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Design of DGS Based Sierpinski Gasket Iterative Models for Ku & K Band Applications

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Abstract

A high bandwidth with higher gain improved factors with DGS is improvised on a frequency range of 11to 18 GHz by using fractal defected ground structure using Sierpinski Gasket from iterations (0-3). The design factors with radiation pattern provide prominent a wide range of applications as its representation is either cycloid in 3D form. The factors such as bandwidth with radiation pattern and other features such VSWR are improved when compared to normal and results in stable directional antenna with Ku and K band frequency model using Sierpinski gasket.The overall Gain of the Sierpinski Gasket at ITER-3 with DGS ITER0 is observed at max value 41dB. Similarly the Bandwidth observed for most of the design cases from upper and lower from ITER(0-2) will be 2.49- 4GHz while only for iteration 3, the observed bandwidth is about 10.98GHz for lower band and for upper at 22.13GHz.

Keywords: Fractal Antenna (FA), Sierpinski gasket (SG), Voltage Standing Wave Ratio (VSWR), Gain (G)

I. INTRODUCTION

In current design of Antenna theory especially Microstrip Patch antenna where the provision of wide range of communications systems that allow us to provide multiple applications scenarios which are integrated with miniature sizes and low-cost modelling with the higher bandwidth in fields of Biomedical, Radar Navigations, Mobile and wireless communications.

Considering the design criteria in field of communication system which utilizes broad bandwidth, improve the robustness in design of trans-receiving which have results the conventional design obsolete [8]. To ensure such standards we improvise with technological standards and FFC which uses different ranges of frequencies from 3-3.6 GHz, with power level of -41.3 dBm, similarly these bands would rise up to Low power consumption and other operability criteria that ensures the design factors which improvise the fractal antenna to prime and beneficial case. The property of the fractal antenna with different set of gaskets provides wide range of applications that lead to suffice the design parametric scenarios which ensures the characteristics with impedance, S11, Radiation parameter and hence providing the larger bandwidth for each set of iterations performed on model[9]. The frequency assigned ranges with different technologies utilized for each set of applications as mentioned such as {WIFI, WIMAX, WLAN etc.…}[10].

Different solutions have improvised to improve the antenna gain and its functional characteristics which improvise on layers of substrate and ground plane. As the patch would work on the Substrate top layer while the bottom layer, we have ground plane with normal and abnormal features that results in improved gain and bandwidth. DGS is one such design criteriaensure on the different structures that effect the improved gain factors ensuring the larger bandwidth [6], [7].

In this paper we improvise a design criterion based on Sierpinski Gasket based DGS for all the iterations such as {iter 0,1,2,3} for ground plane. And moreover, improves each set of improved performance criteria on the Sierpinski gasket. We utilize the same length and other definitions on the patch which are implicated on the DGS as different integrated combinations on Sierpinski gasket. Here section I Describes about the introduction, Section II provides the different sources of survey models on the Antenna and their DGS solutions, Section III defines the formulations using python. Antenna calculations are mentioned in Section IV and in Section V results and discussion for each iteration.

II. LITERATURE SURVEY

Simulation and measurement of a new ultra-wideband CPW fed fractal antenna (UWB). Fractal geometry is applied to various antenna models generate the optimum antenna. Until one obtains an ideal structure in accordance with UWB characteristics Koch fractal presented in the first iteration, additionally, smaller hexagonal slots are positioned to acquire the UW features the notching of the 802.11a WLAN/2 to 5.9GHz frequency band is refused by the implementation of a Notch filter in U. The ground plane design process is capable of increasing the reflection from 3.1 to 10 GHz in the low end of the spectrum. A glass transfer inductor is connected to the upper corner of the hexagonal patch to boost high-frequency reflection. The dimensions for this FR4 antenna are optimized in a substrate of 25 × 25 mm, with a dielectric constant of 4.4, a thickness of 1.5, and a diffraction loss tangent of 0.02, with a maximum operating VSWR of 2.38 9.8GHz over the entire frequency spectrum, excluding the rejected frequencies for WLAN. Compact antenna has a nearly omnidirectional radiation with an acceptable impedance and a loss less than 10dB over the UWB range, this range [1].

An 11.4-11.78 GHz structure-ground isolation, gain, and patch antennas using fractal deflection (Fractional DGS) models that show the antenna efficiency of fractal arrays including network isolation and radiation are compared to a standard patch antenna. In this article, the reciprocal coupling reduces the working frequency by -33dB Conventional antennas give less radiated power in both horizontal and vertical polarization. The more isolated and directional the pattern, the better it is for use in a millimeter wave communication device [2].

A novel technique is used to ground the radiating patch, and the gain of the antenna at the same time. Typically, a rectangular microstrip antennas are used in 2.45 GHz Wi-band wireless networking applications. Some self- symmetry structures are fractal in dimension. The 2.4 GHz Sierpinski carpet has been added to the ground plane of the rectangular patch antenna. The first and second iteration of the simulation results are shown for DGS antenna during the first and second runs, the radiating patch is reduced by 30.78% and 32.9%. As well as the antenna efficiency [3].

In this article, a coplanar waveguide (C-PWG) antenna is designed to improve bandwidth. The planned antenna includes two iterations of Sierpinski hexagonal slots with Sierpinski square feed line. Simulated results suggest an impedance bandwidth of 133% (2.86 to 14.36 GHz) and a maximum gain of 5.5 dBi. This antenna is built on Rogers RO435026/ RO4350B substrate, with a height of 1.524 mm and a cross-mm × 2.6-mm-sized form factor of 26 mm. This antenna is good for UWB systems with compact size and better performance [4]. A 5-GHz resonant fractal patch antenna is designed, and Sierpinski and Koch fractal geometry is incorporated into the design. The proposed fractal DGS has been used to render fractal antennas when the addition of a DGS supports multiplexing, the resultant fractal patch shows better output parameters. For the antenna, various performance characteristics such as return loss, gain, directivity, and radiation efficiency are investigated. It is an S-band and C-band patch antenna. This combined structure yields a 25.39% reduction in profile compared to the original signal with minimal bandwidth increase. Using ADS tools, the antenna is simulated and measured. The findings are substantiated by simulation and experimental proof [5].

III. DEFELECTED GROUND SURFACE (DGS)

3.1 Concept

The interfacing of different structures with geometrical models with compactness and are embedded on the ground plane for the circuits utized in Microwave applications are known to be Deflected Ground Surface.The design models with unit cell or repeated peroidic or aperiodic defects observed on the ground plane with same or different configurations from the patch which lie on the same planar plane enabling a different scenario of the design strucyure for antenna impprovising the best perforamnce changes.In our design we represent the Sierpinski Gasket as the subject of interest utilizing the capabilities of each iterations as the DGS model and its dimensional charatersitics. In order to design a accurate model of the triangular shaped gasket we implement the design using python code for specific values of gaps observed for each triangle on each iterations. The algorithm and formulations are mentioned below.

3.2 Algorithm for sierpinsiki gasket

- To initiate the gasket first a model sides are to choosed to provide a shape of the Circuit antenna
- The Side of the Model is determined with "a" and its calculations are formulated as mention in Tabulation section V. To provide the design with seipinski model we provide a triangular shape as a base on and the fractals are smaller triangulars with same shanpes and different/same gaps from the exisitng sides as mention in figure 1(a).
- $Main_{SG} = ET_r(x, y, -r)$
- $SubSG = ET_r(n, x, y, r)$

$$ET_r(n,x,y,r) = ET_0\ \left(n-1, x - rcos\left(0 * \frac{pi}{3}\right), y - rsin\left(0 * \frac{pi}{3}\right), 0.39 * r\right) \ldots\ldots\ldots\ldots(1)$$

$$ET_r(n,x,y,r) = ET_1\ \left(n-1, x - rcos\left(0 * \frac{2pi}{3}\right), y - rsin\left(0 * \frac{2pi}{3}\right), 0.39 * r\right) \ldots\ldots\ldots..(2)$$

$$ET_r(n,x,y,r) = ET_2\ \left(n-1, x - rcos\left(0 * \frac{4pi}{3}\right), y - rsin\left(0 * \frac{4pi}{3}\right), 0.39 * r\right) \ldots\ldots\ldots(3)$$

- Calling functions:
    - $ET_r(0,0,-r)$.
    - $ET_r(n,0,0,-0.45 * r)$.

To maintain certain gap with value of 0.39 radius and 0.45 as whole number which either contracts or increase the size.

3.3 Working Principle

From the figure 1 presents the a defected ground sufaces as per the Sierpinski iterations. Each iteration have a charaterisitics features that effects the capcitances and inductances of the overall circuit antenna. As any microstrip antenna can be modelled using RLC characterisitcs. For example if we consider an antenna have RLC equation with the cut off frequncy as :

$$F_c = \frac{1}{\sqrt{\alpha R_1^2 + \beta \frac{1}{C_1^2} + \gamma L_1^2}} \tag{4}$$

$$F_{cx} = \frac{1}{\sqrt{\left(\frac{\alpha}{(r+R_1)^2} + \beta\left(\frac{1}{c_1} + \frac{1}{C_2}\right)^2 + \gamma (L_1 + L_2)^2\right))}} \tag{5}$$

Here, the the changed cut off frequency is implemented and observed with changes in resistances, capacitences, and inductances. Hence the sudden shift in the Design occurs whicle the defelected surfaces are utilzied for a antenna's ground plane.

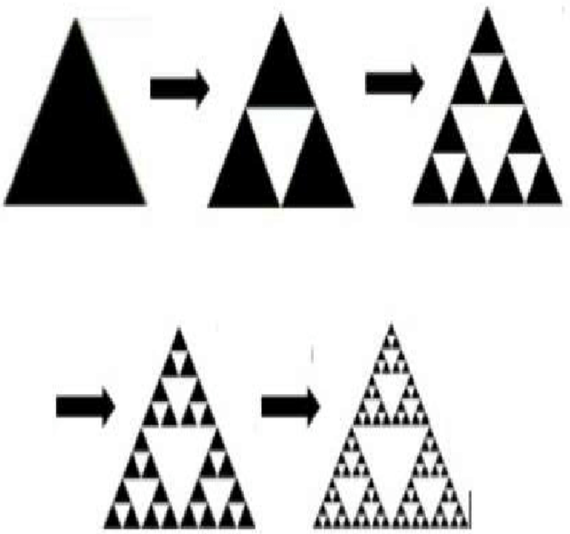

Fig 1: Representing the Sierpinski Gasket with iterations from n=0 to 4.

3.4 DGS Dimensions

Our design impels on the Sierpinski iterations in which creates a different shift observed within the band and improving the performance features that utilizes the Ku and K band as implemented below. The dimensions are the same as per the patch design for each iteration with formulations calculated in section IV. Only factors of (L and W) aren't changed with respect to DGS parametric considerations for its dimensions.

IV. ANTENNA DESIGN PARAMETRIC FORMULATIONS

4.1Antenna Design

As per the above formulations and we have designed an antenna with use of python and its representation on the design characteristics of each set of the iterations considered. The structure of the Antenna as mentioned in Introduction, representing the Sierpinski model with specifications as mentioned below:

- Antenna Model
- Substrate Dimensions
- Radiation Box Dimensions
- Modes of Operations
- Boundaries
- Excitations
- Transmission Line Design

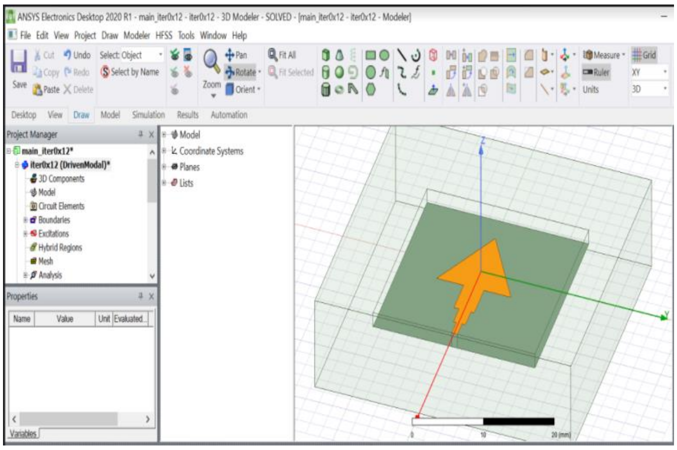

Fig 2: Representing the Structure of Stepped Triangular Antenna.

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4.2 Antenna Model

Formulations for Equilateral Triangle:

1. Side of equilateral = $2 * \frac{c}{3 * f_r * \sqrt{e_r}}$
2. L = 4 ∗ (a)
3. W = 4 ∗ (a)
4. H = 1.6 for FR4_epoxy (consideration for this antenna).
5. Radiation box size:6 ∗ (a)

From the figure, we learn that 4 and 6 are located at ⅛ the distance from the reference antenna. Given the form of the substrate be s and a rectangle have the same dimensions = ¼. As a result, the length would be 2 times as long and the width would be 2 times as wide. We have transmission line L = 2a, so the total lengths will be 4a.

Substrate Thickness

In our design we emphasize the thickness to be 1.6 mm for all possible iterations. As mentioned based on the design characteristics we improvise the length and width of the substrate is 24mm X24mm with center at 12X12 mm. The changes in the substrate thickness have to be implemented with other features of the designed frequency changes as per the equation 5.

Radiation Box Dimensions

Similarly, for this feature characteristics are calculated with the formulations as mention above in section 4.1 antenna model. Box dimensions are estimated with the substrate thickness as 6times of the latter. So the values obtained from the design as 72X72mm.

Modes of Operations

Here our design proposes only single mode of operation asTM_{11}. The other factors of the modes such asS_{11}, VSWR and Gain are estimated in Results and discussion 5.

Boundaries

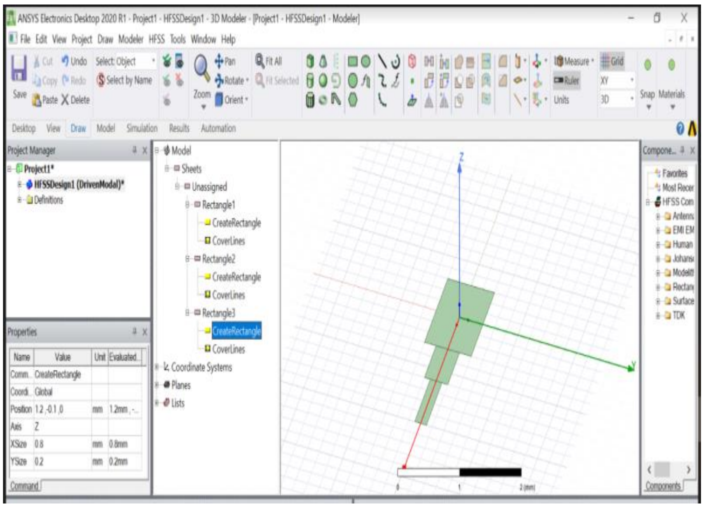
The boundaries of the design model is estimated with the patch, Ground plane, and Radiation Pattern for all the iterations including DGS.

Excitations

The excitations for the proposed model with DGS on all iterations utilized with frequency sweep with factor of varying in 0-400 samples and with frequency setup at 17GHz.

Transmission Line Design

The transmission line is simulated with a 2D model, and the model's approximation with powers of 2 is applied for step 12, the lengths are presumed to be 6 and 4.



Name	Value	Unit	Evaluated...
Comm...	CreateRectangle		
Coordi...	Global		
Position	1.2 ,-0.1 ,0	mm	1.2mm , -...
Axis	Z		
XSize	0.8	mm	0.8mm
YSize	0.2	mm	0.2mm

Fig 3: Represents the design of the step induced line based on rectangular elements.

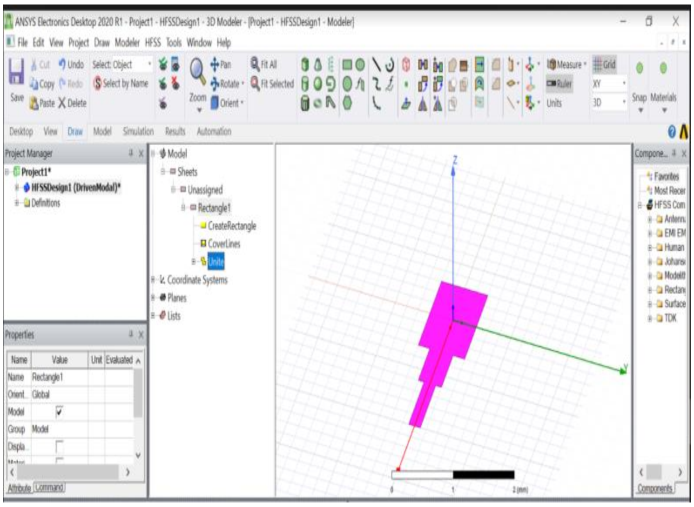


Fig 4: Represents the design of the united step induced line based on rectangular elements.

The design element for the Transmission line is modelled with Rectangular section element for each step variation as its rejoins the three sections. Fig 3 describes the step feature from each center to adjoin the segment of side which enables the correct coordinate points to provide the exact difference in size of the step. Fig 4 represents the adjoined steps which using union option of the tool ensuring the correct plane of the transmission line observed on each step.

V. RESULTS AND DISCUSSION

ITER 0: With DGS 0th Iteration

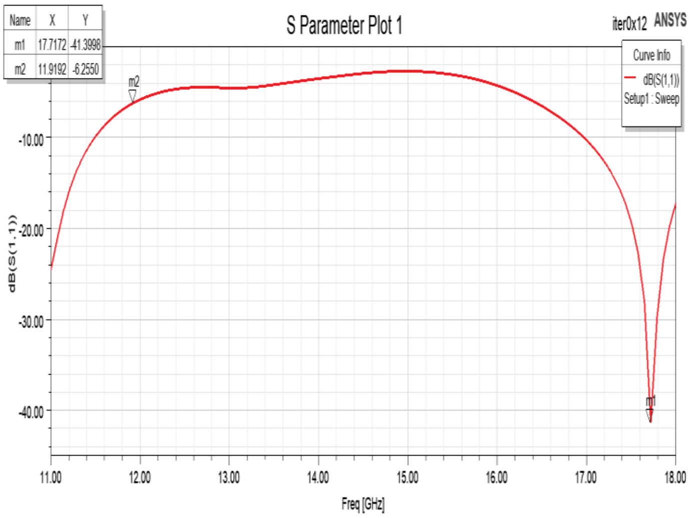


Fig 5a): S11 Representation at 17.7172GHz at -41.3096dB.

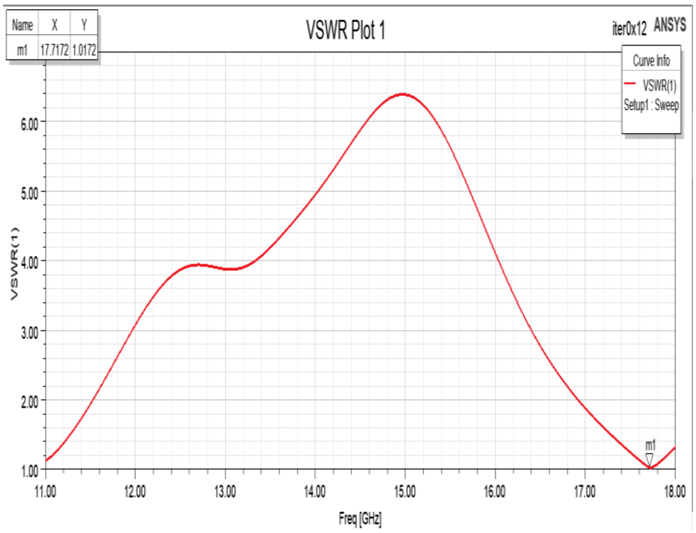


Fig 5b): VSWR Representation at 17.7172GHz is 1.072.

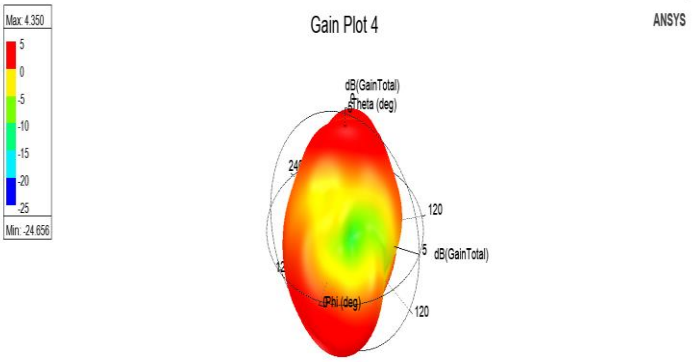


Fig 5c): Total Gain Representation at 17.7172GHz is 29.006dB.

Fig.5. Representing the Simulation analysis of the Iteration-0 with iter-0 for a) S11, b) VSWR and c) Total Gain. The design of the iteration 0 with DGS on iteration 0 represents the functional characteristics as mentioned with the S_{11}, Gain, and VSWR are utilized to ensure the design performance capabilities which are observed at Ku and K bands. This design provides the maximum S_{11} value as -41.3096dB for iteration0. As per the gain we have maximum value at 4.375 while the total would reach at 29dB.

ITER 0: With DGS 1st Iteration

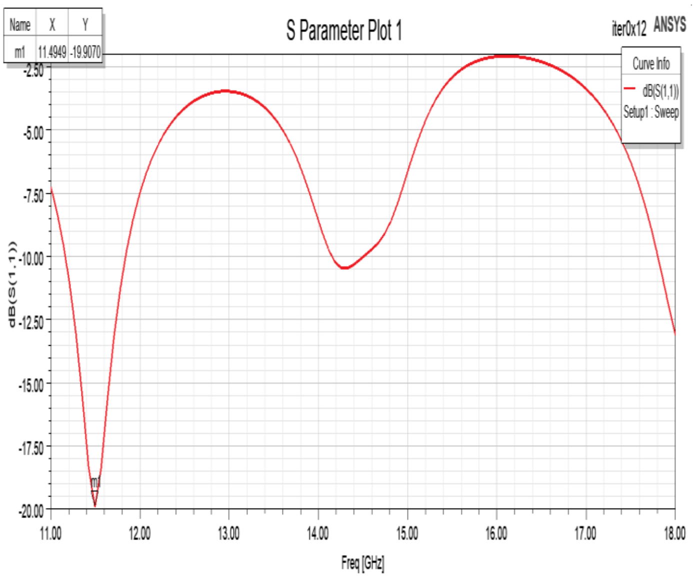


Fig 6a): S11 Representation at 11.4949GHz at -19.070dB.

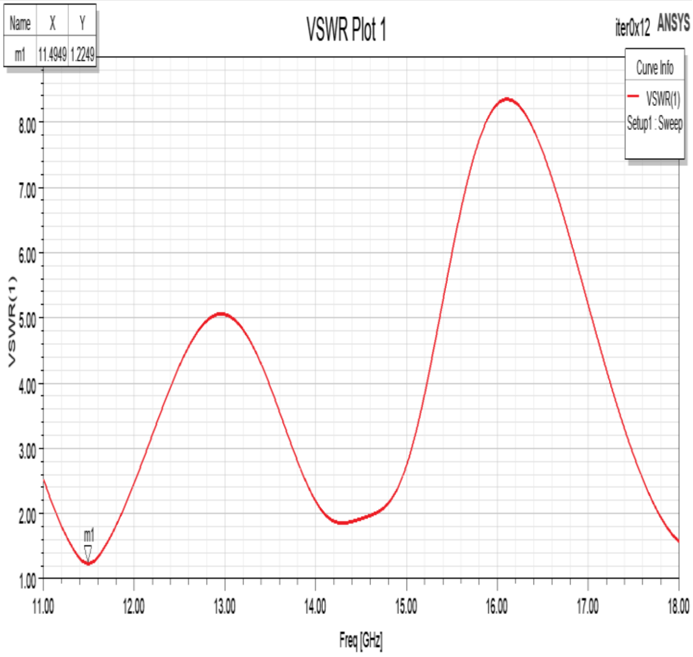


Fig 6 b): VSWR Representation at 11.4949GHz at is 1.2249.

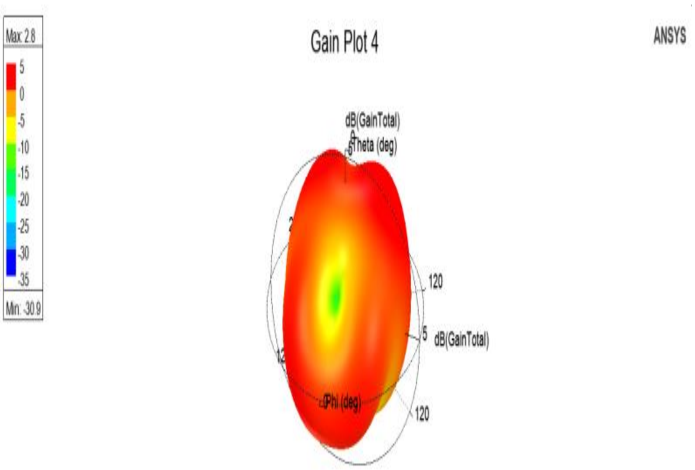


Fig6c): Total Gain Representation at 11.4949GHz is 33.7dB.

Fig.6. Representing the Simulation analysis of the Iteration-0 with iter-1 for a) S11, b) VSWR and c) Total Gain. The design characteristics for which the DGS iteration1 have subsequent shift observed at 11.4949GHz from 17GHz. Also the variations of S_{11} and Maximum gain is reduced with factor of 49%. But the overall gain has been increased.

As per the design criteria the implementation of ITER-0 with {0,1} are simulated with the same length and other dimensions which provides performance characteristics. Apart from the design performance, we have observed the maximum value for S11 is -41dB at 17.172GHz for the ITER-0 with iter-0. Stating that even though the reflection for the first iteration is highest but for Gain the value for (0, 0) iterationwhich is the least value observed from the figures. The operated frequency range for the iterations 0 and 1 in all designs are at 17GHz with length of 5.5mm, results a shift in frequency response for other iterations, as mentioned in figures 5 and 6. The shift is due to DGS applied to the ground plane resulting the structural changes in electrons flow. Hence these shifts are also observed other iterations, but 2 and after we would see the accurate scenario of upper and lower bands observed at S11 measurement.

ITER 1: With DGS 0th Iteration

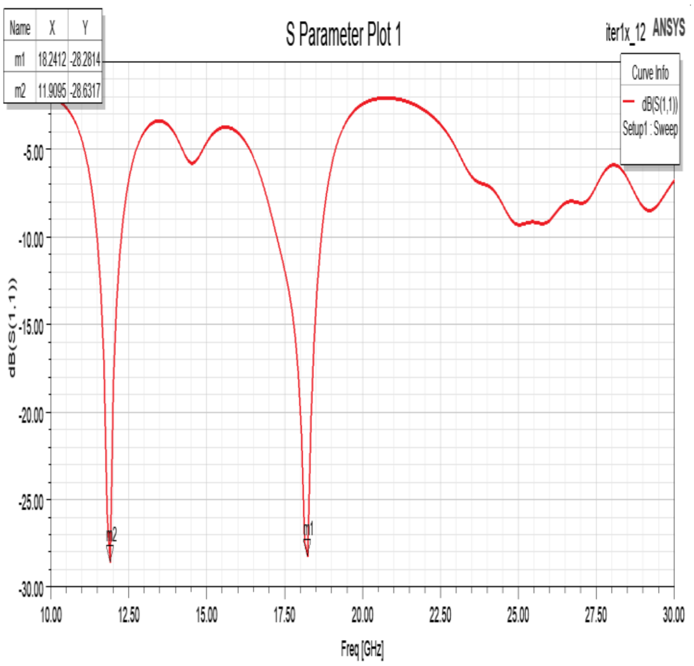


Fig 7(a): S11 Representation at 11.907GHzis -28.6317dB, 18.2417GHz is -28.2814dB.

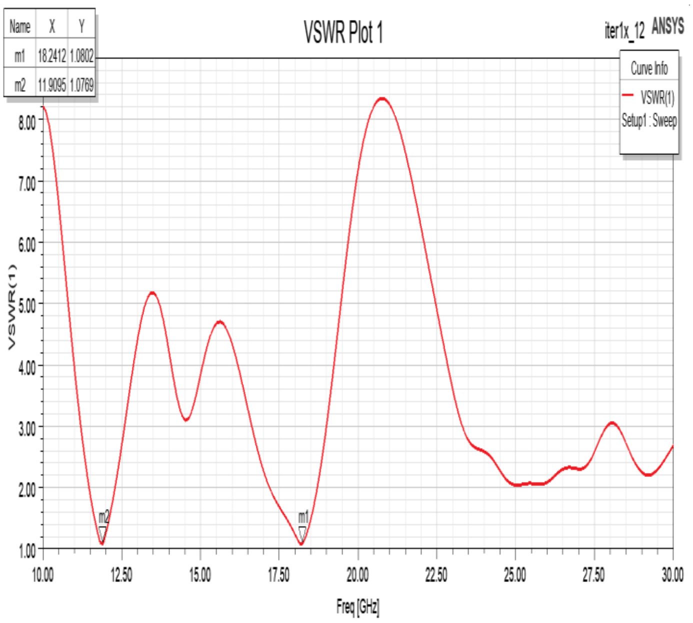


Fig 7(b): VSWR Representation at 11.907GHz is 1.08, 18.2417 is 1.07.

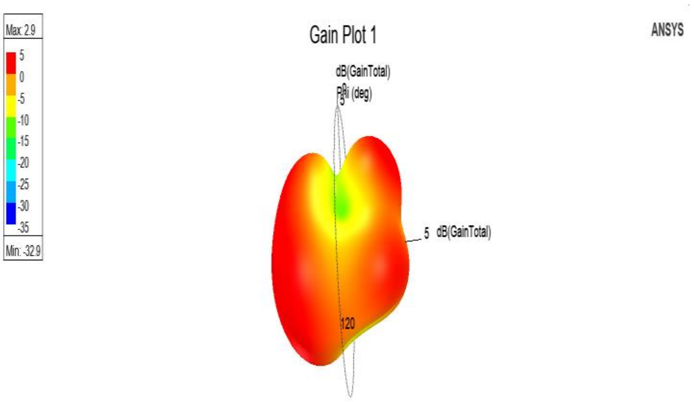


Fig 7(c): Total Gain Representation at 11.907GHz and 18.2417 is 35.8dB.

Fig.7. Representing the Simulation analysis of the Iteration-1 with iter-0 for a) S11, b) VSWR and c) Total Gain. The performance of the Iteration -1 with DGS iteration 0 provides two set of frequencies at 11.907GHz is -28.6317dB, 18.2417GHzis -28.2814dB. The improved Total gain observed is 35.8dB hence resulting the grater gain observed from all iterations from 0 with patch and DGS with 0 and 1.

ITER 1: With DGS 1st Iteration

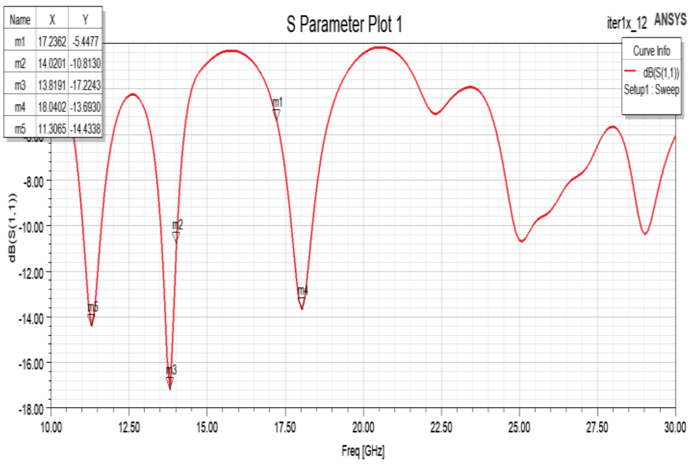


Fig 8(a): S11 Representation at 11.3065GHz at -14.4338dB, at 18.0402GHz is -13.6930dB, at 13.8191GHz is -17.2243dB.

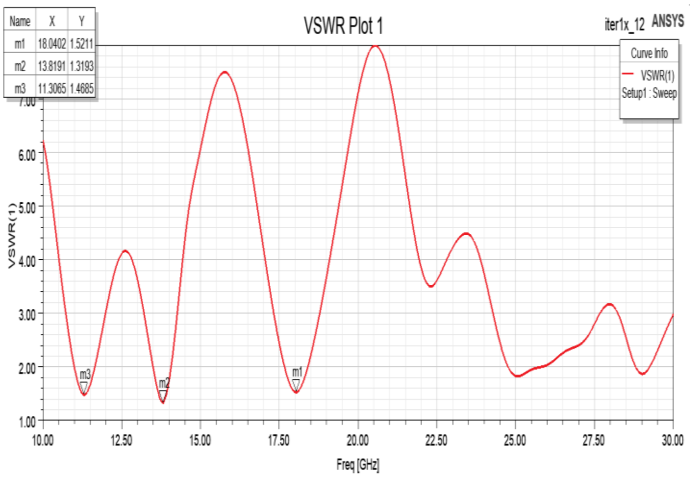


Fig 8(b): VSWR Representation at 11.3065GHz at 1.4685, at 18.0402GHz is 1.5211, at 13.8191GHz is 1.3193.

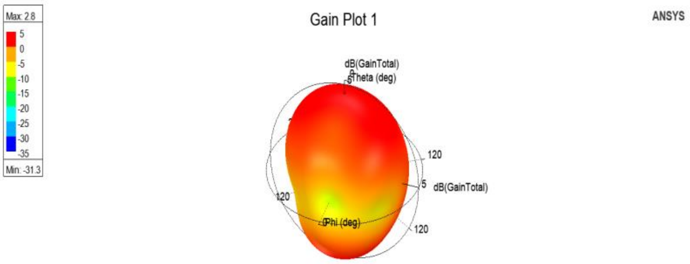


Fig 8(c): Total Gain Representation at 11.3065GHz, 18.0402GHz and 13.8191GHz is 34.1dB.

Fig.8. Representing the Simulation analysis of the Iteration-1 with iter-1 for a) S11, b) VSWR and c) Total Gain. These shifts are observed for the iteration 1 with {0,1} would provide the different upper and lower bands. The observed shift from the 17GHz to 13.7 and from 13.7 to 11.2 are observed within the band. Since the designed frequency of operation is 17GHz for which at iteration 0 with iter1 are shifted at 11.3GHz, similarly at iteration 1 we have two shifted values at 13.7 and 11.2. The representation of each S11, VSWR and Total-Gain values with different frequencies are observed from the graphs and its respective figures from 7 and 8. The VSWR is in the range from 1-2 which ensures that the design is matched with output transmission line.

ITER 2: With DGS 0th Iteration

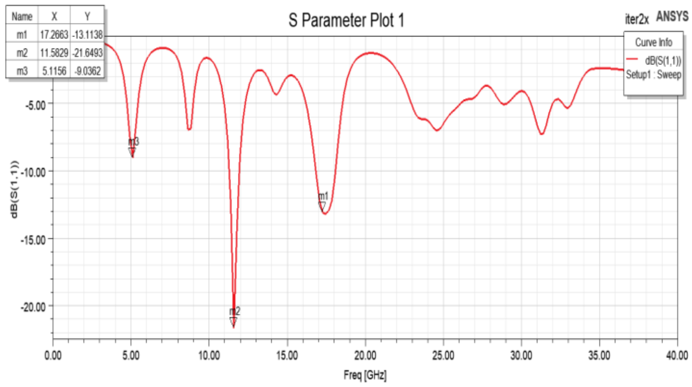


Fig 9a). S11 Representation at 11.5829 GHz at -21.6493dB, at 17.2663GHz is -13.1138dB.

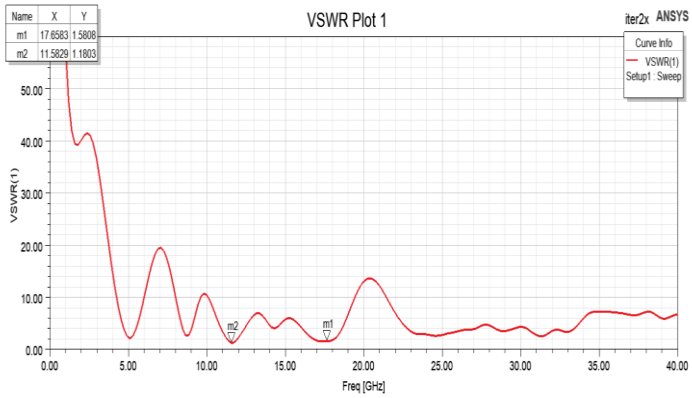


Fig 9b). VSWR Representation at 11.5829 GHz at 1.1803, at 17.2663GHz is 1.5808.

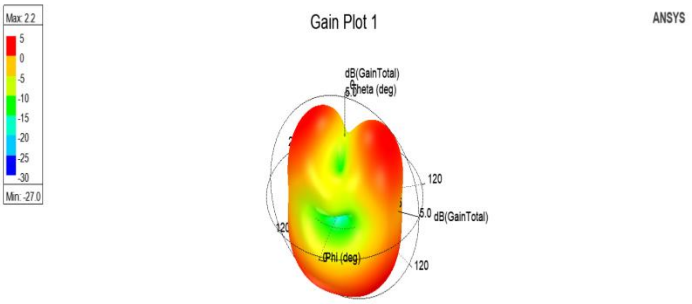
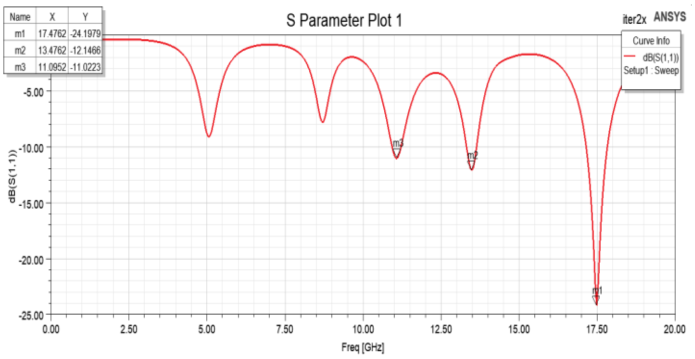


Fig 9c): Total Gain Representing 11.5829 GHz&17.2663GHz is 29.2dB.

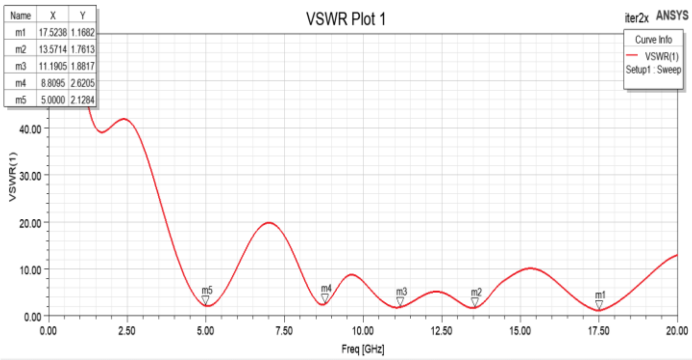
Fig.9. Representing the Simulation analysis of the Iteration-2 with iter-0 for a) S11, b) VSWR and c) Total Gain.

ITER 2: With DGS 1st Iteration



Name	X	Y
m1	17.4762	-24.1979
m2	13.4762	-12.1466
m3	11.0952	-11.0223

Fig 10a): S11 Representation at 11.0952GHz at -11.0223dB, at 17.4762GHz is -24.1979dB, at 13.4762GHz is -12.1466dB.



Name	X	Y
m1	17.5238	1.1682
m2	13.5714	1.7613
m3	11.1905	1.8817
m4	8.8095	2.6205
m5	5.0000	2.1284

Fig 10b): VSWR Representation at 11.1905GHz at 1.8817, at 17.5238GHz is 1.1682, at 13.5714GHz is 1.7163.

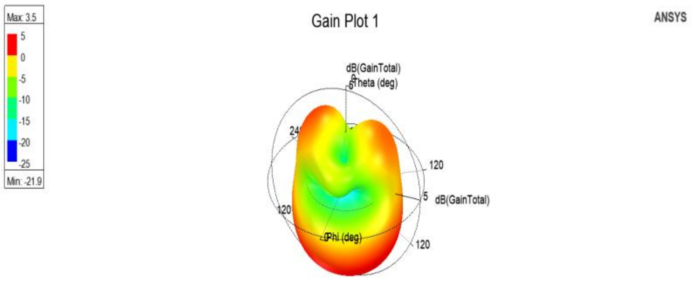
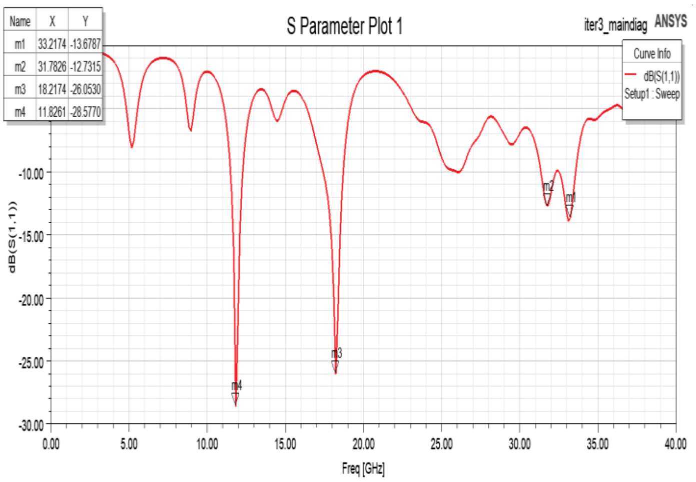


Fig 10c): Total Gain Representation at 11.0952GHz, 17.4762GHz, and 13.4762GHz is 25.4dB

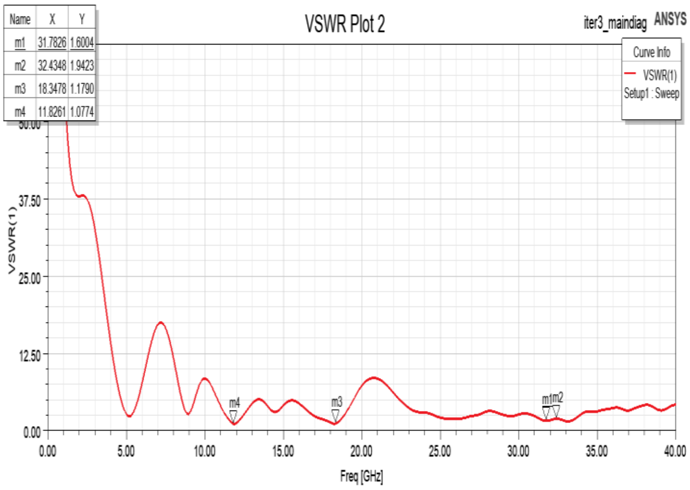
Fig.10. Representing the Simulation analysis of the Iteration-2 with iter-1 for a) S11, b) VSWR and c) Total Gain. In case of iteration 2 with {0,1} iterations for DGS technique on sierpinski model providing the different set of changes in performance parametric as observed in figures 9 and 10. This model for the designed analysis for the iteration 2 with (‘0’ and ‘1) provides the shift in frequencies at 13.42GHz. The gain values on Iteration 2 with iteration 0 has proven the highest value observed 29.2dB at 17.2663GHz.

ITER 3: With DGS 0th iteration



Name	X	Y
m1	33.2174	-13.6787
m2	31.7826	-12.7315
m3	18.2174	-26.0530
m4	11.8261	-28.5770

Fig 11a). S11 Representation at 11.8261GHz is -28.5770dB, at 18.2174GHz is -26.053dB, at 31.7826GHz is -12.7315dB, at 33.2174GHz is -13.6787dB.



Name	X	Y
m1	31.7826	1.6004
m2	32.4348	1.9423
m3	18.3478	1.1790
m4	11.8261	1.0774

Fig 11b): VSWR Representation at 11.8261GHz is 1.0774, at 18.2174GHz is 1.179, at 31.7826GHz is 1.9423, at 33.2174GHz is -1.6004

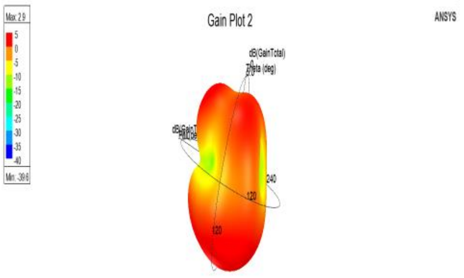


Fig 11c): Total Gain Representation 11.8261GHz, 18.2174GHz, 31.7826GHz, 33.2174GHz is 42.5dB.

Fig.11. Representing the Simulation analysis of the Iteration-0 with iter-1 for a) S11, b) VSWR and c) Total Gain. Considering the case of ITER-3 with DGS-0th iteration provide the design total gain 42.5dB with two frequencies touching -25dB greater in S_{11} characteristics. These values implicates this design to be most accurate and more reliable for the Hardware implementations ensuring the real time case studies on antenna applications in Ku and K band. This design for iteration -3 with all the DGS iterations provisions on Ku, K and Ka bands of operations as mentioned in S_{11} figures mentioned below. The Gain values for Ku band is the highest within the range of 11-18GHz.

ITER 3: With DGS 1st iteration

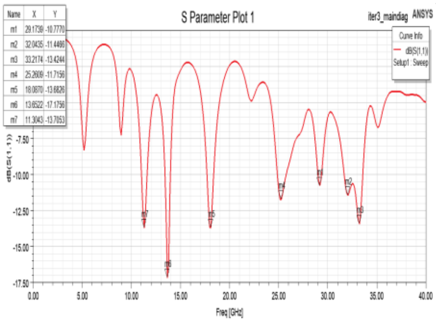


Fig 12a): S11 Representation at 11.3043GHz at -13.7053dB, at 13.6522GHz is -17.1756dB, at 18.0870GHz is -13.6626dB, at 25.2699GHz is -11.7156dB, at 29.1739GHz is -10.770dB, at 33.214GHz is -13.4244dB.

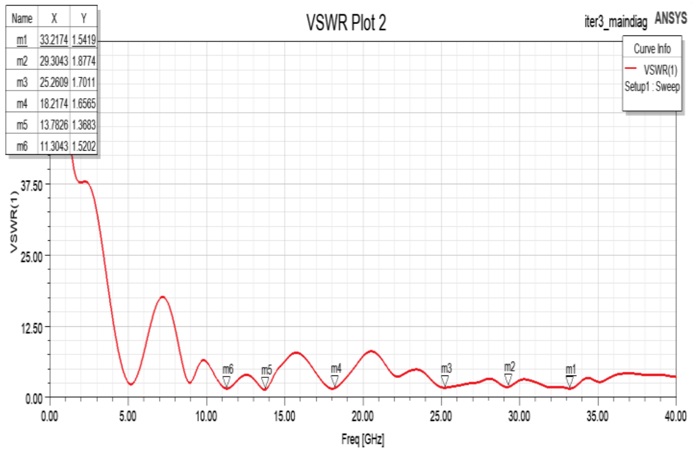


Fig 12b). VSWR Representation at 11.3043GHz at 1.5202, at 13.6522GHz is 1.3683, at 18.0870GHz is 1.5247, at 25.2699GHz is 1.7011, at 29.1739GHz is 1.8774, at 33.214GHz is 1.5419.

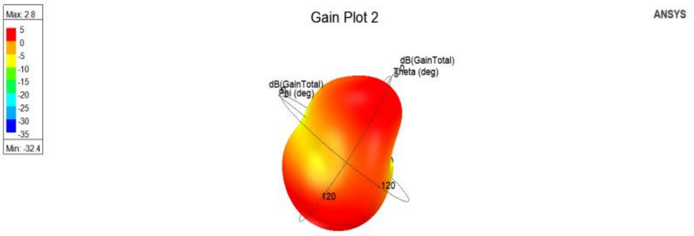


Fig 12c). Total Gain Representation at 11.3043GHz, 13.6522GHz, 18.0870GHz, 25.2699GHz, 29.1739GHz, 33.214GHz is 35.2dB.

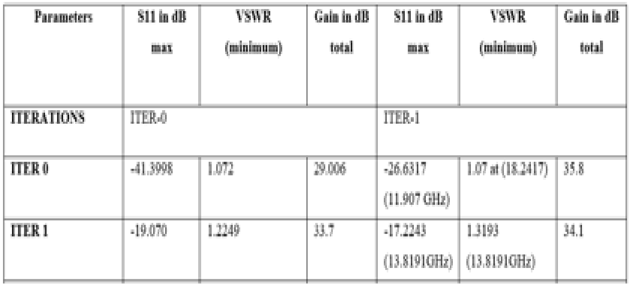
Fig.12. Representing the Simulation analysis of the Iteration-0 with iter-1 for a) S11, b) VSWR and c) Total Gain. The iteration of the current design model as ITER-3 with 0 and 1 on sierpinski model estimating an overall average bandwidth. Hence the desired frequency of operations is estimated and plotted from figures 11 and 12. For each iteration there is shift of the S11. This shift for ITER 3 occurs at 13.6522GHz. The Iteration 3 with 0th case would provide the highest overall gain of 42.5dB .

Table1.Representing the observed Tabulated Results for Sierpiniski Triangle gasket.

Parameters	S11 in dB max	VSWR (minimum)	Gain in dB total
ITER 0	-19.608	1.2337	27.2
ITER 1	-21.19	1.3217	26.8
ITER 2	-15.36	1.3867	34.8
ITER 3	17.6	1.3352	33.7

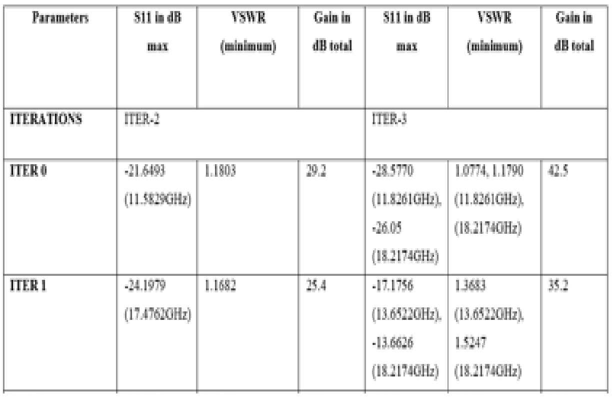
The existing Model without DGS would provide the S11 is tabulated for each iteration, including factors like VSWR and Total Gain Each fractal on the simulation environment is evaluated by a separate collection of antennas that have different iterations. Many change features to use the GAP or with a scripting tool. This solution increases the performance characteristics as described in Table 1. We observed the overall benefit and VSWR to be 2 and case S11's iterations reached their target. This simulation scheme uses different K, Ka bands, process variation methods to produce a variety of different types of performance characteristics according to requirements specified in section III.

Table2(a) & (b). Representing the Proposed Model for Siepinski Model Iteration from 0-1 for DGS model with iterations (0&1).



Parameters	S11 in dB max	VSWR (minimum)	Gain in dB total	S11 in dB max	VSWR (minimum)	Gain in dB total
ITERATIONS	ITER-0			ITER-1		
ITER 0	-41.3998	1.072	29.006	-26.6317 (11.907 GHz)	1.07 at (18.2417)	35.8
ITER 1	-19.070	1.2249	33.7	-17.2243 (13.8191GHz)	1.3193 (13.8191GHz)	34.1

(a)



Parameters	S11 in dB max	VSWR (minimum)	Gain in dB total	S11 in dB max	VSWR (minimum)	Gain in dB total
ITERATIONS	ITER-2			ITER-3		
ITER 0	-21.6493 (11.5829GHz)	1.1803	29.2	-28.5770 (11.8261GHz), -26.05 (18.2174GHz)	1.0774, 1.1790 (11.8261GHz), (18.2174GHz)	42.5
ITER 1	-24.1979 (17.4762GHz)	1.1682	25.4	-17.1756 (13.6522GHz), -13.6626 (18.2174GHz)	1.3683 (13.6522GHz), 1.5247 (18.2174GHz)	35.2

(b)

We implement the 12 iterations on the sierpinski model with normal and DGS technique with iterations varying from 0-1 with 0-3 as noted (0-0, 0-1, 2-0, 2-1, 3-0 and 3-1) are implemented. From the tables we could observe that while the maximum gain observed is with iteration 0 with 0th iteration as 4.375dB. With other factors on verification at 17.9565, 18.24 GHz, 13.6522GHz, we have obtained the impedance values varying from 45-55 ohms. These tables from 1-2 represents the existing model without DGS as Table1 and for table 2 would be of DGS for iterations 0-1.

VI. CONCLUSION

As per the design criteria we have implemented with DGS technique with sierpinski iterations which provides different performance factors which are tabulated from the tables 1-2. Table 1 represents the normal solutions for each set of iterations as designed. The transmission line characteristics are evaluated with the impedance observed at each section of the output. Since for iteration 1 we could observe that the overall gain is more than 33dB from 0-3 iterations with DGS 0-1. The shifts are observed for each set of iterations at different scale which are mentioned at the figure descriptions in section V. These shift occurrences would suggest the operation of DGS is affected and would provide a better gain from normal designs.

VII. FUTURE SCOPE

The other prime scenarios with increase of substrate thickness and other DGS structures have to implement to ensure the design accuracy for all iterations exponentially varying from 2-4. Even though low power and low cost design are implemented with fractals on the SA which improvises usage of hybrid structures on the seirpinski gasket. The sizes of the Gasket for DGS would provide other performance changes ensures different subsystem changes which can be implemented in other bands for different applications.

REFERENCES

1. Josue B. Benavides, Rafael A. Lituma, Paul A. Chasi, Luis F. Guerrero, “A Novel Modified Hexagonal Shaped Fractal Antenna with Multi Band Notch Characteristics for UWB Applications”, 2018 IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications (APWC), 10-14 Sept. 2018, Electronic ISBN:978-1-5386-6765-1.
2.Jingxia Qiang, Feng Xu, Wenjun Fan, “Reducing Mutual Coupling of Millimeter Wave Array Antennas by Fractal Defected Ground Structure”, 2018 12th International Symposium on Antennas, Propagation and EM Theory (ISAPE),3-6 Dec. 2018,Electronic ISBN:978-1-5386-7302-7.
3.R.V. Hara Prasad,D. Vakula, M. Chakravarthy, “A Novel Fractal Slot DGS Microstrip Antenna for Wi-Fi Application”, 2018 IEEE Indian Conference on Antennas and Propogation (InCAP),16-19 Dec. 2018, Electronic ISBN:978-1-5386-7060-6.
4. Youcef Braham Chaouche; Idris Messaoudene; MouradNedil; FaridBouttout, “CPW-Fed Hexagonal Modified Sierpinski Carpet Fractal Antenna for UWB Applications ”, 2018 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting, 8-13 July 2018, Electronic ISBN:978-1-5386-7102-3.
5. Akshata Ramesh Sankhe, Uday PanditKhot, “ Combined Sierpinski Carpet and Koch Fractal Patch Antenna with Fractal DGS for Wireless Applications”, 2018 2nd International Conference on Electronics, Materials Engineering & Nano-Technology (IEMENTech), 4-5 May 2018, Electronic ISBN:978-1-5386-5550-4.
6. L. Liangtao, L. Jun, Q. Liyong and M. Yao, "Complex Permittivity and Permeability Measurement Method of Multiple Free-Space Incident for Structured Absorbing Materials", 2017 5th International Conference on Mechanical Automotive and Materials Engineering (CMAME), pp. 11-14, 2017.
7. D.V. Mayboroda, S.A. Pogarsky, A.V. P1oznyakov, V.N. Sukhov and E.V. Shcherbatiuk, "The Quasi-Fractal Microstrip Antenna", IEEE 2018 9TH International Conference On Ultrawideband and Ultrashort Impulse Signals (UWBUSIS), pp. 349-352, 2018.
8. I.I. Sliusar, V.I. Slyusar, Y.V. Polishchuk and E.I. Stas, "Analysis of space-frequency characteristics of a quasi-fractal dra based on a cube and truncated pyramid", Naukaistudia. Przemysl, no. 11, pp. 3-12, 2018.
9. Ashraf E. Ahmed; Wael A. E. Ali, “Analysis and Design of 3-D Printed Fractal Triangular Antenna for Wireless Communications Applications”, 2020 International Conference on Electrical, Communication, and Computer Engineering (ICECCE), 12-13 June 2020, Electronic ISBN:978-1-7281-7116-6.
10. S. Jindal, J. S. Sivia and H. S. Bindra, "Hybrid Fractal Antenna Using Meander and Minkowski Curves for Wireless Applications", Wireless Personal Communications, vol. 109, no. 3, pp. 1471-1490, 2019.

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