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Design of Sierpinski Gasket Fractal Antenna using Proximity Coupled Feed Mechanism for Multiband Applications- Research Paper

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Abstract: Throughout this paper, the look of Sierpinski gasket form antenna exploitation proximity coupled feed for multiband applications is given. Positive properties of designed antenna structure like come loss and directionality reanalyzed and simulated exploitation 3D magnetic attraction machine cst MWS fourteen. The planned antenna is meant on FR-4 lossy substrate with thickness one.6 mm and theory of relativity theory permittivity four. The projected antenna has resulted once the booming combination of first, second and third iterations. Simulated results show that from second iteration forwards, the antenna starts showing multiband behavior at wholly completely different frequency bands. The broadband and multiple frequency choices of fractal antenna are given and mentioned.

Keywords: Sierpinski Gasket, Proximity coupled Feed, CST MWS V14.0, Return Loss, Directivity, Fractal antenna and Multiband.

I. INTRODUCTION

Though the character of wireless communication and its relevance is incredibly deep and complicated throughout the past few decades, even then the requirement for wireless communication is on the far side the most peak. At this time, wireless technology demand antenna with expanded information measure and lesser dimensions, an antenna that envelopes multiple applications manipulating a single device and thus efforts ar being created to concentrate a lot of on the shape antenna structures. The word shape comes from Latin Fractious‟ which implies broken lines. Geometry is created victimization iterative method that ends up in self-similarity and self-affinity structure. The Sierpinski seal was introduced by Waclaw Sierpinski in 1915 and it's a vital a part of shape set. Shape antenna is employed for multiband applications as a result of it are tiny in size, low value and simple to fabricate. Shape idea has been applied to several branches of science and engineering together with shape electrodynamics for radiation and propagation There are numerous variety of shape antenna geometries mentioned in literature accessible:

- The Von koch curve
- The Sierpinski (Gasket and Carpet)
- Minkowski fractal island

Most of the fractal geometry antennas have 2 common properties that are multi-banding and space-filling. Proximity Coupled feeding technique has been employed in this paper as a result of it provides most bandwidth and additionally reduces the spurious radiation and mutual coupling. Because of the outstanding properties that fractal possesses, it's becoming an attractive manner in designing antenna. The detriment of fractal are gain loss, numerical restrication and computational elaboration tangled. Fractal structure is employed to represent structure in nature like cloud, mountain, and flower and star.

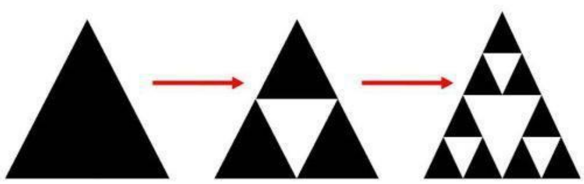

Figure 1: Sierpinski Triangle for Zero, First and Second Iteration [6]

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Through this paper, look of Sierpinski gasket fractal antenna opening with a legitimate polygon with operational frequency one gigacycle per second to four gigacycle per second. Figure one shows the zero/initial, 1st and second iteration of planned Sierpinski gasket antenna. Further, the main points of proposed antenna design square measure illustrated and mentioned during this paper.

II. ANTENNA DESIGN AND SPECIFICATIONS

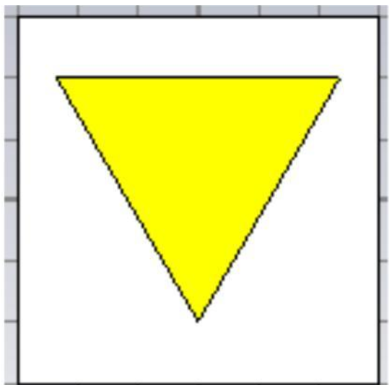
The procedure of how to make Sierpinski Gasket fractal antenna is shown in Figure 2(a), Figure 2(b) and Figure 2(c). The numerical design values of various antenna parameters are presented in Table I.

TABLE I: SUBSTANITIAL DIMENSIONS OF PLANNED ANTENNA

S.NO	Antenna Parameter	Design Value
1	Dielectrical Material	FR4_LOSSY
2	Substrate Height	1.7 mm
3	Flare Angle	60
4	Side Length	46.90 mm
5	Height	40.60 mm
6	Scale Factor	2.2
7	Dielectric Constant	4.6

The final designed Sierpinski seal antenna shown in Figure 2(c) is meant on FR-4 lossy Substrate (dielectric constant four.4) with substrate thickness of one.6 mm. There are 3 vital parameters for the designing of designed antenna: height of substrate, dielectric material of substrate and resonant frequency. first a simple triangle is taken as shown in Figure 2(a). For 1st iteration, minimize central inverted triangle from main triangle and style is frequent for further iteration [9]. This antenna is fed through proximity coupled feeding technique that provides most bandwidth with the advantage of minimizing spurious radiations.

Figure 2(b): First iteration of designed antenna



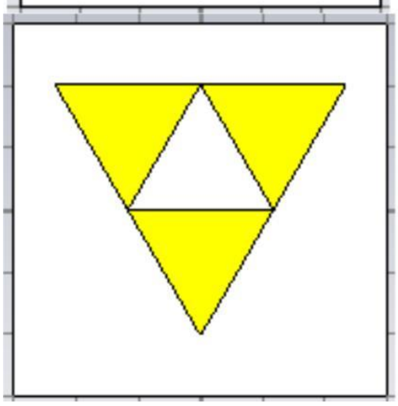


Figure 2(a): Zero (Initial) iteration of designed antenna

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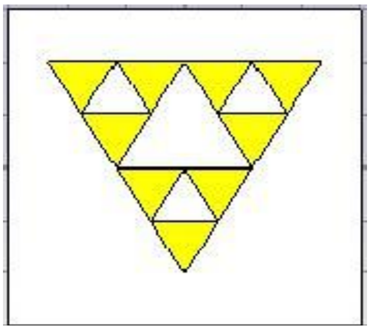

Figure 2(c): Second iteration of designed antenna

III. RESULTS AND DISCUSSION

The dimensions of designed antenna are optimized by hit and trial method using parameter sweep option available in transient solver window of CST MICROWAVE STUDIO Version 14.0. S11 parameter reveals restoration Figure 4(a): Rebound loss of first iteration of devise antenna

Loss and it is construe as maximal reflection of power from the given antenna. The devise antenna formation is simulated origin from the initial iteration/generator to second iteration. The corresponding return loss curves are also shown side by side for all the three iterations thus illustrating the value of frequency of resonance and return loss. As the number of iterations hike, numbers of resonating frequencies also hike.
The second iteration of the proposed antenna shows multiband behavior. Directivity is defined as maximum value of directive gain [1]. The simulated return loss curves of proposed antenna for initial, first and second iterations are shown in Figures 3(a), 4(a) and 5(a) respectively. 3D radiation patterns that represent directive gain are also analyzed for all the three iterations using the field monitors option in CST MWS V14.0 and are presented in Figures 3(b), 4(b), 4(c), 5(b), 5(c) and 5(d) correspondingly. The quick analysis of return loss and directivity for all the three resonating frequencies is tabulated in Table II.

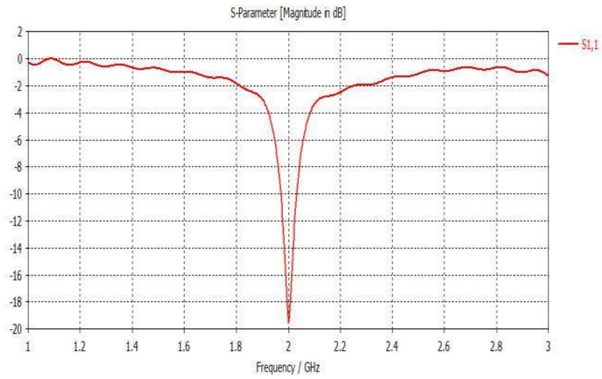

Figure 3(a): Return loss of initial iteration of designed antenna

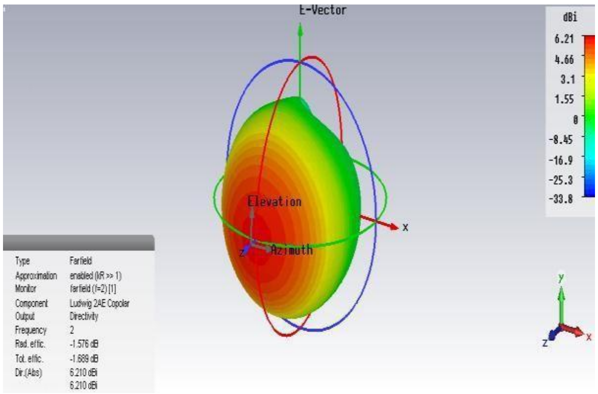

Figure 3(b): Directivity of initial iteration of designed antenna at 2 GHz

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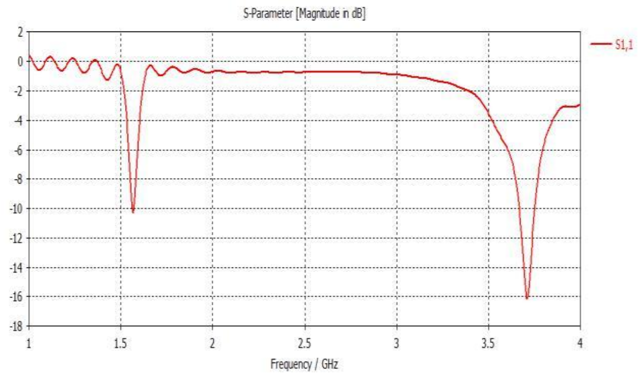

Figure 4(a): Rebound loss of first iteration of devise antenna

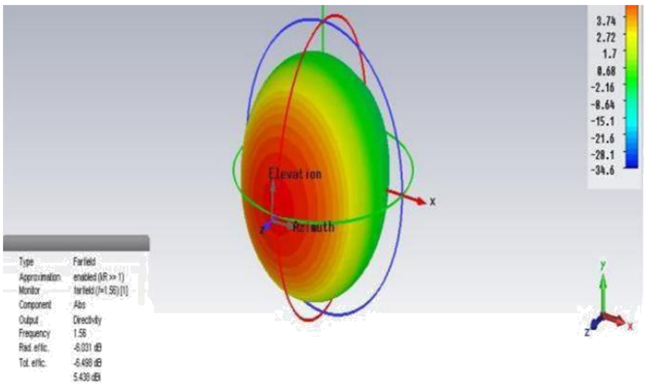

Figure 4(b): Directivity of first iteration of devise antenna at 1.67 GHz

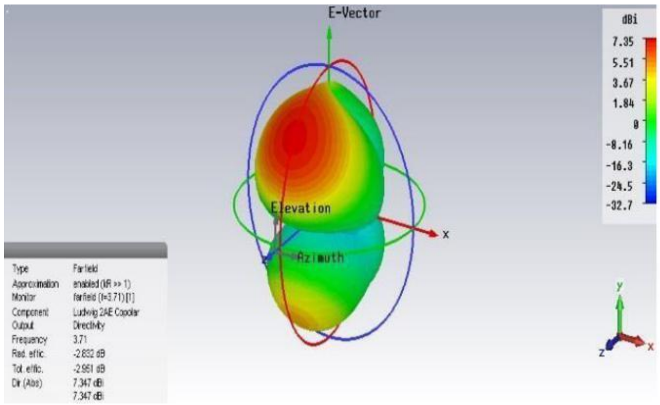

Figure 4(c): Directivity of first iteration of devise antenna at 3.72 GHz

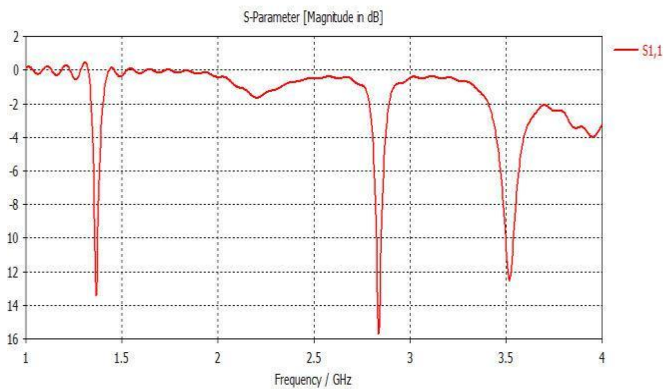

Figure 5(a): Return loss of second iteration of designed antenna

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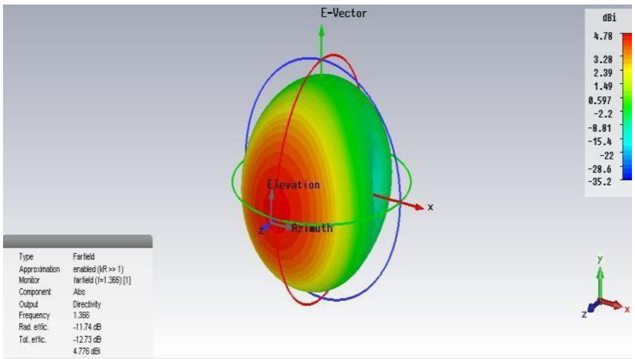

Figure 5(b): Directivity of second iteration of designed antenna at 1.37 GHz

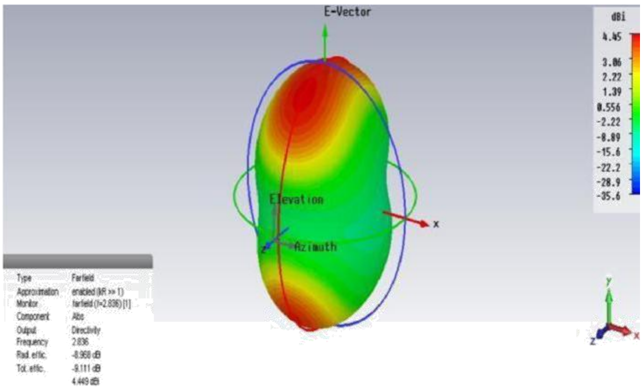

Figure 5(c): Directivity of second iteration of devise antenna at 2.84 GHz

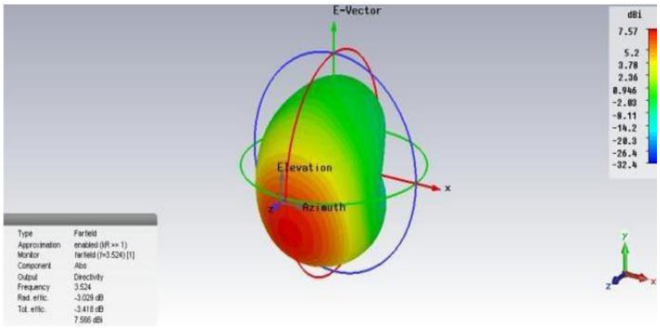

Figure 5(d): Directivity of second iteration of devise antenna at 3.53 GHz

Table Ii: Comparison Of Return Loss And Directivity At Various Frequencies For Zero, First And Second Iteration

ITERATION	RETURN LOSS	DIRECTIVITY (dBi)	FREQUENCY (GHz)
First	-19.6	6.22	2
Second	-10.4	3.71	1.67
Second	-16.2	7.35	3.72
Third	-13.5	4.76	1.37
Third	-15.9	4.45	2.84
Third	-12.6	7.57	3.53

The initial iteration starts with a triangular patch resonating at the frequency of 2 GHz with return loss -19.5 dB and directivity 6.21dBi. After this iteration, Sierpinski Gasket antenna resonates at two different frequencies viz. 1.67 GHz and 3.72 GHz with return loss values -10.4 dB and -16.2 dB and directivity 3.72 dBi and 7.35 dBi respectively. In the last iteration Sierpinski Gasket fractal antenna resonates at three different frequencies viz. 1.36 GHz, 2.84 GHz and 3.53 GHz with return loss values -13.5dB,-15.9dB, -12.6dB having directivity 4.78dBi, 4.45dBi, and 7.57dBi respectively.

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IV. CONCLUSION

Sierpinski Gasket fractal antenna with proximity feeding technique has been presented in this paper. This fractal antenna has been examine using CST Microwave Studio V14.0. It is ascertained that from second iteration onwards, it starts parading multiband behaviour with an satisfactory frequency response at multiple frequencies at the same time.
As number of iterations hike, number of resonant frequencies also hike which devote multiband performance to the Sierpinski Gasket antenna structure. The results show that antenna gives appreciable return loss and directivity with miniaturization and is best suited for wireless applications.

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