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Small Size Multiband Octagonal Antenna for Wireless Applications

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Abstract: In this study, the design of a novel small size, low profile and multiband octagonal antenna is presented. The design analysis and characterization of the antenna is performed using the Method of Moments (MoM) technique. The new designed antenna has an operating frequency of 1.99 , 2.985 and 3.677 GHz with acceptable bandwidth which has a useful application for new wireless applications. The radiation characteristics, VSWR, reflection coefficient and input impedance of the proposed antenna are described and simulated using 4NEC2 package and NEC viewer.

Key words: Small antenna, fractal antenna, multiband antenna

INTRODUCTION

With the advance of wireless communication systems and increasing importance of other wireless applications, wideband and low profile antennas are in great demand for both commercial and military applications. Multiband and wideband antennas are desirable in personal communication systems, small satellite communication terminals and other wireless applications. And some of these applications also require that an antenna be embedded into the airframe structure (Tiehong and Zheng, 2003). Dual band behavior for the Octagonal patch antenna had been demonstrated in Paul *et al*. (2007) and Paul *et al*. (2005). In this study, the wire octagonal antenna are described for obtain at the multiband and small size property.

The Method of Moments (MoM) is used to study the radiation characteristics of octagonal antenna to performa detailed study of VSWR, reflection coefficient, input impedance and radiation pattern characteristics of the proposed antenna in a free space.

PROPOSED ANTENNA GEOMETRY

The first step in the construction of the proposed octagonal antenna is to construct the connecter points of the antenna, as shown in Fig. 1a. By connecting all the selected points, a octagonal antenna is produced as shown in Fig. 1b and the final geometry of octagonal antenna are shown in Fig. 1c.

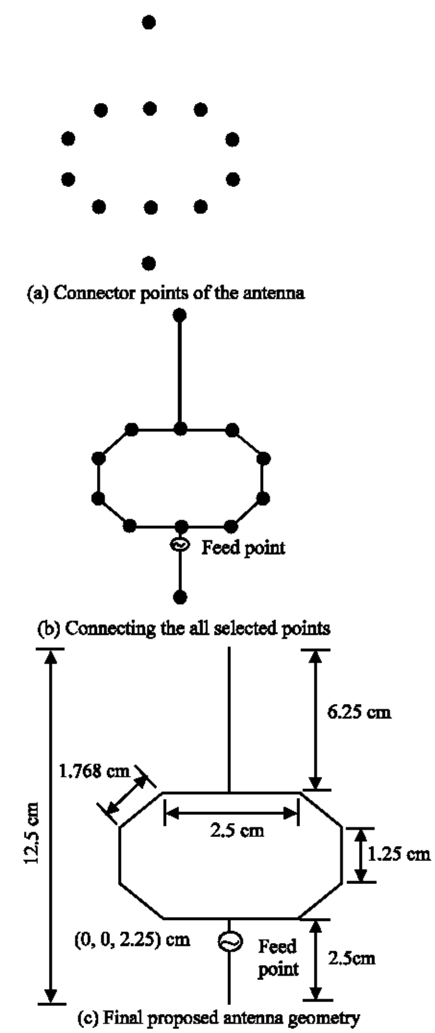

Fig. 1: Antenna geometry

ANTENNA DESIGN AND RESULTS

The octagonal antenna shown in Fig. 1c which positioned in the XZ-plane has been simulated using numerical modeling commercial software 4NEC2, which is moment-method based software. The Method of Moment (MoM) is used to calculate the current distribution along the proposed octagonal antenna and hence the radiation characteristics of the antenna (Balanis, 1997). 4NEC2 program is used in all simulations. This is very effective in analyzing antennas that can be modeled with wire segments, such as the one under consideration here. To suit the requirements, the antenna is modeled without any dielectric present, although some of the practical implementations do require dielectric support (Vinoy *et al*., 2001).

The modeling process is simply done by dividing all straight wires into short segments where the current in one segment is considered constant along the length of the short segment (Khalid, 2007). In NEC, to modeling a wire structures, the segments should follows the paths of conductor as closely as possible (Burke and Poggio, 1981).

The feed source point of this antenna is placed at point (0, 0, 2.25) and this source set at 1 V. Figure 2 shows the visualization of this geometry by using NEC-viewer software.

The design frequency chosen to be 300 MHz for which the design wavelength λ is 1m (100 cm) then the length of the corresponding λ/8 dipole antenna length will be of 12.5 cm, as shown in Fig. 1c.

The real and imaginary parts of the input impedance of this proposed antenna are shown in Fig. 3 over a frequency range from 0 GHz-4 GHz. The input impedances characteristics of this octagonal antenna geometry show the multiple resonance characteristics of the antenna.

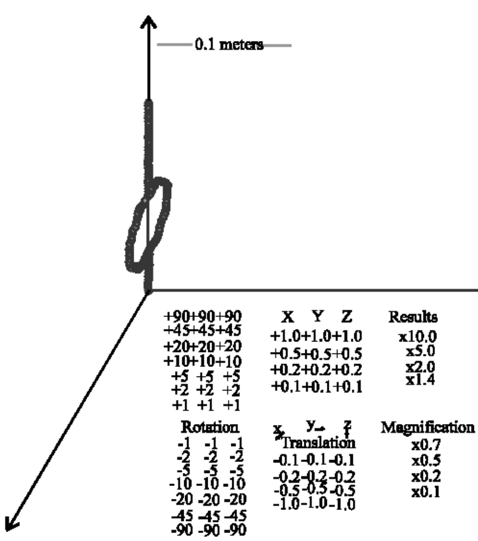

Fig. 2: Visualization of the antenna geometry

VSWR of the antenna is shown in Fig. 4. It is found that the antenna has triple-band behavior at the resonance frequencies 1.99, 2.985 and 3.677 GHz with acceptable bandwidth and at these frequencies VSWR<2.

Table 1 shows these resonant frequencies, VSWR, reflection coefficient and the corresponding input impedances of each one and Table 2 shows the spacing between each adjacent resonance frequencies.

The radiation patterns at these resonant frequencies in the planes YZ-plane, XZ-plane and XY-plane have been

Table 1: Resonant Frequency and Input Impedance for proposed antenna

Frequency (GHz)	Input impedance (Ω) R	X	VSWR	Reflection (dB) coefficient
1.99	74.77	-j0.14	1.495	-14
2.985	43.26	-j0.21	1.156	-22.8
3.677	84.73	-j0.15	1.695	-11.8

Table 2: Difference between two adjacent frequencies

Frequency spacing (f_n-f_{n-1})	Results (Ghz)
f_2-f_1	0.995
f_3-f_2	0.692

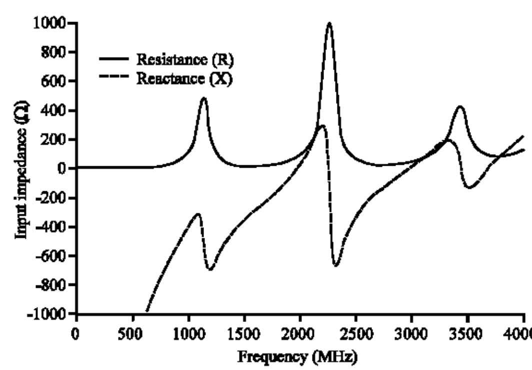

Fig. 3: Antenna input impedance

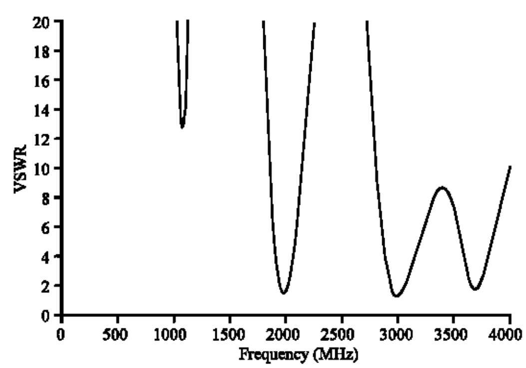

Fig. 4: Simulated 50Ω-VSWR vs. frequency

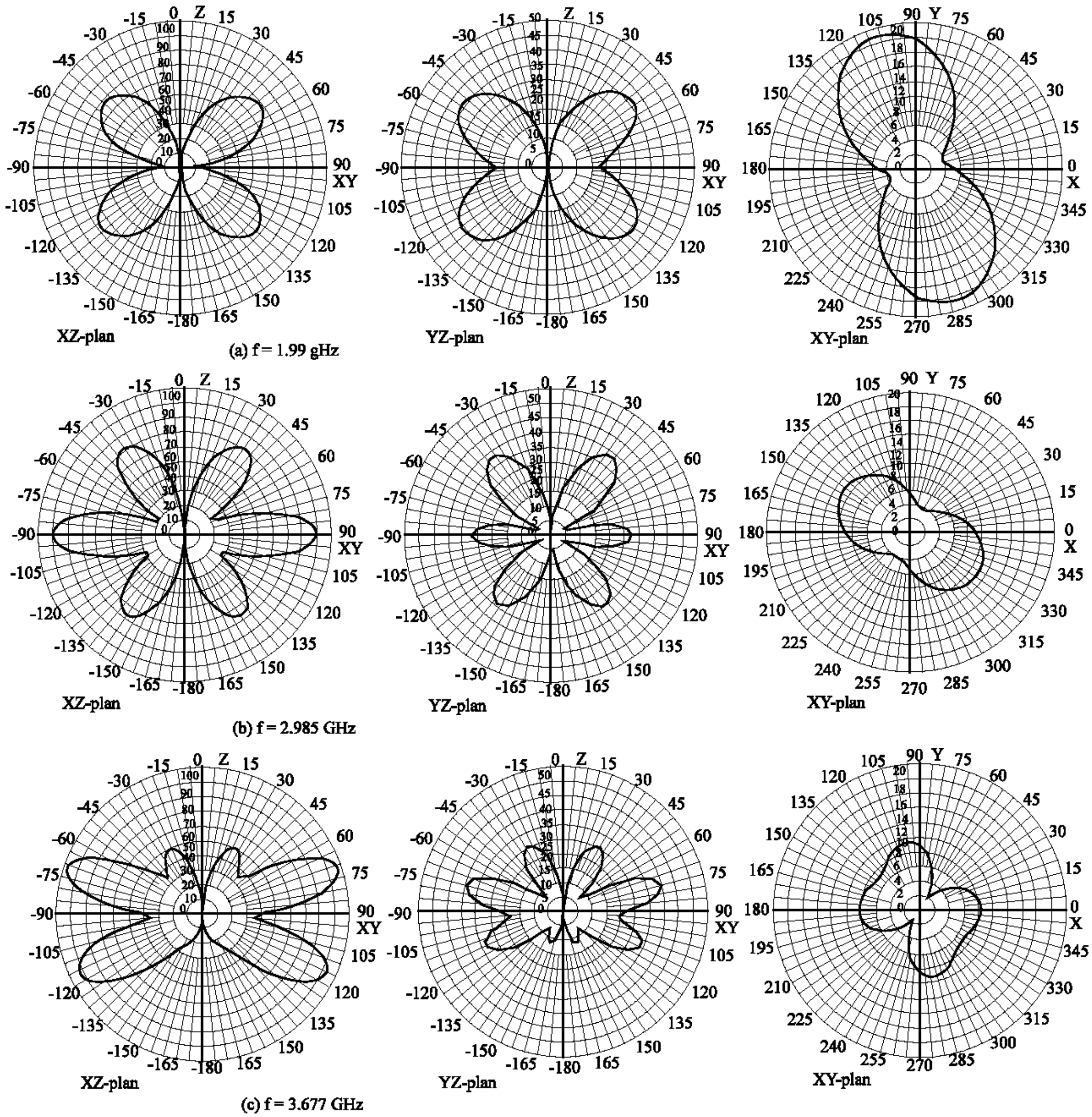

Fig. 5: Radiation pattern of the proposed antenna

demonstrated as in Fig. 5, where the antenna is placed in the XZ-plane.

CONCLUSION

The octagonal antenna has been investigated and its performance has been evaluated. The simulations results show that this antenna can be efficiently operates as a multiband antenna and have compact size property. The proposed antenna has three bands of frequencies are 1.99, 2.985 and 3.677 GHz and at these frequencies this antenna have VSWR<2. According to these frequencies, this antenna can operate as a multiband antenna in the UHF and SHF applications. Once optimized for radiation characteristics, this antenna can find many applications in UHF and SHF communication systems.

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