

DESIGN OF A SIERPINSKI FRACTAL SHAPED BOW-TIE ANTENNA FOR WLAN APPLICATIONS

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Abstract- A bow-tie shaped fractal antenna fed by microstrip line is proposed, that has the potential of operating in a several of the currently broad band commercial existing systems for WLAN applications. The impedance bandwidth increases by using the fractal configuration. A 50-ohm Microstrip line is used to excite the patch. The antenna has been simulated using HFSS simulation software, and the performance is studied for the second iteration of the patch. The measured results demonstrate that the structure exhibits a wide impedance bandwidth of 59.8% ranging from 2.5 GHz to 4.3 GHz, which covers WLAN applications.

Index Terms- Fractal antenna, Sierpinski triangle, Microstrip Line, Multiband, Return loss, VSWR, HFSS

1 INTRODUCTION

Recently, the antenna engineering field has been greatly evolved by a major innovative discovery of microstrip patch antenna. The vibrant research in this field led to many fascinating and challenging experience for the antenna designers. Microstrip Antenna has a wide range of applications in wireless communications due to their low profile, small size, low weight and low cost. In today's world the use of microstrip fractal geometry antenna has become a recent topic of interest. The self-similarity concept of fractal antenna can achieve multiple frequency bands because of different parts of the antenna are similar to each other at different scales and also results in the size reduction. The fractal geometry is a space-filling curve, since with a larger iteration depth, it tries to fill the area. The term iteration depth refers to the number of iterations that should be used in the design a higher order structure. The applications of fractal shapes are on array techniques, scattering problems reduced size, multiband and wideband antennas.

In this paper a gain enhancement for multiband fractal antenna is presented. Sierpinski Fractal Techniques are here introduced into the conventional triangular patch antenna with microstrip feed to obtain better return loss and gain. Sierpinski gasket in dimension, bandwidth, gain and efficiency, makes it a good choice for applications of WLAN, WiFi, WiMAX, and other communication systems.

2 ANTENNA GEOMETRY

Figure 1, shows the geometry of the bow-tie antenna and its dimensions are demonstrated. The antenna is designed at an operating frequency of 2.4 GHz. The designed antenna has a bow-tie patch on a FR4 substrate. For efficiency FR4 epoxy material is used for the substrate.

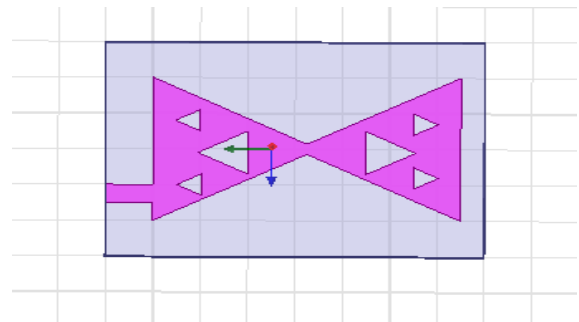


Figure 1. The HFSS generated bow-tie fractal antenna.

The bow-tie patch is the combination of the two equilateral triangular patches with the Sierpinski fractal design to modify the typical bow-tie antenna. The design is iterated two times. The first iteration is done by scaling down the main triangle by 50% followed by the second iteration in the similar manner.

For this antenna the FR4 substrate of height 1.6mm with the dielectric constant 4.4 and the dimensions being 80x60 mm are used. The other essential parameters are shown in the Table 1. The feed location is chosen such that proper impedance matching takes place.

Table 1

Description	Optimal Value(mm)
Arm Length	17.3
Feed Location	35x15x0
Length of feed	10
Width of feed	5

3 EXPERIMENTAL RESULTS

Design procedure and simulation of the proposed antenna is carried out by Ansoft HFSS software. Simulated results of VSWR, gain and return loss were obtained to validate the antenna for wireless applications. Figure 2, shows the simulated and measured return loss. The measured impedance bandwidth of the antenna is approximately 59.8%. Since the antenna has second iteration structure considerable bandwidth is observed at number of resonant frequencies. Triple resonance is achieved at 2.4GHz (-15.75db), 3.1GHz (-18.7db) and at 4.3GHz (-19.57db).



Figure 2. Return Loss

The VSWR is basically a measure of the impedance mismatch between the transmitter and the antenna. As studied in literature VSWR should be less than 2 for practical implementation of antenna. Figure 3 show the VSWR of the proposed antenna. The gain of the antenna is 5.1db (Figure 4).

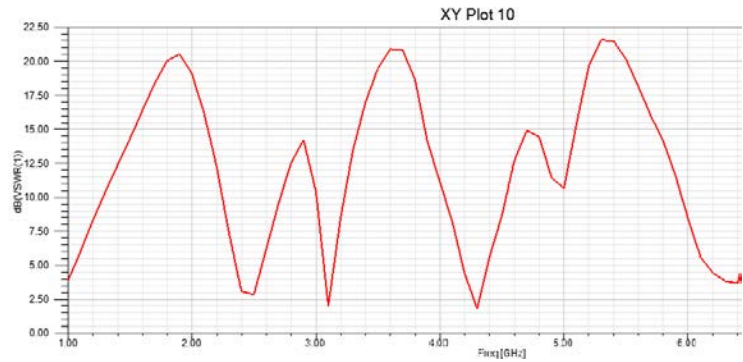


Figure 3. VSWR

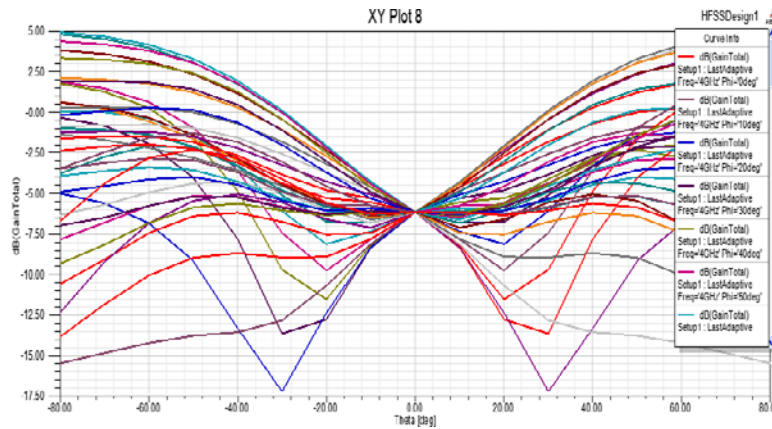


Figure 4. Gain of the bow-tie antenna

The characteristic of the proposed antenna is summarized in the Table 2. It shows that antenna behaves with a good multiband characteristics after second iteration.

Table 2

Frequency(GHz)	Return loss(dB)	VSWR	Bandwidth(MHz)
2.5	-15.75	2.02	300
3.1	-18.70	1.91	270
4.3	-19.57	1.82	500

4 CONCLUSION

All the simulations were done using HFSS software. In fractal bow-tie antenna, bandwidth increases as compared to the conventional bow triangular patch antenna. As long

as the design matching is correct, the desired return loss can be obtained. The antenna has multiple resonant frequencies at 2.4GHz (-15.75db), 3.1GHz (-18.7db) and at 4.3GHz (-19.57db) by making it fractal. The proposed antenna exhibits $VSWR \leq 2$, and a gain of 5.1db with the antenna covering the WLAN applications. Fractal geometry offers numerous variations in dimension and design, hence gives wide scope for various commercial applications and making it an interesting replacement in the multiband antenna.

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