEE International RF and Microwave Conference* 329–332.

Abdulkarim SF, Salim AJ, Ali JK, Hammoodi AI, Yassenb MT and Hassan MR (2013). A compact Peano-type fractal based printed slot antenna for dual-band wireless applications." In *RF and Microwave Conference (RFM), 2013 IEEE International* (IEEE) 329-332.

Choukiker YK, Behera SK and Sharma SK (2013). Hybrid fractal planar monopole antenna with MIMO implementation covering multiband wireless communications for handheld devices, presented at *IEEE International Symposium on Antennas and Propagation*, Florida, USA (7–12).

Dong YD, Toyao H and Itoh T(2011). Compact circularly-polarized patch antenna loaded with metamaterial structures. *IEEE Transactions on Antennas and Propagation* **59** 4329–4333.

Hansen RC (1981). Limitations in Antennas. *Proceedings of the IEEE* **73**(4).

Holheld Robert G and Cohen Nathan (1999). Self-similarity and the geometric requirements for frequency independence in Antennae. *Fractals* **7**(1) 79–84.

Jung YK and Lee B (2012). Dual-band circularly polarized microstrip RFID reader antenna using metamaterial branch-line coupler. *IEEE Transactions on Antennas and Propagation* **60** 786–791.
Mandelbrot BB (1982). *The Fractal Geometry of Nature*, (W. H. Freeman and Company) New York.
Nasimuddin ZN Chen and Qing X (2012). A compact circularly polarized cross-shaped slotted microstrip antenna. *IEEE Transactions on Antennas and Propagation* **60(**3) 1584–1588.
Oraizi H and Hedayati S (2011). Miniaturized UWB monopole microstrip antenna design by the combination of giuseppe peano and sierpinski carpet fractals. *Antennas and Wireless Propagation Letters* **10(**1) 67–70.
Park BC and Lee JH (2011). Omnidirectional circularly polarized antenna utilizing zeroth-order resonance of epsilon negative transmission line. *IEEE Transactions on Antennas and Propagation* **59** 2717–2720.
Park BC and Lee JH (2012). Dual-band omnidirectional circularly polarized antenna using zeroth- and first-order modes. *IEEE Antennas and Wireless Propagation Letters* **11** 407–410.
Puente-Baliarda C, Romeu J, Pous R and Cardama A (1998). On the behaviorof the Sierpinski multiband fractal antenna. *IEEE Transactions on Antennas and Propagation* **46(**4) 517 524.
Rumsey VH (1957). *Frequency Independent Antennas*, (University of Illinois), Urbana, Illinois.