A Dipole Antenna using Sierpinski Carpet Fractal Technique for RF Altimeter System.

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Abstract – **A dipole antenna using Sierpinski carpet fractal with step impedance operates at 4.3GHz. Based on Sierpinski Carpet fractal and step impedance theory, it can suppress harmonics frequency. The proposed antenna is constructed on brass, include reflector and dipole. Its size of this antenna is 97.75 * 67.56 mm including reflector. This small size antenna is more compact to install in the aircraft instruments. The proposed antenna provides bandwidth of 325.3 MHz which covered an operational range of RF altimeter, gain of 11.3 dB and unidirectional pattern. The experimental result of this antenna is agreed very well with simulation expectation using CST package.**

***Index Terms* — Sierpinski Carpet Fractal, Step Impedance, Dipole, RF Altimeter**

1. Introduction

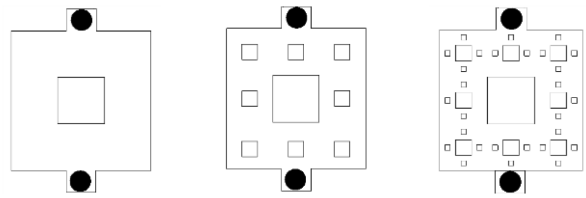
RF altimeter is an aircraft instrument that used to measure the altitude of an object above reference level by using RF transmitting between ground station and the aircraft, operating at 4.3 GHz. Antenna in modern altimeter system required high gain for measuring between transmitted and reflected signal.

Using of Sierpinski fractal structure to design the antenna is one of many structure selected because of more efficiency such as size reducing and higher gain providing. The Sierpinski structure can control the desired frequency by its slots which cause a current flow around the edges of antenna. The resonance would occur at the frequency which corresponds to the shape of fractal antenna [1-5].

So, this paper proposed the modified Sierpinski slot antenna with stepped impedance structure to control harmonics, good impedance matching and also added the reflector to providing an aircraft altimeter system which needs the unidirectional pattern. .

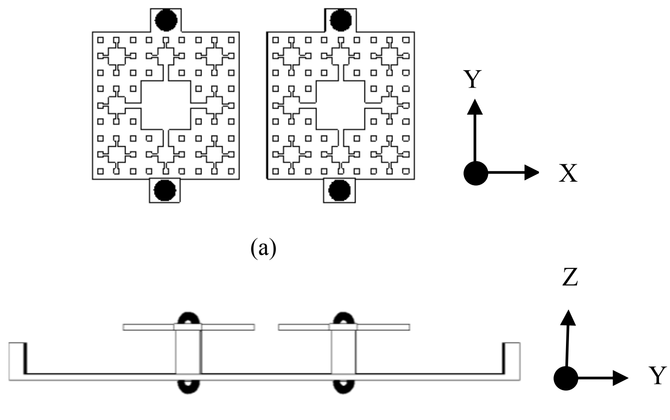
2. Antenna Design

The proposed antenna has done by Sierpinski Carpet fractal as shown in Fig. 1. Fig. 1 (a) shown 1^{st} initiation on one side of a dipole. (b.) shown 2^{nd} initiation and (c.) shown 3^{rd} initiation. The structures and details of the proposed antenna are shown in Fig. 2. Illustrate the slotted fractal dipole antenna with step impedance which increase antenna gain and reduce first harmonic to desire frequency.



(a) (b) (c)

Fig. 1. One patch of the Sierpinski antenna
(a) 1^{st} initiation (b) 2^{nd} initiation (c) 3^{rd} initiation



(a) (b)

Fig. 2. Modified Sierpinski antenna mounted with reflector
(a) Front view (b) Top view.

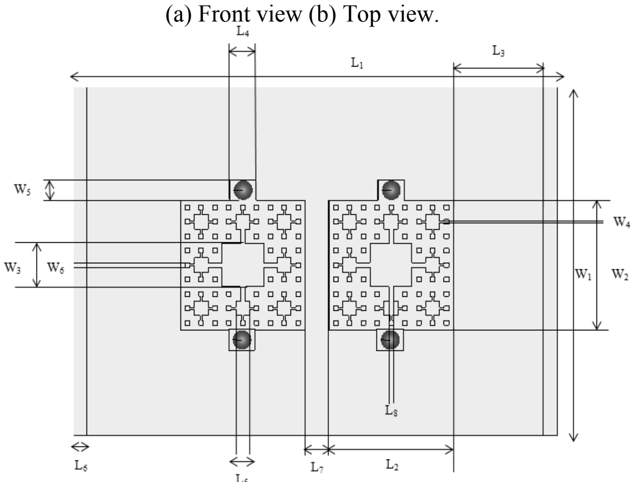


Fig. 3. Modified Sierpinski antenna dimensions.

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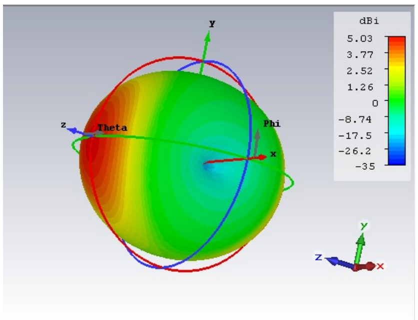
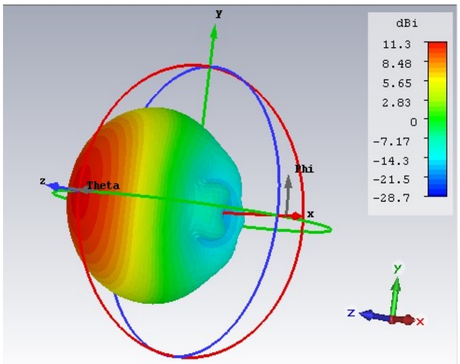
In Fig. 3 show the dimensions of the proposed antenna as; L_1 = 97.75 mm, L_2 = 25.087 mm, L_3 = 28.75 mm, L_4 = 5.324 mm, L_5 = 2.414 mm, L_6 = 1 mm, L_7 = 7 mm, L_8 = 0.99 mm, W_1 = 67.56 mm, W_2 = 25.087 mm, W_3 = 8.362 mm, W_4 = 0.372 mm, W_5 = 3.951 mm, W_6 = 0.929 mm , The antenna is attached to a rectangular shape reflector by 4 screws mount with polyamides. Gap between antenna and reflector is 7 mm. This step can provide the antenna with higher gain and unidirectional pattern. Size of this antenna is 97.75 mm length, 67.56 mm wide and 9.56 mm height including reflector.



(a)



(b)

Fig. 4. 3D Pattern at 4.3 GHz (a.) without a reflector (b) with reflector

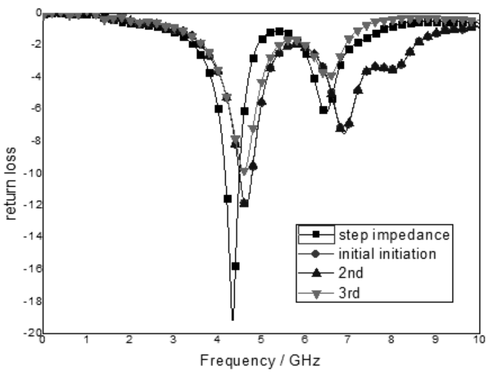


Fig. 5 Return loss comparison of each initiation.

3. Result

The proposed antenna is given far field pattern as shown in Fig. 4 (a.) provide the far field plot at 4.3 GHz without a reflector. As you can see that it is bidirectional and low gain of 5.03 dB which is too low to operate in radio altimeter system. In Fig 4 (b.) Antenna gain is 11.3 dB which it is efficient for operating as altimeter.

In Fig. 5 illustrated S_{11} parameters of 1st initiation slotted, 2nd initiation, 3rd initiation and step impedance slotted. At 1st initiation first harmonics is not a desire frequency and provides low attenuation as shown. At 2nd initiation, the attenuation increased approximately to -11 dB but operate in not desire frequency. At 3rd and 4th initiation the first harmonic is shifted to desire frequency at 4.3 GHz, also the second frequency is shifted. At last result slotted the step impedance to increase attenuation and antenna gain which provide -19.192 dB of attenuation, bandwidth of 325.23 MHz according to CST Studios simulation packages.

4. Conclusion

The Dual band fractal slotted dipole antenna for altimeter is operated at 4.3 GHz frequency. It provides the antenna gain of 11.3 dB in unidirectional radiation and practical far field pattern. The proposed antenna is made of brass which has 97.75 mm length, 67.56 mm wide and 9.56 mm height including reflector, which is very small size of antenna. This size can be more comfortable for install on the aircraft.

5. Acknowledgment

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6. References

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