ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 5, Issue 6, June 2016

Bandwidth Enhancement through Fractal Nature of Hexagonal Microstrip Patch Antenna

Tejal Nilakhe, Vijaykumar V. Patil

***Abstract* :A novel modified microstrip-fed ultrawideband (UWB) comparison of Basic Hexagonal monopole antenna and proposed Hexagonal With Side Element is presented. A simple Basic Hexagonal patch antenna is UWB bandwidth can be covered while antenna dimensions are only 25x 25 mm. parametric analysis is performed. Proposed Antenna works in a wide band of 4GHz to 11 GHz with VSWR< 2. Such type of antenna can be used for modern wireless communication.**

***Index Terms*—Monopole antenna, ultrawideband (UWB), CPW –feed.**

I. INTRODUCTION

In the development of wireless technology, many systems can operate in more than one frequency band. Satellite navigation systems, wireless LANs, ultra wideband (UWB) systems. During the recent years, different types of monopole antennas using modified ground plane, radiation patch, or feeding structure. Small polygon elements are added to the corners of Hexagonal patch an antenna radiator to increase the bandwidth of the Hexagonal patch antenna. Recently, the fractal-shaped slots are incorporated into the main slot to improve the antenna bandwidth [3-4].

In the past decades, fast development of wireless communication has urged the need for dual-band, multiband, and ultrawideband (UWB) antennas. The antenna is a different type of feeding structures (coplanar waveguide type, coaxial, and microstrip) and shapes have been found as suitable candidates to fulfill UWB system requirements [5-6]. On 14 February 2002 the FCC Federal Communication Commission adopted the formal rule changes officially permitting ultra-wideband operations. The ruling defines access to a 7,500-MHz-wide swath of unlicensed spectrum between 3.1 and 10.6 GHz that is made available for commercial communications development in the United States. With its inherent high speed data communication feature, UWB seems to be promising and prominent technology for current and future needs. Ultra-wide-band (UWB) antennas in time and in frequency domain are specified [8-10].

Manuscript received May, 2016

Tejal Nilakhe,Dept.of ENTC,KIT's College of Engineering,Kolhapur, 416234,Maharashtra,India.

Mr. Vijaykumar V. Patil, Dept.of Electronics, KIT's College of Engineering, Kolhapur, 416234,Maharashtra,India

II. STRUCTURE OF AN ANTENNA

The configuration of the proposed antenna labeled with the design parameters is shown in Fig. 1. The antenna is printed on FR4 substrate with permittivity of 4.4 heights 1.53mm and patch thickness of 0.1mm.

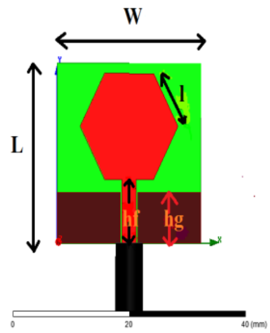


Fig.1: Structure of the proposed Basic Hexagonal CPW-fedantenna.L=25mm,l=8.5mm,W=25mm hf=8.84mm, hg=7mm

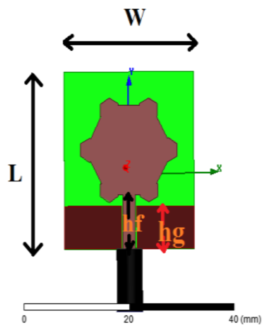


Fig.2: Structure of the proposed Hexagonal With Side Element. L= 25mm, W=25mm, hf=8.86mm, hg=7mm

The proposed antenna is simulated by electromagnetic analysis software Ansoft HFSS ver. 14. In Fig1.on rectangular FR4 substrate of size 25 mm x 25mm. Height of the substrate is 1.53 mm with relative permittivity 4.3 and radius of the radiating patch is optimized to 9.2 mm with feed-line width of 3.95mm and feed-line length is 8.84mm ground length is7mm and Hexagonal patch of side edges is 8.5mm. In Fig.2. The monopole comprises a coplanar waveguide (CPW) feed structure and a hexagonal radiator to which six small hexagonal elements are added. The antenna is printed on FR4 substrate with permittivity of 4.4 height 1.53mm and patch thickness of 0.1mm. The proposed antenna of small elements at its corners is simulated by electromagnetic analysis software Ansoft HFSS ver. 14. on rectangular FR4 substrate of size 29 mm x 25mm. Height of the substrate is 1.53 mm with relative permittivity 4.3 and radius of the radiating patch is optimized to 9.2 mm with feed-line width of 3.95mm and feed-line length is 8.86mm ground length is7mm.

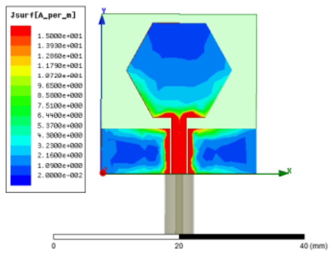


Fig3: Current distribution at frequency 1.654 GHz basic Hexagonal patch antenna

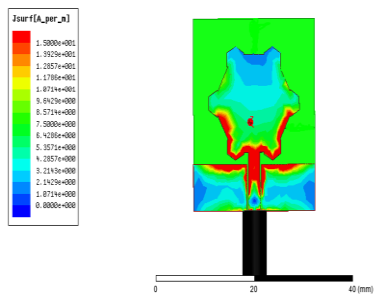


Fig.4: Current distribution at frequency 4.8693 GHz

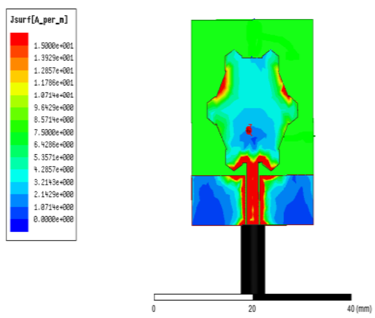


Fig.5: Current distribution at frequency6.8040 GHz

It is observed in Fig.3 that the electric current distribution at 1.654GHz is concentrated on the lower edge of the radiator. This means the antenna lower edge affects impedance characteristic at low frequencies. Other current distribution is a Structure of the proposed CPW-fed antenna. Fig. 4 presents the surface electric current density on the antenna radiator and ground planes at frequencies 4.8693 GHz in this Fig that the electric current distribution at 4.8693 GHz is concentrated on the lower edge of the radiator and upper edge of half part. This means the antenna lower edge and upper edge of half part affects impedance characteristic at low frequencies. Fig. 5 shows the electric current distribution at 6.8040GHz.Current distribution is mainly concentrated on the four lower fractal elements and side edges. It is seen that the current distribution is more complicated than the first resonance frequency current distribution. The currents excited by the four lower fractal elements have strongly affected.

III. SIMULATED RESULTS

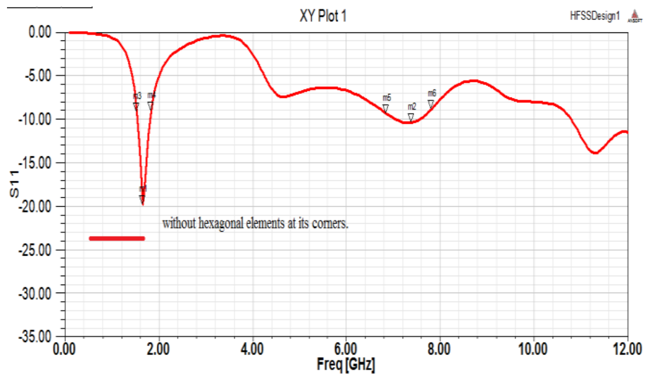


Fig.6: Simulation results for the proposed antenna, S11 without hexagonal elements at its corners.

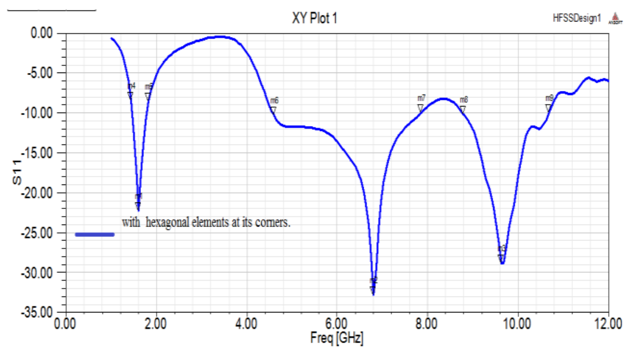


Fig.7: Simulation results for the proposed antenna, S11 with hexagonal elements at its corners.

In Fig 6 Simulation results for the proposed antenna, S11 without hexagonal elements at its corners in this fig a two resonant frequency is shifted from 1.6548GHz to7.3955GHz. In Fig7 Simulation results for the proposed antenna, S11 with hexagonal elements at its corners in this fig a three resonant frequency is shifted from 1.6080GHz to6.8040GHz to9.6231GHz. In Fig 8 Simulation results for the proposed antenna, comparison of S11 with and without hexagonal elements at its corners. The proposed antenna is optimized first for each design parameters two achieve the required ultra wide bandwidth. In this, ground width, ground length, feed width, gap between feed and ground optimized.

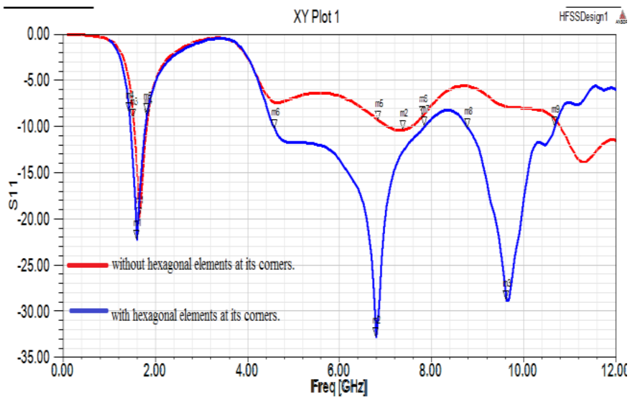
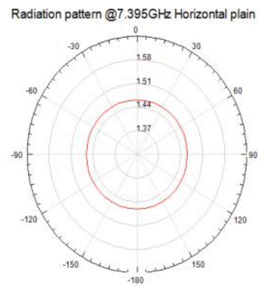
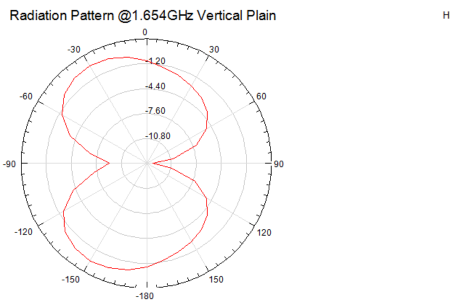


Fig.8: Simulation results for the proposed antenna, comparison of S11 with and without hexagonal elements at its corners.

IV. RADIATION PATTERNS

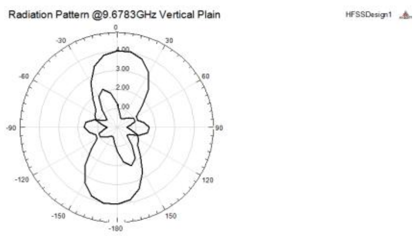


(a)

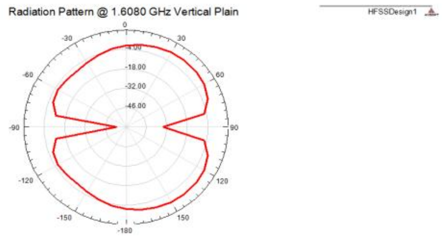


(b)

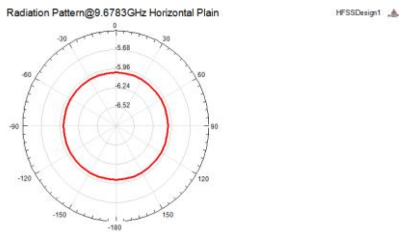
Fig.9: Radiation pattern the proposed Basic Hexagonal CPW-fed antenna @ 1.654GHz in (a) Vertical Plain and (b) 7.395GHz in Horizontal Plain



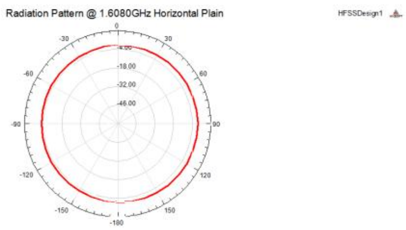
(a)



(b)

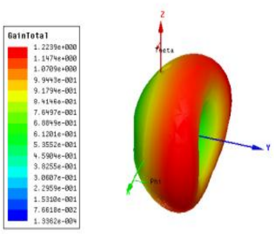


(c)

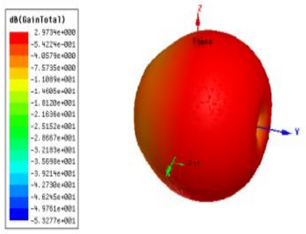


(d)

Fig.10: Radiation pattern of proposed Hexagonal With Side Element antenna at (a)1.6080GHz in Vertical Plain and(b) Horizontal Plain, (c) 9.6783GHz in Vertical Plain (d)Horizontal Plain



(a)



(b)

Fig.11: 3DPolar Plot a) Proposed Basic Hexagonal CPW-fed antenna b) Proposed Hexagonal With Side Element antenna.

The radiation patterns of proposed CPW-fed antenna are simulated at selective frequencies. I.e. 1.654GHz, 7.395GHz, 1.6080GHz, 9.6783GHz.In Fig.7 radiation pattern is Omni-directional at 7.395GHz and second radiation pattern is a bidirectional at 1.654GHz. In Figure8 the radiation patterns in Horizontal plane and Vertical Plane at 1.6080GHz and 9.6783GHz. Figure 9 the first polar plot is half part of apple shape at1.6724GHzand second polar plot is a Omni-directional radiation pattern as like apple shape at 1.6080GHz.

Comparison Table Of Proposed Basic Hexagonal Cpw-Fed Antenna And Proposed Hexagonal With Side Element

Table 1:Resonant frequency

Antenna Type	No. of bands	Resonant Frequency
A)Basic Hexagonal Antenna	3	1)1.6080GHz 2)6.8040GHz 3)9.6231GHz
B)Hexagonal With Side Element	2	1)1.6548GHz 2)7.3955GHz

Table 2: Band and Bandwidths

Antenna Type	Bandwidth	Total Bandwidth
A)Basic Hexagonal Antenna	1)386.9MHz 2)3261.3MHz 3)1879.4MHz	7020.1MHz
B)Hexagonal With Side Element	1)299MHz 2)956MHz	1255MHz

V. CONCLUSIONS

In this technique Basic Hexagonal Antenna and Hexagonal with Side Element is described and comparison of these two antennas shows upper hand of later. The proposed antenna presents Omni-directional patterns across the whole operating band in the H-plane and bidirectional in E-plane. The antennas have a compact size of 25 mm x 25 mm and second antenna is a 25mm x 25mm. The results have been simulated using An soft HFSS simulation software. This type of UWB antenna can be utilized for various applications where compact size, low profile and multiple band rejections are required. Accordingly, these antennas are expected to find applications in various UWB systems.

REFERENCES

[1] Wei-Chung Weng, Chia-Liang Hung,''An H-Fractal Antenna for Multiband Applications'' *IEEE Antennas and wireless propagation letters* VOL. 13, 2014

[2] Hojjatollah Fallahi and Zahra Atlasbaf, "Study of a Class of UWB CPW-Fed Monopole Antenna with Fractal Element", *IEEE Antennas and wireless propagation letters* VOL 12,2013.

[3]Abolfazl Azari, Alyani Ismail, ''A New Super Wideband Fractal Monopole-Dielectric Resonator *Antenna''IEEE Anteantennas And Wireless Propagation Letters* VOL. 12, 2013.

[4]Reza Zaker, Abdolali Abdipour*,''* Bandwidth Enhancement and Miniaturization of Fork-Shaped Monopole Antenna'', *IEEE Antennas And Wireless Propagation Letters* VOL. 10, 2011

[5]Changiz Ghobadi, Javad Nourinia*,''* Novel Modified Pythagorean Tree Fractal Monopole Antennas for UWB Applications'' *IEEE Antennas And Wireless Propagation Letters* VOL. 10, 2011.

[6]Homayoon Oraizi, Shahram Hedayati'' Miniaturized UWB Monopole Microstrip Antenna Design by the Combination of Giusepe Peano and Sierpinski Carpet *Fractals'' IEEE Antennas and Wireless Propagation Letters* VOL. 10, 2011.

[7] Mahdi Naghshvarian Jahromi, Abolfazl Falahati, '' Bandwidth and Impedance-Matching Enhancement of Fractal Monopole Antennas Using Compact Grounded Coplanar Waveguide'' *IEEE Transctionson antenna and propogation*, VOL. 59, 2011.

[8] Ke Zhang, Yuanxin Li, Member*,''* Band- Notched UWB Printed Monopole Antenna With a Novel Segmented Circular Patch'' *IEEE Antennas And Wireless Propagation Letters* VOL. 9, 2010.

[9] Hossein Eskandari, Mahmood Rafaei Booket, Manouchehr Kamyab'' Investigations on a Class of Wideband Printed Slot Antenna'' *IEEE Antennas And Wireless Propagation Letter*VOL. 9, 2010.

[10] M Naser-Moghadasi, R.A.Sadeghzadeh T.Sedghi, "UWB CPW-Fed Fractal Patch Antenna With Band-Notched Function Employing Folded T-Shaped Element", *IEEE Antennas and Wireless Propagation Letters* VOL 12, 2009.