Design of Sierpinsky Shared Hexagonal Fractal Antenna for Wireless Applications

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Abstract— Antennas are an most important device in a wireless communication system because their performance will have a direct impact on the quality of wireless communication. Continuous compression of the size of electronic devices requires antenna elements of the same size to properly accommodate wireless devices without compromising the other radiation properties of the antenna. The microstrip patch antenna is a pretty clear choice. But the two main disadvantages of typical microstrip antennas are low gain and narrow bandwidth. These are drawbacks have limited its application despite its advantages over the traditional antennas. To overcome this problem, fractal antennas can be introduced in this area to effectively reduce the size of the antenna for multiband application. The main goal of a fractal antenna is to avoid interconnection between two rigid compact antennas. In this thesis report, an arrow-shaped fractal antenna design is given, then study the different effects of different parameters such as patch length, patch width, height of the substrate and continuous dielectric for wireless applications. The antenna is built using Advanced Design System (ADS). To obtain the best antenna, antenna parameters such as return loss, bandwidth, resonance frequency, directivity, gain, and VSWR are calculated for each antenna design. The proposed arrow shaped fractal antenna was designed and resonates at frequencies of 6.325GHz, 7.464GHz, 10.60GHz and can be used in RF and remote sensing applications, radar applications, IEEE 802.11A, UWB applications such as high frequency applications. . The application provides. The antenna parameters examined in this study include the substrate and its dielectric constants, power line, modified ground structure, and grooves in the ground plane. Antenna parameters such as proposed operating frequency, input impedance, VSWR, bandwidth, return loss, directivity, and gain, are determined for the proposed antenna configuration.

Keywords: Fractals, Resonant Frequency, Microstrip Antenna, Antenna Measurements, Frequency Measurements, Antenna Radiation Patterns

I. Introduction

For modern telecommunication systems, the antennas must be compact, low-profile, multi-band, and broadband. There are many different ways to achieve these goals. The antenna is a component of a modern

The current wireless revolution transforms the existing global telecommunications network into a unified system that will initiate the antenna, provide comprehensive ubiquitous communication services to customers anywhere, anytime, on the move or by stabilizing.

Wireless device that has a history of over one hundred and fifty years. During this time it takes different forms for certain applications. Many changes have been made to the antenna design, including the publication of thousands of documents related to the design, analysis and optimization. New design concepts for small design with broadband behavior were introduced in the reporting period. This research is based on a new trend called "fracture antennas". Fracture geometry has been used to model passive components in RF and microwave fields for more than a decade. This led to the discovery of antennas in different directions that could be used as partial-shaped antenna elements to improve antenna properties and many subsystems have been proposed for antenna application and the properties have not improved significantly. Many of these formats are especially useful for reducing antenna sizes, while others try to combine multi-band or broadband functions.

II. Design Parameters of Antenna

A. Reciprocity

The power characteristics of the antenna, listed in the next section, are important features of the antenna. For example, gain, radiation, resistance, bandwidth, resonance frequency, polarization, regardless of whether the antenna is ejected. For example, when the antenna functions as a radiator when used for the reception, the antenna's "reception pattern" is identical to the antenna pattern. This comes from the Theory of Electromagnetic Communication

B. Gain

Incoming radiant energy is a function of the power of the antenna to point in a specific direction, and is measured at full radiant intensity. The density of power radiated by a remote isotropic antenna with power of input Po is determined by S = Po / 4πR2. Also, the isotropic antenna rotates in all directions and its radial energy density is determined by dividing the radiated energy by 4πR2. Isotropic transmitters are regarded as efficient at 100 percent. The advantage of a real antenna is that it increases the power density in the direction of peak emission.

GP = Pload/Pinput

Average power supplied to the network, if maximum power supplied to the load exists.

C. Directivity

Directional antenna gain is a function of the transmitted power density in a given direction. This is an antenna's ability to direct a ray of radiation energy in a given direction. It is typically a function of the total radiation concentration in a given direction.

Directivity= Power of radiation in a provided guidance
Average force of radiation

D. Transmission Capacity

The bandwidth given for each antenna is another significant parameter. Usually, bandwidth is just symbolic. However, to reduce bandwidth loss, it's important to recognize that there are different meanings of bandwidth, direction of bandwidth, polarization of bandwidth and bandwidth. To attain output, steering and performance are often combined.

Bandwidth Impedance / Bandwidth Loss Return

It is a series of frequencies, and the device has dynamic bandwidth above all other resistors, usually with a limit of 50. The accelerated model's bandwidth depends on a great number of parameters related to the component of the radiation patch antenna (eg. Quality, Element) and type of feed that was used. The following plot shows the bandwidth of the loss of revenue from the patch antenna and the return on the correct S 11/VSWR (S 11 Required/VSWR). This is a major drawback for an antenna with base patch antenna

where Q is the quality factor.Bandwidth=SWR-1/Q√SWR

E. Radiation Pattern

The antenna pattern is a map of the field strength of radio waves produced from different angles by the antenna. It typically appears as a triangular figure or as a circular figure with lateral, horizontal and vertical divisions. The circle looks like a perfect isotropic antenna style and it is evenly distributed in all directions. Many common antennas, such as mono poles and dipoles, use the same power in all horizontal directions, and the power decreases up and down. It's called Omni, which looks like a bull or a donut while examined. The radiation emitted by different antennas has a maximum pattern of radiation or "lobe," separated by a "navel cord" where the radiation is zero. In addition, radio waves produced from various parts of the antenna typically interact with the angle and reach the peak where the radio waves touch, while at all angles there is zero interference where the radio waves are out of sight. Sure. It's going to be laid.

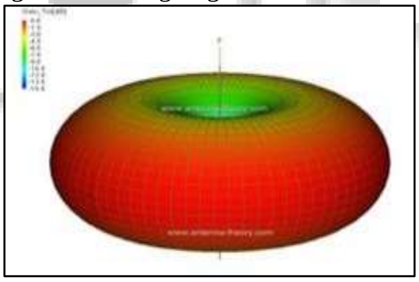


Fig. 1: Radiation Pattern

In that sense, the lobe is a directional antenna projecting radio waves in a certain direction. It is larger than the other clubs and is called the "main club". Other petals are generally known as "side petals" and reflect harmful radiation. The axis is known as the "primary pole" or "drilling pole" that moves through the central lobe.

F. Polarization

Antenna polarization is the direction of the electromagnetic field of the ground radio waves and is determined by the antenna's physical structure. This rarely occurs with the concept of antenna orientation, "horizontal", "vertical" or "circular". Therefore, even in one installation, the antennas are polarized in a straight line, and in a horizontal installation, another straight line is polarized. "An electromagnetic wave polarization filter is a device that can be used to filter the flow of unwanted polarized wave units directly from the electromagnetic waves and to transfer the flow of wave energy to the desired polarization.

III. PROPOSED METHOD

A. Fractal Geometry

Benoit Mendelbrot, formerly scientist. Mentor geometry has been chosen as a method for scientifically designed compositions. Webster's Dictionary refers tofractal as "the importance of broken, lost Latin fractals": differently surprising curves or shapes that repeat themselves can be observed on any basis. The analysis of fractal properties is a branch of mathematics. For Euclidean geometries like coast length, tree roots, etc., this geometry used to make these objects in nature is difficult to understand. The Euclidean geometric works are more difficult to understand than nature. Fractal antennas are augmentation of old style receiving wires which utilize fractal geometry. In this way, the fractal geometry and the reception apparatus hypothesis structure the foundation of fractal antennas

B. Measurement of Fractals

The most common method of calculating fractures is usually done using certain types of measurements, which are fractions or non-integers. Measurement is an important part of calculating a fractal, because its size represents the most fragmented aspects of anobject.

C. Measurement of Fractals Dimension

This geometry can be interpreted differently,usually the same number, but it is not mandatory. Some examples include topology dimensions, Euclidean dimensions, self-similarity parameters, Hausdorff axes,etc. Those are all special ways to define the fractal dimensions of Mandelbrot. However,the easiest concept to grasp is the self- similarity dimension. The geometry is divided into smaller, but equivalent, copies to obtain this value. If n copies of the original geometry (as a fraction) are countedin fraction F, a square may be divided into 4 scale 1, 1 scale 3 and 9 copies, for example.

Copies 16 1 14, or 1/N. Copies scale N 2. In the following formula, geometry is defined as dimension 2

IV. PROPOSED ANTENNA DESIGNAND DISCUSSION

Antenna features and operation and different types of antennas based on fractal geometry operations with a multi-band study. We havedeveloped arrow-shaped fractal antennas formultiband applications using the ADS tool.

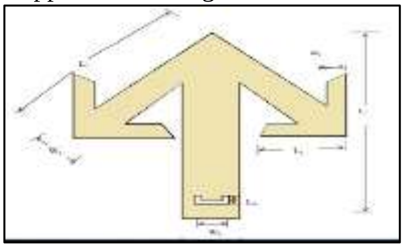


Fig. 2: Geometry of the measurementsof the planned Arrow Shape Fractal antenna

A. Design for fractal antennas

The thickness of the patch depends on the length of the formula, the basic dielectric constant, the fractal width and the frequency of the antenna resonance. The microstrip antenna system can be used either alone or combined with other related components. In any case, the designer offers a step-by-step process for designing elements The overarching goal of the project is to obtain those output characteristics at a generally specified level of operations. Once the Microstrip antenna design achieves these thegoals, the first option is to choose the right geometry for the antenna. A fractal antenna can be created using the technique mentioned in the next substrate selection.The first design step is the selection of a suitable dielectric substrate with the corresponding tangential thickness h and losses. A thicker substrate is mechanically stronger, but increases radiation energy, reduces loss in the conductor and increases resistance. However, weight, dielectric loss, surface wave reduction and external radiation from the probe supply also increase. The dielectric constant acts similarly to the thickness of the substrate of the substrate. A lower Ɛr value for the substrate increases the area at the edge of thepatch and thus the radiation power. A substrate with r = 4.4 is therefore preferred. For the ideal antenna (FR4), the substratum thickness H = 1.6 mm and the dielectric constant Ɛr = 4.4 are taken into account. Width and length of the component. A design phase that leads to the final design of the fractal is defined based on basic terms.

B. Design Procedure

Step 1: Width Measurement (W) the dynamic width for an effective radiator which gives the best radiation efficiency is calculated by the transmission line modelequation. Where M and N are L and W modes, respectively. Rate and wavelength ofresonance from the patch W.

$$f0 = c / 2 \sqrt{Ɛeff ((m/L)2 + (n/W)2)}$$

Step 2: Effective Permeability Measurement(Ɛreff) Effective permeability is obtained by referring to the following equation. If Ɛreffis the effective permeability, Ɛr is the dielectric substrate constant, h is the dielectric substrate height, and w is the width of the patch.

$$Ereff = (Er +1) / 2 + (Er -1) / 2 (1 + 12 W/ h) 1⁄2$$

Step 3: Calculation of the active period (Leff) The total period is calculated using equation

$$Leff = L +2\Delta L$$

Step 4: Calculate the amplitude (ΔL) of the length. Using the equation, you can get the value of L

$$\Delta L = 0.412h (Ereff + 0.3) (W/h + 0.264) / (Ereff – 0.258) (W/ h + 0.8)$$

Step 5: The actual length of the patch (L) is calculated by the impression of the actual length of the received patch

$$L = Leff - 2 L$$

Step 6: Calculation of field measurements (Lg, Wg), configuration of the transmission line only extends to limitless dirt. It is therefore necessary for practical purposes to have a small ground plane. Similar results have been shown for finite and infinite floors when the ground floor is approximately six times the patch size. Therefore, for this design, the horizontal dimensions of the floor are

$$Lg= 6h + L (3.6), Wg= 6h + W$$

V. Simulated Results andanalysis

The antenna is modeled using the ADS simulation tool to determine the recommended antenna characteristics. The effects of tuning antenna parameters are investigated for analysis of multi-band antenna coverage. Antenna analysis for various parameters was performed by changing one parameter and keeping the other parameters constant.

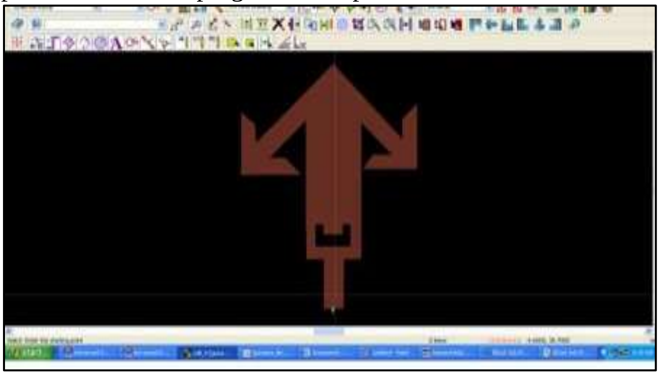


Fig. 3: Proposed Antenna Geometry

The antenna's built values are optimized with ADS device. The optimization for optimal impedance bandwidth was done. The proposed antenna's simulated return loss"S 11" is shown in the Figure. This specifically shows that the multi-band antenna resistance frequency is 6.3 at 6.62 GHz, 7.42 at 7.58 GHz, 10.45 at 10.83 GHz, and the resonances are 6.325.7.464 and 10.60 GHz, respectively. For this reason, four key parameters must be met: antenna bandwidth, antenna gain, antenna loss return, and antenna radiation pattern. With these parameters, you can understand if the antenna you are designing is the best design for your application.

VI. Return Loss

Backflow loss is a measure of the performance of a microstrip antenna feed. The echo frequency of the model antenna is 6.325 GHz, 7.464 GHz and 10.60 GHz. The return loss of the proposed fractal antenna inthe boom design is -11 dB, -28 dB and -30 dB.

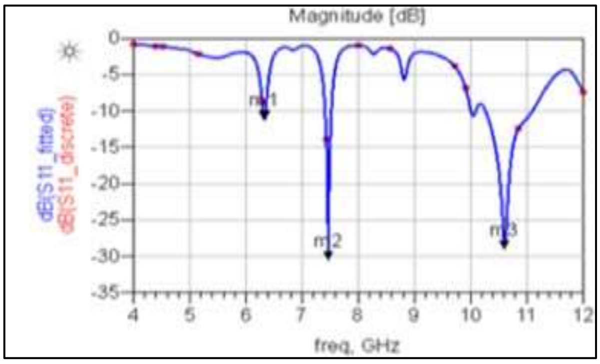


Fig.4 S11Response of Rectangular patch antenna

VII. RADIATION PATTERN

The important parameter is antenna radiation pattern. This parameter is highly a function of the antenna program. We had to have an Omni directional radiation pattern inthe case of the antenna our group built. Which means the radiation pattern had to be uniformly distributed across the antenna 360 degrees. The reason for this is that the emitted signal should be distributed as muchas possible so that the receiver can receive the transmitted signal since the transmitter location is not assigned. At 6.325, 7.464, 10.60 GHz, the simulated radiation pattern of level E and level H is achieved. The H plane was found in the omnidirectional andE plane, and the radiation pattern was 6.325 GHz.

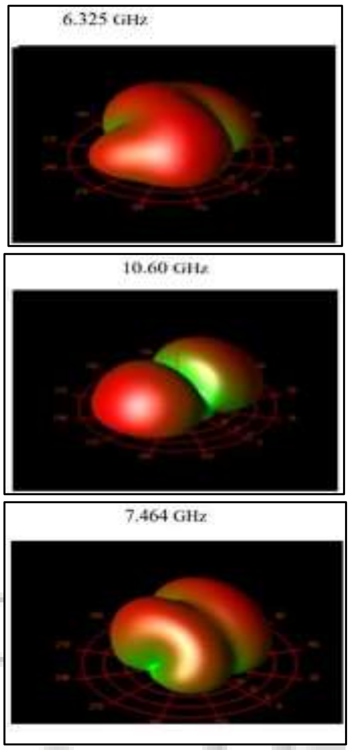
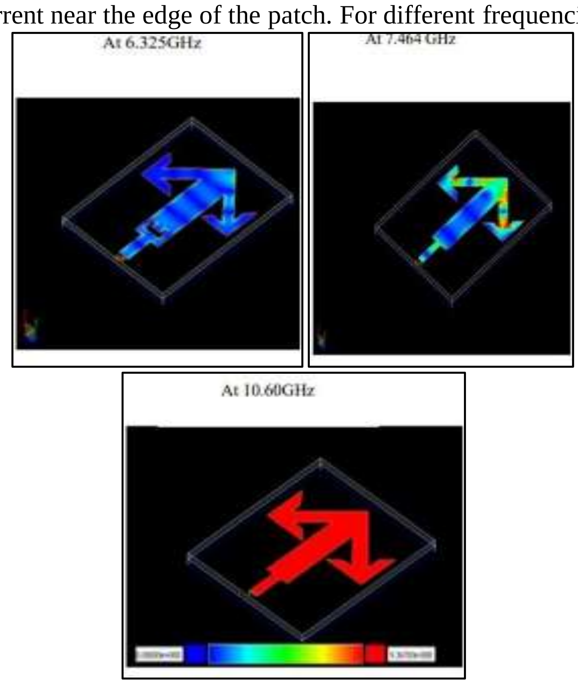


Fig. 5: 3D-Radiation Pattern

VIII. SIMULATED CURRENTDISTRIBUTION

The actual distribution of the proposed antenna is obtained taking into account the optimal values of the design parameters shown in the figure, which is frequency 6.325 GHz, 7.464 GHz, 10.60 GHz. The highest possible radiation at these frequencies is shown to be due to the distribution of current near the edge of the patch. For different frequencies



IX. CONCLUSION

In this paper, an arrow shaped the fractal antenna has been developed for resonance at 6.255 GHz, 7.464 GHz, 10.60 GHz and includes wireless applications such as remote sensing and RF applications, radar applications, IEEE 802.11a, UWB, high- frequency satellite applications. In this analysis, the physical parameters investigated include the substrate and its permitting, supply lines, solid soil structure and soil surface drainage The suggested design of antennas measures parameters such as operating frequency, input impedance, VSWR, distance, return path, direction and gain. Check the radiation pattern, bandwidth, gain and loss of revenue by changing the position of the supply line, the length and width of the proposed fractal component. The main goal of this project was to make UWB applications capable of the antenna. This was done as we can see in the simulations and First the antenna size is suitable for such applications, the properties of then the antennas are very promising. Theinput impedances are very close to 50 times, the return loss is below -10dB which is our margin, which means that the VSWR is always below 2. We conclude with reasonable performance that the proposed antenna is capable of working at 6.325GHz, 7.464GHz and 10.60 GHz. We conclude that the objectives of this assignment have been successfully achieved.

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