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Design and Stimulation of New Fractal Antenna with Improved Return Loss at Various Frequencies for Ultra Wide Band Applications

Deepti Singh[1], Sukhwinder Kumar[2]

Student, Electronics and Communication, Thapar University, Patiala, India [1]

Associate Lecturer, Electronics and Communication, Thapar University, Patiala, India [2]

Abstract: In this paper the design of micro strip feed ultra wideband fractal antenna under different resonance frequency. A single feed compact fractal antenna for multi band is demonstrated in this paper. Five iteration is introduced over the patch for reducing the resonant frequency. Four resonant frequencies at 1.95 GHz, 3.6 GHz, 4.8 GHz, and 6.4 GHz respectively are obtained for the proposed antenna. The experimental results of fractal antenna shows ultra wideband characteristics from frequency range of 1.8GHz to 6.5 GHz.CST software is used to design and stimulate the proposed antenna and extensive analysis of return loss is done for the same.The simple design of proposed antenna makes it suitable for application in UWB,C band and satellite communication.

Keywords: Fractal, ultra wideband (UWB) antenna, Partial ground plane, Micro strip feed-line.

I. INTRODUCTION

The recent progress in UWB wireless communication applications have remarkably increased the demand for wideband antennas with smaller dimensions than conventionally possible[1].Wideband antennas are meant to be the most feasible antenna for the application in UWB communicationsas they have wide frequency impedance bandwidth as well as Omni directional radiation pattern along with simple structure to be designed. This makes them easy to be fabricated on PCBs [2]. As per the research done since years it is noticed that UWB technology helps in high-speed data transmission rate along with low power consumption.
Micro strip antennas have several advantages over conventional microwave antenna [3],

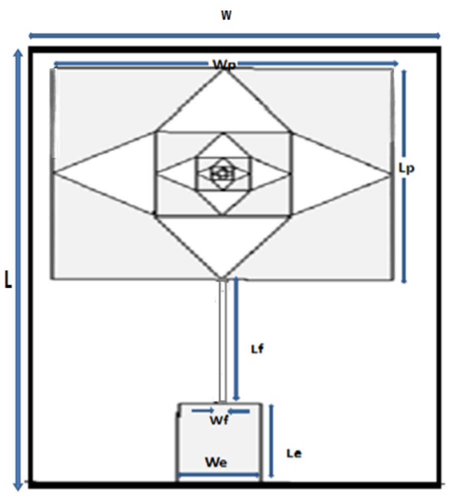

Fig 1 Geometry of the proposed antenna.

Butthe size of these antennas was the matter of concern as they were too large to be managed properly.

As in some application miniaturization of antenna was as essential requirement along with maintaining the same performance of the large antennas. Fractal geometry is considered as the solution to the problem. Self-similarity property and space filling property of fractal antenna are useful for multiband or ultra wideband feature and antenna miniaturization respectively.It can be concluded that the self similarity properties of the fractal structure are translated into its electromagnetic behaviour [5]. D. L. Jaggard et al. [6] showed that the same kind of geometrical similarity relations at several growth stages were found in the electromagnetic behaviour of the fractal body. Different types of fractal antennas discovered and their consequences have been considered in [8]. Fractal designs helps to create multiple resonance frequency.Antenna size and wavelength affects the radiation characteristics, gain, and efficiency.
The design presented in this paper is fractalgeometry with microstrip feed which is used for achieving ultra wideband bandwidth [4].The results show that the proposed fractal antenna can achieve a return loss less than -10 dB over a bandwidth in the range of 1.9 GHz to 6.4 GHz.

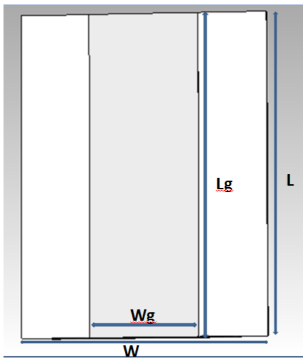

Fig2 Modified ground plane

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Several modifications have been done in antenna structure like increase in the number of iteration, introduction of partial ground plane to achieve desired bandwidth and return loss. This paper present UWB antenna which resonates at 4.8 GHz. The designed antenna resonates at multiple frequencies of 1.95 GHz , 3.6 GHz,4.8 GHz, 6.4 GHz which are used for personal communication satellites (PCS), WiMax (3.3GHz-3.8GHz),WLAN(IEEE 802.11) and satellite applications respectively.Further description of design of the proposed antenna is done in section II. The simulated results of the proposed antenna are shown and discussed in section III.
Conclusions of this paper are given in the section IV.

II. ANTENNA DESIGN

The design of the proposed UWB microstrip fed fractal antenna is shown in Fig. 1 and the modified ground plane is shown in Fig 2.The antenna demonstrated in this paper is generated by combining the rectangular and triangular geometry. The recursive procedure for generation of antenna using fractal geometry is used. The 1st iteration is formed by triangles between two rectangles. The higher order iteration of the antenna could be achieved by repeating the above mentioned iterative process. Generation of Fractal antenna is an iterative procedure, where an initial structure called generator is replicated many times at different scales, positions and directions, to grow the final fractal structure [7]. Here the triangles between rectangles works as the initiators in the evolution of the required fractal design .The initial structure of antenna before applying the fractal geometry is in Fig. 3 .

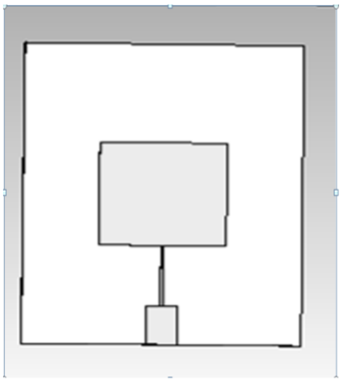

Fig 3 Zero iteration

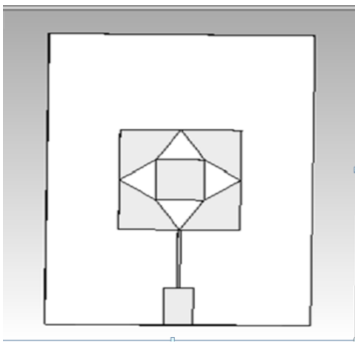

Fig 4 First iteration

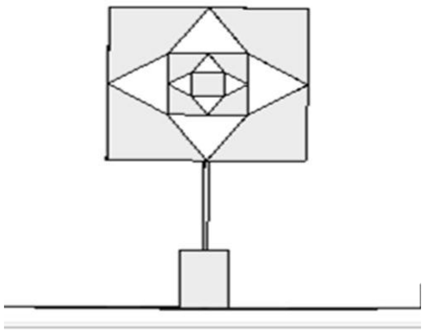

Fig. 5 Second iteration

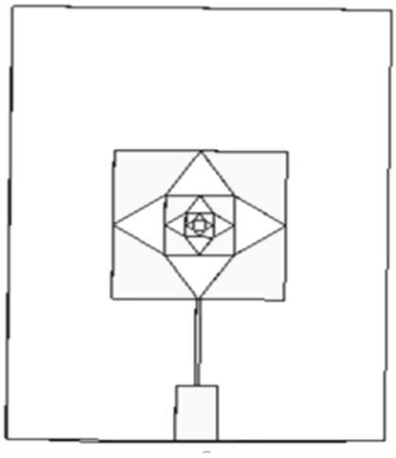

Fig. 6 Third iteration

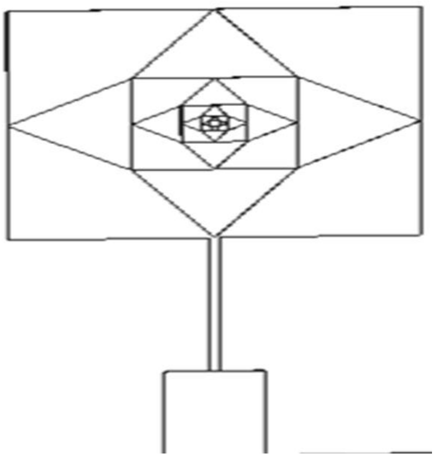

Fig 7 Fourth iteration

Here Fig. 4, Fig. 5, Fig. 6, Fig. 7shows the structure of antenna after applying 1^{st}, 2^{nd}, 3^{rd} and 4^{th} iterations. In this paper the antenna is etched on an economical roger RT5880 dielectric substrate of thickness 1.57 mm relative permittivity Єr = 2.2 and loss tangent of 0.0009. Therefore RT5880 is chosen as a basic structure of proposed antenna due to good radiation and characteristic of wideband operability. The length and the width of the dielectric substrate are L = 120mm and W = 90 mm respectively. In

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this paper 50Ω characteristics impedance micro strip feed line has been used. The size of the radiating patch is Lp=40mm and Wp=40mm with thickness 0.2mm. A partial conducting ground plane with thickness 0.2mm is placed on the other side of the substrate. The modified ground plane is placed at the other side of substrate with length Lg = 120 mm and width Wg = 40 mm.

III. MEASURED RESULTS AND DISCUSSIONS

The stimulations are done using CST microwave studio 2014. The stimulated return loss curves derived using different iteration are shown in Fig 8.The -10 dB return loss bandwidth according to the proposed antenna is 1.9GHz to 6.4 GHz which gives a total bandwidth of 4.5 GHz. The best results are obtained for 4th iteration. It shows that the return loss of proposed antenna increases if number of iteration is increased. Iteration plays important role in achieving ultra wide band frequency. Result after 4th iteration is shown in Fig 8.

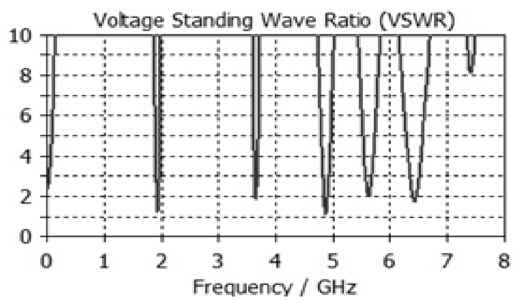

Fig 8 Simulated return loss curves for fourth iteration

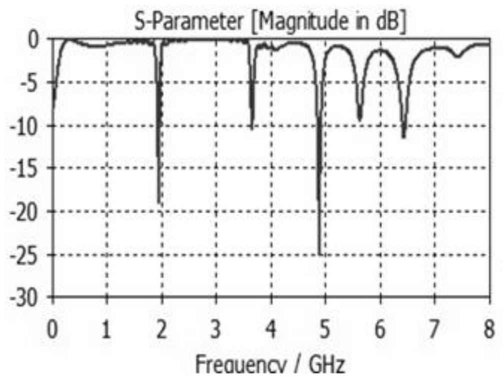

Fig 9 VSWR magnitude of the antenna.

It is noticed that if we increase the number of iteration than the performance of antenna can be increase. So to achieve better performance more iteration is done on the proposed antenna. The stimulated return loss and VSWR of proposed antenna are shown in Fig. 8 and Fig. 9 respectively. For better performance and better throughout the frequency band. So from Fig 4. It can be noticed that VSWR<2 impedance matching the VSWR<2 throughout the frequency band. Far-field radiation pattern are calculated at freq 3.6 GHz, 4.8 GHz, 6.4 GHz .Nature of radiation pattern is bidirectional. E plane radiation pattern are shown in Fig. 10, Fig. 11, Fig. 12 at frequencies 3.4 GHz, 4.8 GHz and 6.4 GHz respectively. The return loss of proposed antenna increases if number of iteration is increased. Iteration plays important role in achieving ultra wide band frequency. Result after 4th iteration is shown in Fig 8.

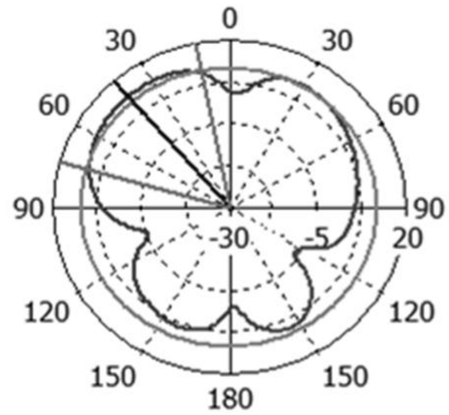

Fig 10E plane radiation pattern at 3.4 GHz

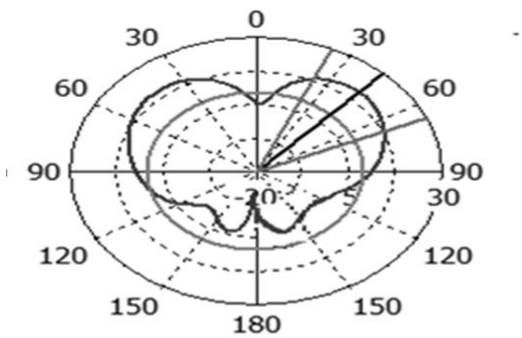

Fig 11 E plane radiation pattern at 4.8 GHz

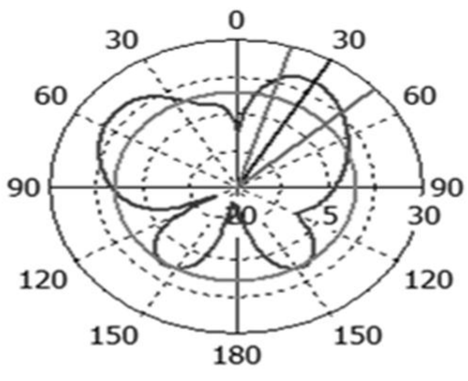

Fig 12 E plane radiation pattern at 6.4 GHz

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IV.CONCLUSION

In this paper, a UWB multiband fractal antenna with modified ground plane has been realized for bandwidth of 4.5 GHz in the range of 1.9 GHz to 6.4GHz for return loss of less than -10 dB. Designed antenna resonates at multiple resonant frequency i.e 1.95 GHz, 3.6 GHz, 4.8 GHz and 6.4 GHz.

Radiation pattern obtained are good. Further improvement is possible if more number of iteration is introduced or by further modifying the ground plane used.

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BIOGRAPHIES

Deepti Singh is a Post Graduation student who is pursuing M.E. (2013-2015) in ECE from Thapar University Patiala, India. She completed her B.tech in 2012 from career institute of management and technology, Faridabad, Haryana.

Sukhwinder Kumar is an Associate Lecturer in department of Electronics and Communication of Thapar University, Patiala, India and is in teaching profession for about 11 years. He completed his masters in engineering in electronics and communication in year 2007 from Punjab Engineering College, Chandigarh, India and received his bachelors of engineering from Beant College of Engineering and Technology, Gurdaspur, Punjab, India in 2003. His areas of specialization are embedded system and Wireless Communication Engineering.

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