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A Novel Micro Strip Fractal Fork Antenna for Digital Broadcasting Applications

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Abstract: - The design of a novel microstrip fractal fork antenna with parasitic patch and double substrate layers for Broad Casting applications has been proposed. The proposed antenna can be used in military satellite communications, weather monitoring, air traffic control, terrestrial broadband, and amateur radio. The antenna's dimensions are 40mm*40mm*2.3mm. The antenna has shown a return loss of -50.89dB at 9.54GHz. Far field pattern is calculated at 9.54GHz. The entire simulation is done using CST Microwave Studio.

Keywords: - Antenna, Broad Casting applications, far field pattern, fork, fractal, micro strip and return loss.

I. INTRODUCTION

An antenna is an electrical transducer which converts electrical input signal into electromagnetic waves. Antennas are widely used for broad casting information. The continuous shrinking size of electronic equipments demands similar size antenna elements in order to fit properly in wireless devices without compromising the other radiation properties of the antenna. Hence, the demand for microstrip antennas is increasing day-by-day.

When a micro strip is excited on one end, it acts as an antenna. A micro strip antenna is constructed by mounting a radiating patch on a dielectric substrate. The other side of the dielectric substrate has a ground plane. The patch and the ground plane have very good conducting properties. The patch and the feedlines are mounted on the dielectric substrate by a process called photo-etching. To simplify the analysis and performance prediction, the patch is generally square, rectangular, circular, triangular, and elliptical or some other common shape [6].

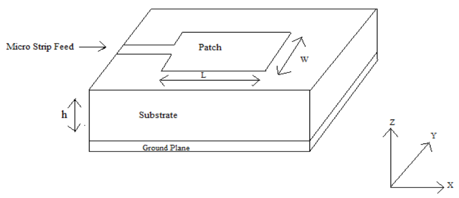

Figure1: Perspective view of micro strip antenna.

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II. BASIC FORK ANTENNA DESIGN

The basic fork antenna has a ground plane made of copper with the following dimensions i.e., length is 40mm, width is 40mm (square patch) and thickness 3.7mm. A substrate is present on the ground plane and the substrate is made from the material FR-4 (lossy), having dielectric constant (ϵ_r) =4.3 and μ =1. The substrate has the same dimensions as that of the ground plane except the thickness or height which is 2.1mm. The proposed antenna is a series of patches which are made of copper (annealed) which is a lossy metal and has μ=1 and ρ= 8930 (kg/m^3) with the dimensions of 40mm length and 40mm width (square patch) [6].

Antenna Components	Corresponding values for the proposed antenna (mm)
Patch	L=W=40
Feed	W=4
Ground plane	L=W=40, T= 0.1
Substrate	L=W=40, T= 3.5

Table 1: Details of proposed antenna

a	20mm
b	4mm
c	2.37mm
d	15mm
e	6.625mm
f	10mm
g	40mm
h	6.75mm

Table 2: Dimensions of the patch

A micro strip fork shaped antenna is designed using the above dimensions and the prototype of this antenna is shown in figure2.

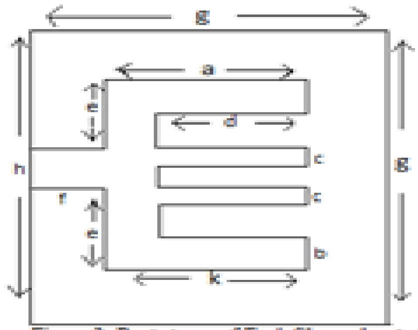

Figure2:-Prototype of Fork Shaped antenna

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The above antenna is simulated in CST microwave studio and the results obtained are illustrated in figures 3 and 4. The antenna has shown a return loss of -49.2dB at 10.02GHz as in figure3. Figure4 shows the far field directivity plot for the designed basic fork antenna. It is observed that the thickness (3.7mm) of the antenna is quite high.

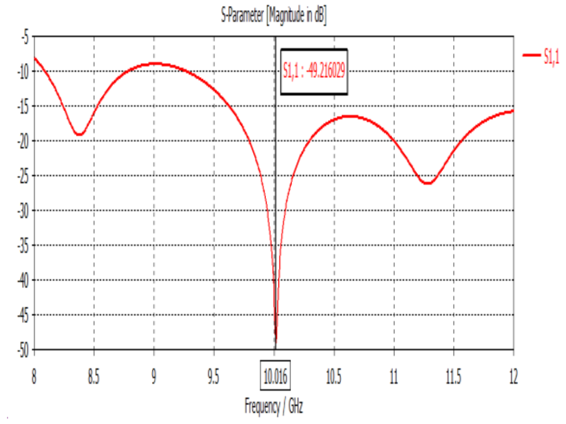

Figure3: Return Loss for the basic fork antenna

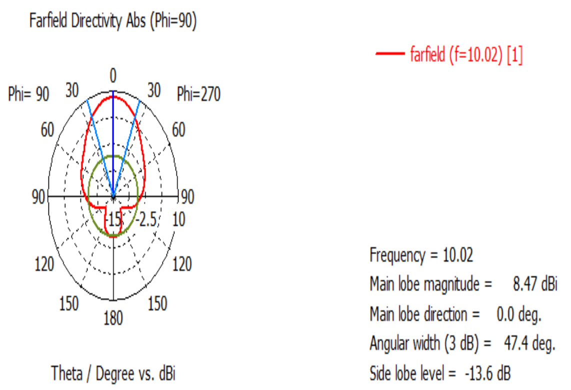

Figure4: Far field directivity plot for the basic fork antenna

III. FRACTAL FOR ANTENNA DESIGN

The above antenna is modified by adding a parasitic patch. Parasitic patch is a component of the antenna to which direct feed is not given. After adding the parasitic patch, the antenna's substrate is divided into two parts. The part immediately above the ground plane is Rogers RT6006 (lossy) and the part below the radiating patch is FR-4 (lossy).

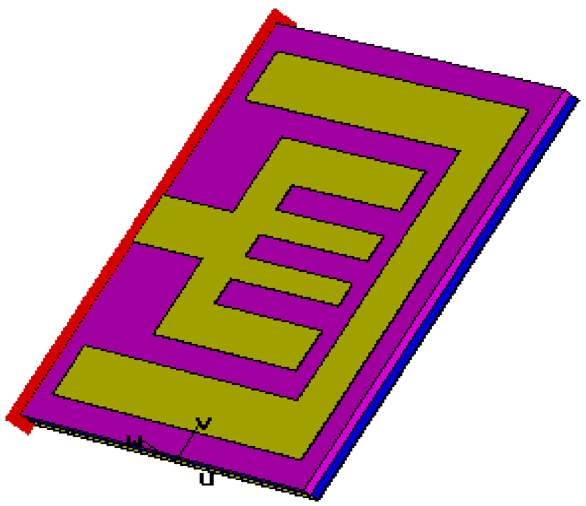

Figure5: Perspective view of double substrate layer antenna

The antenna after simulation has shown a return loss of -53.02dB at 9.792GHz as in figure6. Figure7 shows the far field directivity plot for the designed basic fork antenna. The thickness of the antenna here is reduced to 1.815mm without compromising on the antenna characteristics.

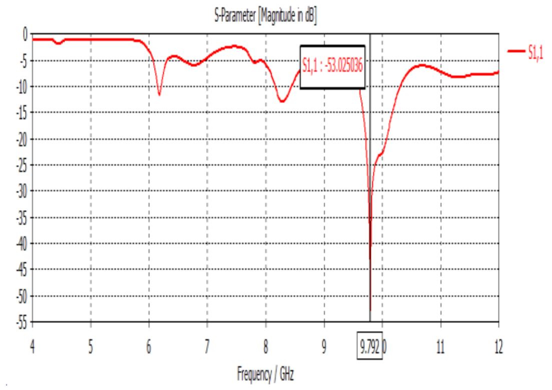

Figure6: Return Loss for double substrate layer antenna

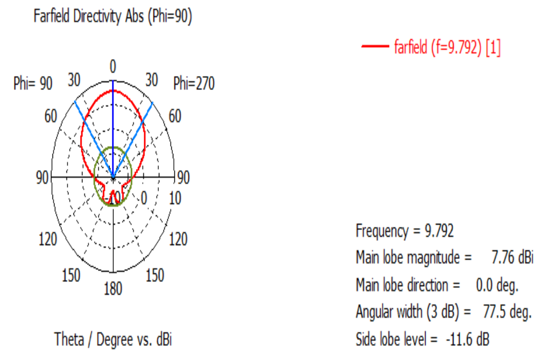

Figure7: Far field directivity plot for double substrate layer antenna

In order to reduce the side lobes effect, circular shaped fractures are etched out of the fork shaped patch and the parasitic patch as shown in the figure8. The modified antenna is simulated and the results are illustrated in figures 10 and 11.

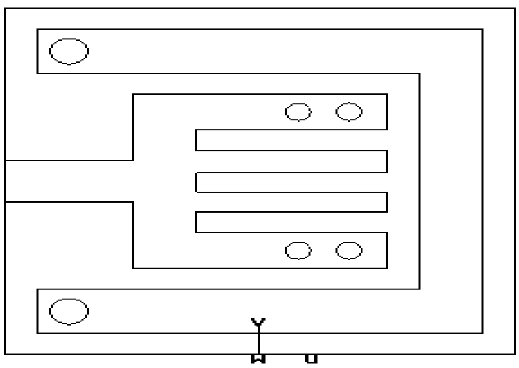

Figure8: Front view of fractal antenna

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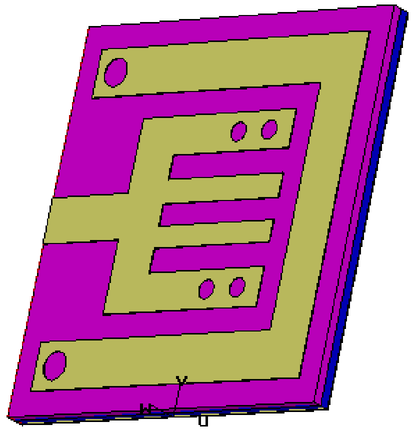

Figure9: Perspective view of fractal antenna

Observing the polar plot, it can be seen that the side lobe effect is reduced and the antenna can be used in broad casting applications.

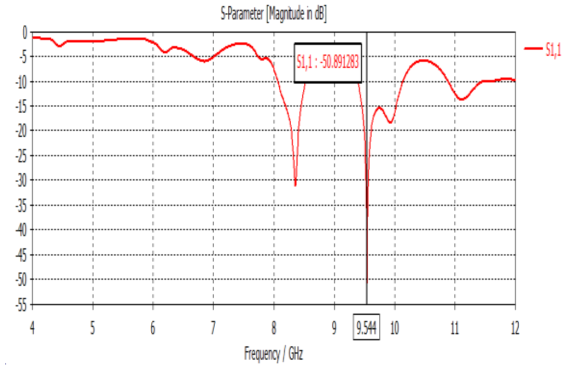

Figure10: Return Loss for fractal antenna

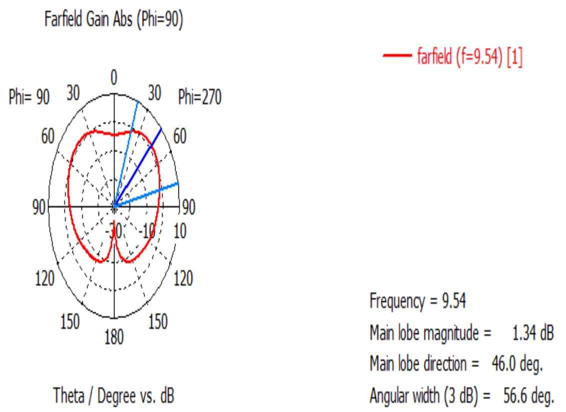

Figure11: Far field directivity plot for fractal antenna

IV. CONCLUSION

In this paper, a novel microstrip fractal fork antenna is proposed. The height of the antenna is reduced by replacing one half of the substrate with a substrate having higher dielectric constant value. The side lobe effect is reduced by incorporating symmetric circular fractures in the design.

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