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PERFORMANCE CHARACTERISTICS OF A SQUASHED UWB FRACTAL AERIAL FOR WEATHER RADAR SYSTEMS

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Abstract: In this proposal, a compacted octagonal- formed Ultra wide-band aerial along with fractal-shaped Minkowski notch and a twofold C- formed notch is offered. The projected antenna exhibits a four band frequencies operating at 3.9.GHz, 5.9.GHz, 7.9.GHz and 9.9.GHz. Furthermore, a rectangular aperture besides inserted the position plane, which helps to attain the required UWB bandwidth. The size of the planned structure is 27.1X16.6 mm^2, shows suitable matching of impedance, constant radiation pattern with superior directivity over the entire UWB frequency range. The planned structure can be used for UWB Applications such as satellite (3.7 to 4.2 GHz) and weather radar systems. This frequency band is also used in civil and military applications for maritime navigation radar systems.

Keywords: Fractal design, Compact antenna, Dual band frequencies, UWB, Radiation Pattern.

I. Introduction

Especially wide band antenna have enormous notice of exploration because lots of profit such as more information rate, less power spending, potency to fading, small spectral density, transmission facility of small-period pulse and large bandwidth [2]. Many authors have concentrating at dual band frequencies by means of different design approaches also to get dual band notched features. These systems employ the operating band from lower 3.12.GHz to higher 10.62.GHz, owed to the UWB systems for the Federal Communications Commission (FCC) [1].Latest UWB designers focussing on miniature printed antennas for the reason that their easiness of manufacture and the capability to be incorporated with former apparatus on the same PCB's. A L-shaped circularly polarised slot antenna is design by Steven Yang et.al., [3]. Thomas et.al., [4] has investigated the oval shaped disc monopole radiator for worldwide portable announcement systems and extensive broad band applications. The Monopole consists of an elliptical structure radiator by means of a hexagonal shaped position level surface, provided wide impedance bandwidth for UMTS (1.92-2.17 GHz) and UWB (3.12.-10.62.GHz) with excellent stable omnidirectional pattern.

Liang et.al., studied a in-print planar spherical monopole transmitter for U.W-B range are striking mainly as of their exciting material quality such as smallness in structure, less developed cost [5]-[7]. S. tripati et.al, [8] discussed innovative hexagonal formed structure for U.W.B monopole design through slice description. This was introduced by with a rectangular slot in the position surface which improves the reflection coefficient over the complete U.W.B functional range. Amir. H. Nazeri et.al., [9] developed a tiny spherica fractal radiating element among three reconfigurable mark elimination bands for WI-MAX, W-LAN and X- band interferences produced in UWB communication systems.

As clear from the literature survey, a fractal notch is produce with Minkowski shape imprinted by the antenna aperture to impart two frequency band designations. A rectangular notch is initiated in the surface plane to offer a large bandwidth at superior operation band. It shows the validated UWB bandwidth over the lower resonator 3.21GHz to superior 10.92.GHz with four band operation. The innovation of the reported design is the etching of two C-shaped slots placing on both sides for feed line and a fractal notch in the octagonal aerial plan which provide four resonating band designations at 3.9/5.9/7.9/9.9 GHz in addition to bandwidth enhancement in ultra wideband applications.

In this plan miniaturization is achieved in two steps, first a connection was established between fed and patch later on radiator and ground plane are corrugated for further reduction in antenna size without compromising its performance. The ultra wide bandwidth is larger than 95% fidelity factor for face-to-face operation was achieved.

The designed antenna provided the wide bandwidth from 3.2 to 12.2 GHz with the C-slot truncated ground plane and notched radiator. Experimental results provides nearly omnidirectional radiation pattern with VSWR <1.58. A fine conformity among numerical simulation and fabricated results is observed.

Section II describes the design of projected Fractal UWB aerial geometry. Implementation of the ultra wide band characteristics of the planned transmitter parameters is evaluated in provisions of return loss, gain and efficiency @ radiation patterns are validated by both simulations and measurements in section III. Finally Section IV reported the ending of the present work.

II. Planned Structure of design geometry

The introduction of minkowski fractal geometry and the use of twofold C-shaped notches helps in the operation of UWB range at four different frequency bands namely at 3.9, 5.9, 7.9 GHz and 9.9 GHz. The behaviour of the planned structure having physical substrate FR4 fed by a 50-X patch line with dielectric constant 4.44 and loss tangent of approximate 0.024 for nominal size of 26.2 × 16.5 mm^^{2} is reported in figure 1. The initiation of rectangular notch in the surface plane gives the better value for VSWR at superior desired frequency range.

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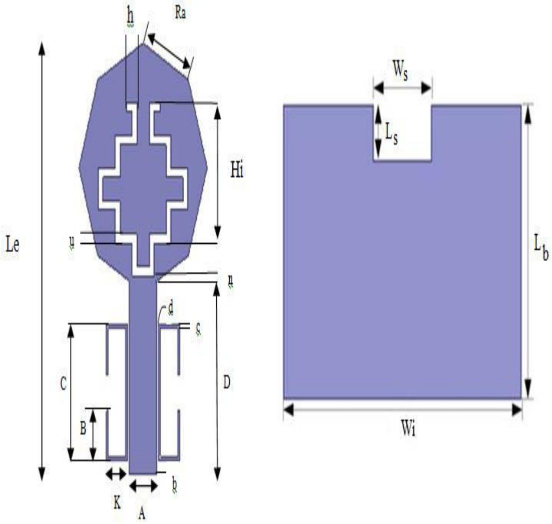

Figure-1. Planned structure of fractal aerial design

The physical constraints of proposed structure are optimized and are tabularised in Table1.

Table .1 Final construction Geometrical Dimensions

Constraints names	Proportions (mm)	Constraints names	Proportions (mm)
Le	26.2	Hi	8.6
Wi	16.5	H	1.6
Ra	5.85	C	8.1
A	3.1	K	2.4
D	11.5	B	3.01
W_s	2.1	B	1.1
L_s	4.1	N	0.45
L_b	10.6	U	0.56
D	0.21	C	0.21

The arrangement of intended structure is simulated and validated in HFSS software that are reported in figure.2.

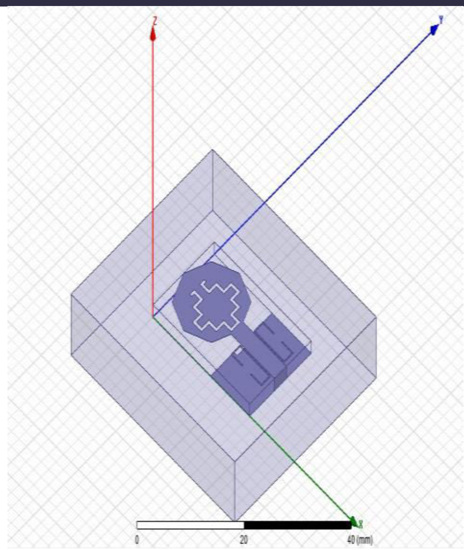

Figure -2: Projected planned arrangement in HFSS simulation method

III. Numerical Simulations and Measurement Results

Simulated and fabricated S11 parameter of the proposed design is reported in the figure-2, the importance of VSWR for four band frequencies is less than 2 will be shown in the figure-3. The value of return loss and VSWR are validated in simulation and measurement results that are tabularize in table-2. The assessment of gain for four band frequencies are more than 3dB can be obtained and are shown in figure-7.

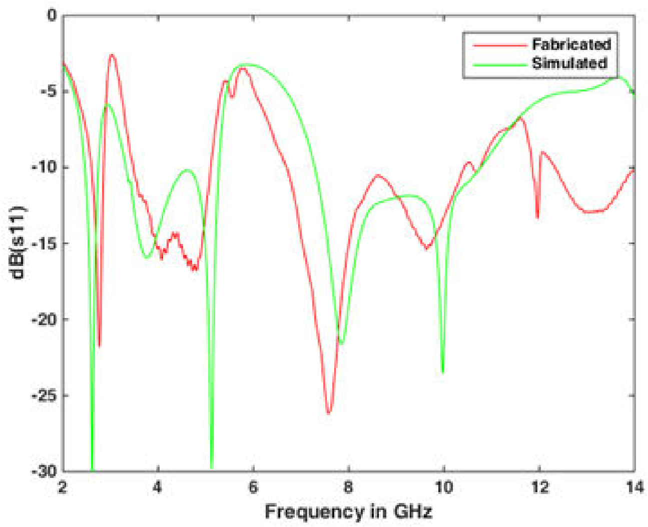

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Figure-3. Simulated and Fabricated results for Return loss S_{11}

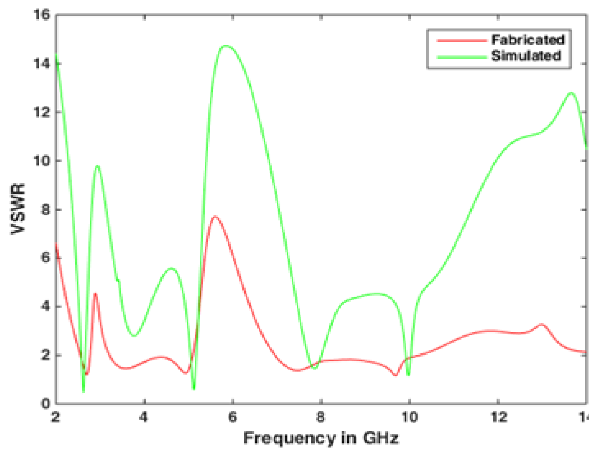

Figure-4. Simulated and Fabricated VSWR Curve

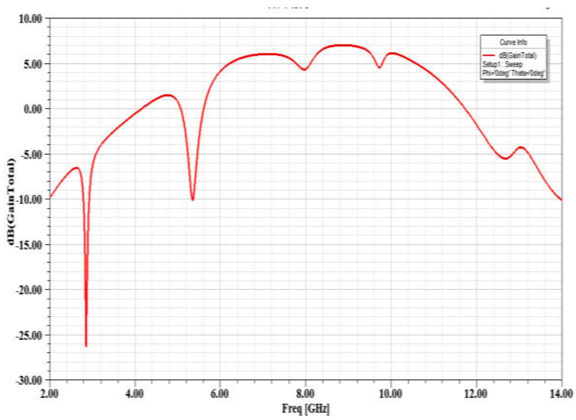

Figure-5. Gain Vs Frequency

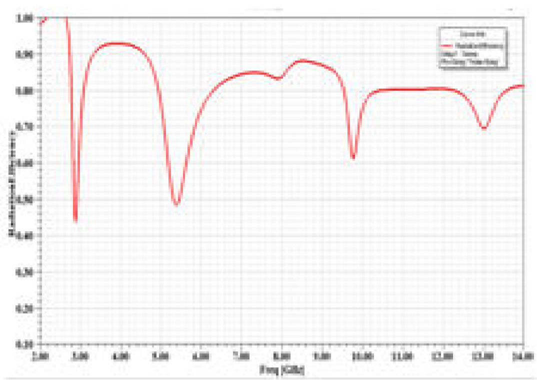

Figure-6. Plot for Radiation efficiency over frequency

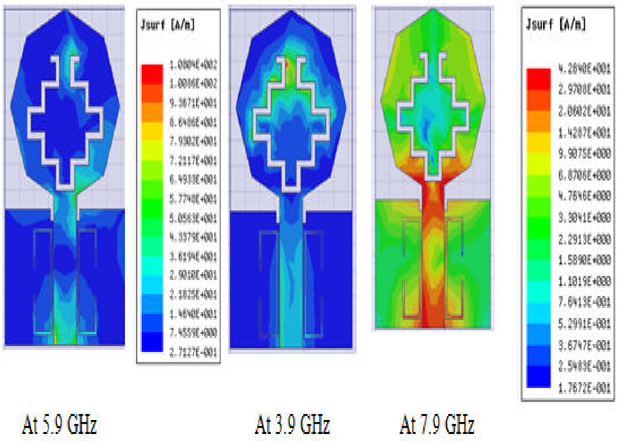

Figure-7. Jsurf Current Distribution

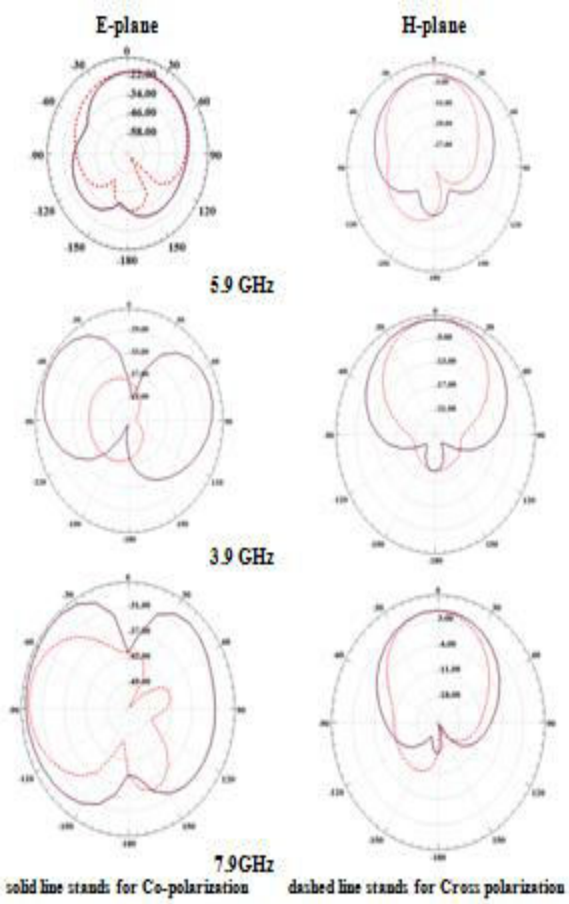

Figure-8. Polar plots of E-plane and H-plane radiation patterns

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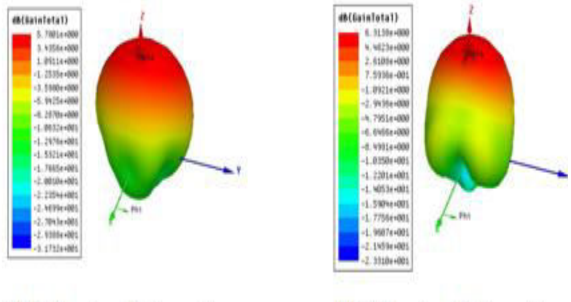

7.9 GHz gain radiation pattern | 9.9 GHz gain radiation pattern

Figure-9. Gain Radiation pattern

Figure-10. Fabricated antenna

Table-2: Results Comparison of Simulated and Fabricated antenna

Constraints	Type of antenna/ (Resonate Frequency)	3.9 GHz	5.9 GHz	7.9 GHz	9.9 GHz
S_{11} (dB)	Simulated antenna	-31.2	-32.09	-22.40	-24.05
Return loss	Fabricated antenna	-26.03	-18.02	-26.20	-17.12
VSWR	Simulated antenna	0.5	0.6	1.48	1.43
	Fabricated antenna	1.01	1.52	1.02	1.32

IV. Conclusion

As clear from the results fractal element helps to obtain band rejection at Wi-MAX (3.32–3.72 GHz) band, while twofold C-shaped notch on either side of feed line provides the band rejection at WLAN (5.25–5.625 GHz) band. Furthermore, a rectangular slot is inserted in the surface plane to obtain the required range of UWB bandwidth. The results obtained for this proposed antenna shows that the antenna provides four band frequencies namely at 3.9 GHz 5.9 GHz, 7.9 GHz and 9.9 GHz. The manufactured antenna shows proper matching of impedance and constant radiation pattern with better gain. The present radiating element can be used for UWB Applications such as Personal Area Networks, Radar Imaging Technology, weather radar systems and Automatic Target Recognition.

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