A Novel Ultra Wideband Microstrip Antenna for 2.8 to 14.2 GHz Applications.

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Abstract - In this research, a compact size (UWB) Ultra wideband fractal microstrip antenna is designed and simulated for wider bandwidth applications ranging from 2.8 to 14.2 GHz. The proposed work introduces a methodology that adding of structures increases the bandwidth and minimizes the return loss. Communication systems require small size, Ultra wideband antennas. Fractal geometries have been used to fabricate ultra broad-band antennas. In addition, fractal geometries can be reducing the size of antennas. In this work, we have investigated a new fractal antenna with ultra broad-band properties. The proposed design is a loaded the 3 iteration of a new fractal geometry to a monopole CPW fed ultra wideband microstrip patch antenna. The simulation is performed via HFSS electromagnetic simulator software. The simulation proves that the proposed antenna is applicable in 2.8- 14.2 GHz frequency range.

Keywords-CPW fed Microstrip Antenna, UWB Antenna, UWB Antenna Designing, and Compact Antenna, UWB.

1. INTRODUCTION

Antenna plays such a significant role in communication systems and one of the main part of ultra wideband (UWB) communication systems. UWB communication systems require smaller antennas with large bandwidth, thus the design, simulation and manufacturing of these antennas are very essential. This is the main reason of wide research on UWB antennas in recent years. There are many techniques; One of the good technique is using fractal geometry to design of Ultra wideband antennas. Applying fractals to the antenna geometry allows for smaller size, multi-band and broad-band properties [1-4]. Fractals have self-similar structure and can be subdivided into small parts such that each part is a reduced size copy of the main geometry. Self-similarity of fractals provides multi-band and broad-band properties and their unusual shapes provide design of antennas with small size. Fractals have convoluted and serrated shapes with many corner as these discontinuities increases the bandwidth and the effective radiation pattern of antennas. Fractals can be placed all along the electrical length in to a small area using their facility of space-filling [5-9].

In this paper, new fractal geometry is proposed. By applying this fractal generator to proposed antenna elements, we have achieved a Ultra wideband antenna.

The Finite Element Method (FEM) based electromagnetic simulator HFSS has been used for the design and simulation of the proposed antenna. This new fractal antenna is applicable in 2.8 GHz-14.2 GHz. Also, the radiation patterns are studied in multi frequencies.

2. ANTENNA DESIGN

In general, the bandwidth of a microstrip patch antenna is not very wide because it has only one resonance mode. Thus, to design a Ultra wideband radiator, two or more resonant parts with each part operating at its own resonance is essential, and the overlapping of these multiple resonances mode may lead to broadband operations. Therefore, this design is chosen to generate two or more resonance bands for achieving wide bandwidth . In addition, the conventional Ultra wideband monopole antenna using a solid ground plane on the further side, in this design, the two grounds were designed on the same plane of the monopole as shown in Fig. 1.

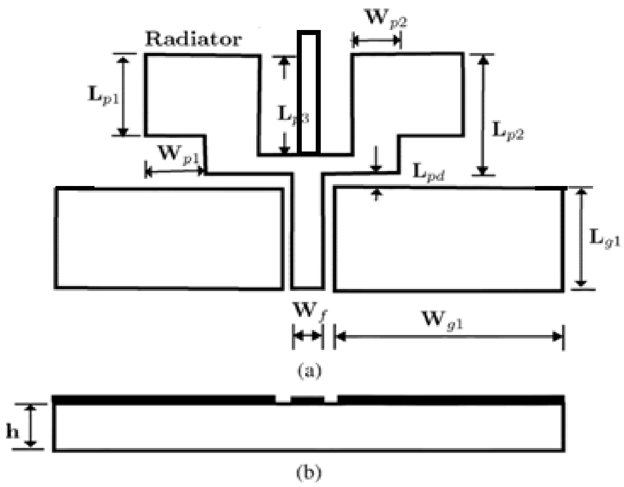

Fig. 1.The proposed Ultra wideband microstrip antenna.

The design skills are introduced to obtained Ultra wideband accompanied with good impedance matching above the entire operating band. The basis of the monopole antenna is a rectangular patch, which has the specification of length L_{p2} and width W_{p3}, and is produce with two ground structure strips from the patch's both sides.

As for the ground plane, distinct the general use of a solid rectangular plane for a microstrip line fed monopole antenna, ground planes are set in from the patch's left and right sides on the same plane of patch to provide the CPW feed. The overall size of the antenna is 25x25x1.6 mm^3, and each of the surrounded grounds has a vertical section of 25 mm as well as a horizontal section at the upper and bottom structure of 10.5 and 10.6 mm, respectively. The width of the CPW microstrip feedline is fixed at 3.0 mm to achieve 50 Ω characteristic impedance. Since the antenna is surrounded by a ground plane for reducing the antenna area, the small gap between the patch geometry and the ground plane is a major factor to cause very strong capacitive coupling. The horizontal feed section (x-axis) is separated from the ground by a gap of 0.4 mm (Fig. 1). The detailed dimensions of the proposed Ultra wideband antenna are listed in Table I. This UWB antenna was simulated using HFSS software by keeping the substrate of a 1.6 mm thick, FR4_epoxy substrate permittivity of 4.4 and a loss tangent of 0.02.

Table I. Design Parameters of the Proposed Compact Wideband Microstrip Antenna Shown in Fig.1

Parameters	Lp1	Lp3	Lg1	Lg2	Lpd
Unit (mm)	5	6.5	8	1	0.8
Parameters	Wp1	Wp2	Wf	Wg1	Wg3
Unit (mm)	2.5	2.5	1	10.6	1.5

3 SIMULATION AND RESULTS

The electromagnetic waves solver, Ansoft HFSS, is used to investigate and optimize the proposed antennas configuration.

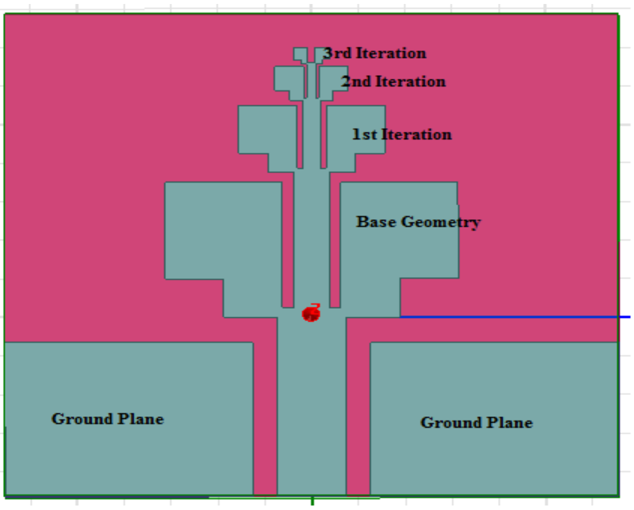

Fig.2 Proposed geomtery with 3rd Iteration of fractal.

Fig. 3, shows the simulated return loss of the proposed antenna with the iteration optimized parameters. Obviously, the simulation results the ultra wideband of frequency for which the antenna designed is optimized i.e., 3 to 14.1 GHz with S11 value beyond -10 dB and the range of frequencies as per the results shows it has a wider bandwidth as compared to other microstrip antenna..Comparative results are mention in Table II.

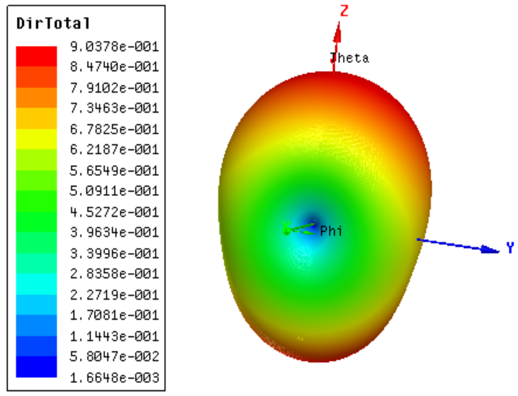

Fig.3 Radiation Pattern at 4.5 GHz

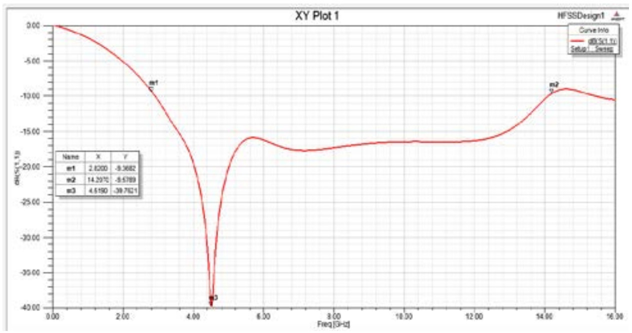

Fig.4 return loss for 3rd Iterstion of fractal.

Table II Comparative results

Geometry	Freq (GHz)	S_{11} (dB)	VS WR	Gain	Bandwidth (GHz)
Base Geometry	4.5 GHz	-31.5 dB	1.2	0.8 dB	11.1 GHz
Fractal 1st Iteration	4.4 GHz	-38.5 dB	1.1	0.9 dB	11 GHz
Fractal 2nd Iteration	4.6 GHz	-30 dB	1.5	0.7 dB	11.1 GHz
Fractal 3rd Iteration	4.5 GHz	-40 dB	1.1	0.9 dB	11.4 GHz

4 CONCLUSION

In this paper, a compact UWB microstrip antenna is proposed. The measured results of the simulated antenna show stable radiation patterns over the whole of the ultra wide band frequency of 4.5 GHz. The good impedance matching characteristic, constant gain, and an omnidirectional radiation patterns over the entire operating range 2.8 to 14.2 GHz make this antenna a good choice for WB applications.

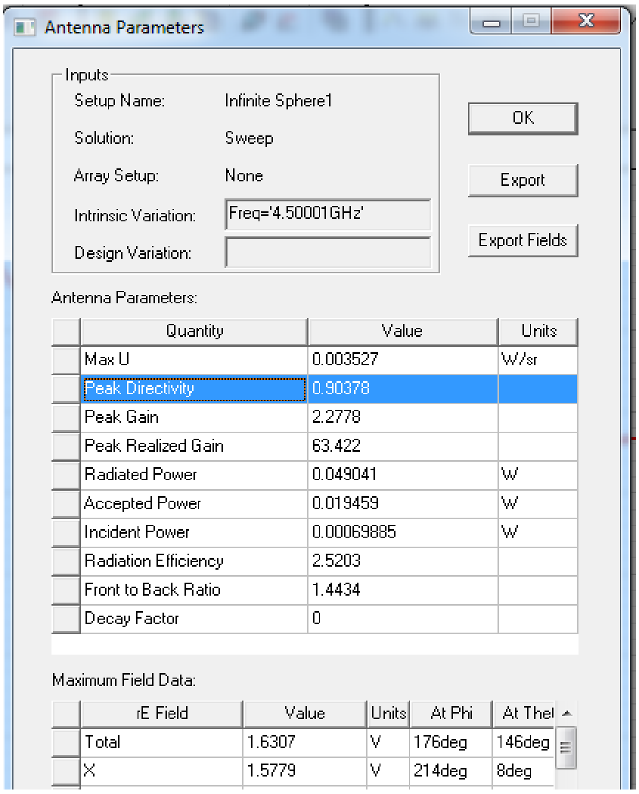

Fig 5 Computed Result for 4.5 GHz.

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