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Design of Smiley Shaped Fractal Antenna for Multiband Applications Using HFSS

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ABSTRACT: The objective of this paper is to design and analyse a novel Smiley shaped fractal antenna and simulate proposed antenna for multiband applications. Designing an antenna of compact size for portable wireless devices is one of the challenges. This proposed novel design of SFA has some uniqueness, such as compact size, antenna design with basic circle geometry, low cost, nearly omnidirectional. The simulated and measured results of the proposed antenna are also analysed.The use of fractal geometries has meaningfully impacted many areas of science and engineering, one of which is antennas. Antennas using some of these geometries for numerous telecommunications applications are already obtainable commercially.
Keywords: Smiley shaped Fractal antenna (SFA), Fractal antenna (FA)

I. INTRODUCTION

Modern telecommunication systems involve antennas with wider bandwidths and smaller dimensions than predictably possible. This has originated antenna research in several directions, one of which is by consuming fractal shaped antenna elements. In recent years numerous fractal geometries have been introduced for antenna submissions with varying degrees of achievement in improving antenna characteristics. Yet no momentous progress has been made in corroborating fractal belongings of these geometries with appearances of antennas.These are low profile antennas with moderate gain and can be made functioning at multiple frequency bands and hence are multi-functional. In this work the multi-band feature of antenna designs are discovered further with special importance on recognizing fractal properties that impact antenna multi-band characteristics. Antennas with condensed size have been obtained using Hilbert curve fractal geometry. Furthermore, design equations for these antennas are attained in terms of its geometrical parameters such as fractal dimension. Antenna properties have also been associated to fractal dimension of the geometry.

1.1Fractal theory:

In recent wireless communication structures wider bandwidth, multiband and stumpy profile antennas are in excessive demand for both commercial and military solicitations. This has originated Antenna research in various guidelines; one of them is expending fractal shaped antenna elements. Conventionally, each antenna operates at a single or dual frequency bands, where different antennas are necessary for different applications. Fractal shaped antennas have previously been proved to have some exclusive appearances that are linked to the various geometry and possessions of fractals. Fractals have been applied in countless field like image compression, analysis of high altitude lightning singularities, and rapid studies are apply to generating new type of antennas.. Fractals are geometric forms that can be found in nature, being obtained after millions of years of evolution, assortment and optimization. There are many benefits when we functional these fractals to cultivate numerous antenna features [2].

1.2 Smiley Shaped Fractal Antenna:

This anticipated novel design of SFA has some individuality, such as compact size, antenna design with basic circle geometry, little cost, approximately omnidirectional, and it shields the complete UWB band frequency 3.1–10.6 GHz. N-notch and a ground slit have been familiarized in order to accomplish the desired UWB characteristics as defined by FCC[9]. The contamination pattern of our suggested antenna is omnidirectional, which makes this antenna a good applicant for UWB based wireless submissions. Need for introducing ground slit and N-notch is discussed. The simulated and dignified results of the proposed antenna are also investigated.

1. Simulated Results:Smiley Shaped Slot Antenna (Photograph in HFSS) Figure

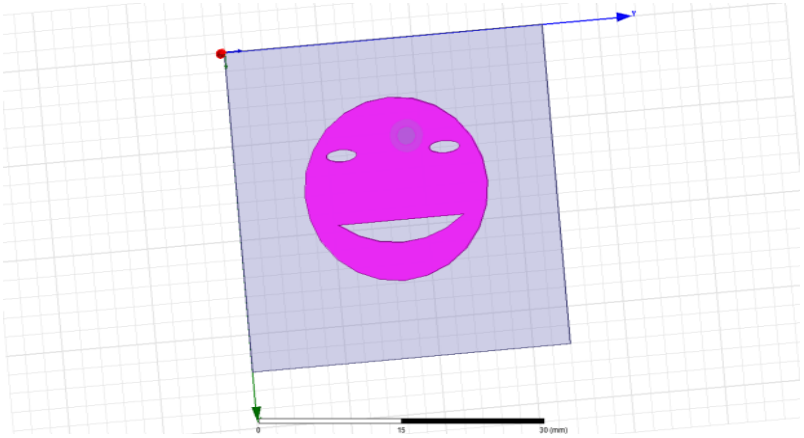

Figure 1: Photograph of Smiley Shaped Slot Antenna

Slot antenna: A slot antenna consists of a metal surface, usually a flat plate, with a hole or slot cut out. When the plate is driven as an antenna by a driving frequency, the slot radiates electromagnetic waves in a way similar to a dipole antenna. Slot antennas are used typically at frequencies between 300 MHz and 24 GHz.The currents travel around the slot perimeter increasing the electrical length. As such, a slotted small size antenna is made to perform equivalent to its larger counterpart.

1) Return Loss parameter of Smiley Shaped Slot Antenna (Figure 2)

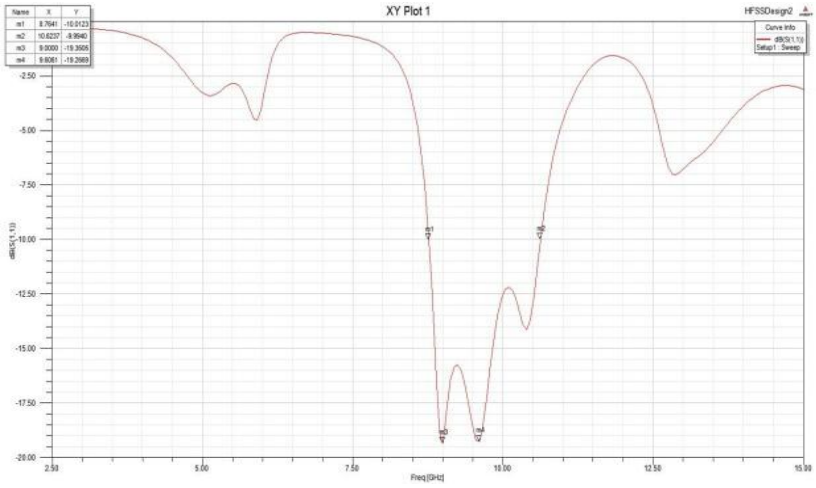

Figure 2: S11 parameter (Return Loss) OF Smiley Shaped Slot Antenna

Return loss:

In telecommunications, return loss is the loss of power in the signal returned/reflected by a discontinuity in a transmission line or optical fibre. This discontinuity can be a mismatch with the terminating load or with a device inserted in the line. The return losses of the proposed antennas were studied using HFSS.

1) Return loss is related to both standing wave ratio (SWR) and reflection coefficient (Γ).

2) Increasing return loss corresponds to lower SWR. Return loss is a measure of how well devices or lines are matched.

3) A match is good if the return loss is high. A high return loss is desirable and results in a lower insertion loss.

2) Return loss is used in modern practice in preference to SWR because it has better resolution for small values of reflected wave.

Total Gain of Smiley Shaped Slot Antenna (Figure 3)

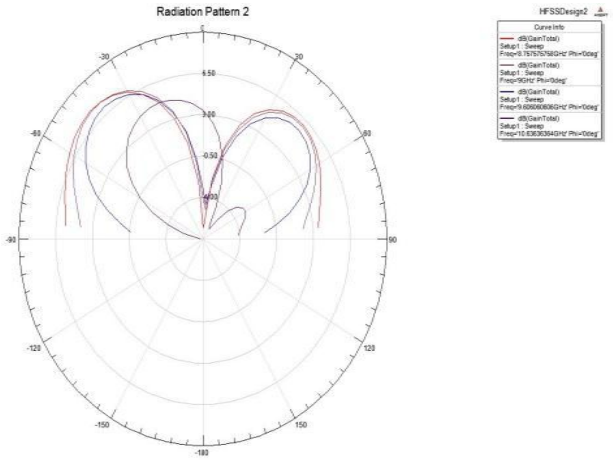

Figure 3: Total gain of smiley shaped slot antenna at all resonant frequencies

2.To validate the designed fractal antenna system.
Design: Smiley shaped Microstrip patch antenna

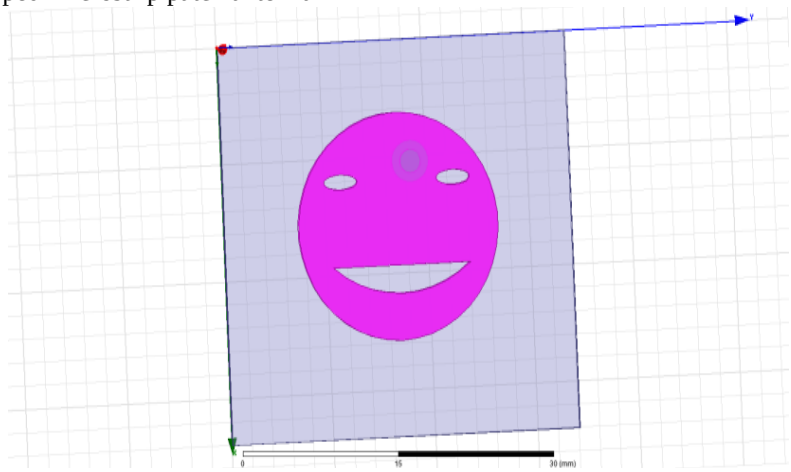

Fig.4 Photograph of Smiley Shaped Fractal Antenna

II. RESULTS OF SMILEY SHAPED MICROSTRIP PATCH ANTENNA

Figure 5. Shows the input reflection coefficient of the smiley shaped fractal antenna.

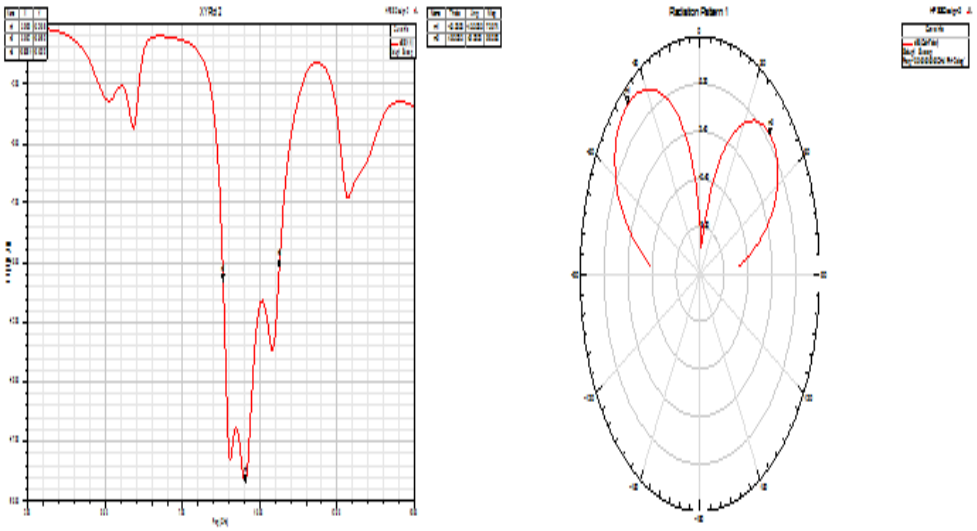

Fig.5 S11 parameter of smiley shaped fractal antenna Fig.6 Total Gain of smiley shaped microstrip antenna

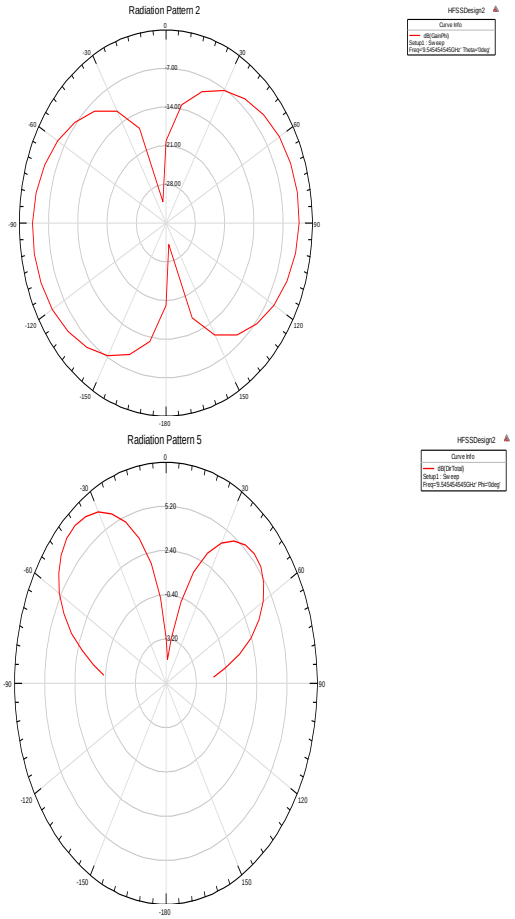

Fig. 7 Azimuth Pattern of smiley shaped microstrip Fig. 8 Total Directivity of Smiley shaped fractal antenna antenna

Dimensions of Smiley shaped microstrip patch antenna

Radius of circle – 9.75 mm

Position of first ellipse – x = 12mm, y = 11.5 mm, z = 1.2 mm

Major Radius (1^{st} ellipse) = 0.65 mm

Position of 2^{nd} ellipse = x = 12.5 mm, y = 22.5 mm, z = 1.2 mm

Major Radius (2^{nd} ellipse) = 0.65 mm

Position of arc – (Position 1) x = 19.3 mm, y = 10.5 mm, z = 1.2 mm (Position 2) x = 19.5 mm, y = 23.7 mm, z = 1.2 mm

III. CONCLUSION

A Novel smiley shaped Fractal Antenna has been proposed designed and fabricate. A complete parametric study has been performed in order to obtain an optimal design with each parameter investigated carefully. The radiation pattern of proposed antenna is omnidirectional which make the antenna good for wireless application. The proposed antenna is of small size, low cost. The procedure proposed in this paper can be applied in HFSS software thus; practical implementation will be simple and effortless.

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