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Near and Far-Field Radiation Characterization of Super Hybrid Shaped Microstrip Antenna

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Abstract: **The near field and far field radiation patterns will give the range of radiation of the antenna in all directions. The present paper deals with the near and far field radiation characterization of super hybrid shaped serrated microstrip patch antenna. All the four sides of the patch consist of different shapes like square, triangular, pyramidal and conical with different dimensions. The performance characteristics of the proposed super hybrid serrated antenna are simulated with respect to the radiation pattern characterization. The antenna output parameters like returnloss, gain and field distribution are also presented in this paper.**

Keywords: Nearfield, farfield, super hybrid microstrip patch antenna.

I. INTRODUCTION

Larger bandwidth of serrated coupling microstrip patch antenna makes it applicable for wideband communications as a simple antenna for both transmission and reception. Edge treatments reduce the discontinuity of the reflector/free space boundary caused by the finite size of the reflector by providing a gradually tapered transition. Common reflector edge treatments include serrations and rolled edges.The serrated edge of a reflector tapers the amplitude of the reflected fields near the edge an alternative interpretation of the effects of serrations is based on edge diffraction. Serrations produce many low impedance diffractions as opposed to four straight edges and corners of the patch edge [1-5].

The antenna serrations with respect to the microstrip patch dimensions will improves the general characteristics of the radiating element but can also act to stabilize the output and reduce uncontrolled oscillations and other undesired behaviors [6-7].The impedance matching will be improved and the return loss can be analyzed interms of the serrations while using measurements of arrange of serrations in microstrip patch antennas improves the performance through ground plane edge serrations .This will include the low cross-polarization level, increased beam width and impedance tuning [8-9]. Fig. 1. Shows the model of the proposed antenna.

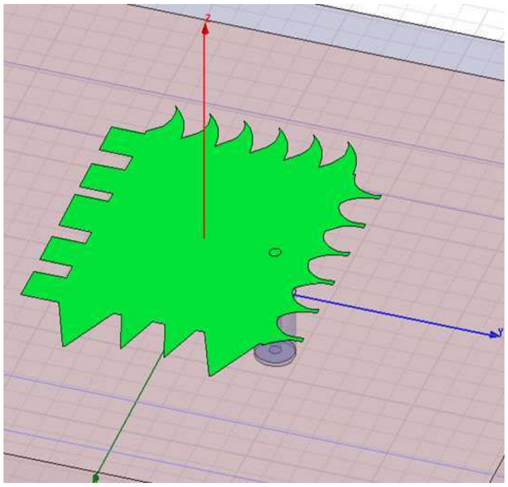

Fig.1. model of the proposed antenna

II.DESIGN EQUATIONS

The serrations described by the boundary functions are expressed as a Fourier series of width and height modulated identical segmented convex function. The Fourier series expansion is given by

$$h^{-}(x')=C_{01}+\sum_{n=-\infty}^{\infty} C_{n1}e^{\frac{jn\omega}{T}t}$$

$$C_{01}=\frac{1}{T}\{2t_1p_1+2t_2p_2(1-e^{-ap_1})$$

$$+2t_1(p_2-p_1)[1-e^{-a}(p_2-p_1)]\}$$

$$C_{n1} = \frac{1}{T}\{\frac{2t_1}{n\omega}\; e^{-a(p_2-p_1)}(\sin(n\omega p_2)-\sin(n\omega p_1))$$

$$+\frac{2t_1}{n\omega}\sin(n\omega p_2) + \frac{2t_2}{n\omega}\sin(n\omega p_1)(1+e^{ap_1})$$

$$+[a - e^{-ap_1}((a\cos(n\omega p_1) - n\omega\sin(n\omega p_1))]$$

$$+\frac{2t_2 e^{-ap_2}}{a^2+n^2\omega^2}[e^{-ap_1}(a\cos(n\omega p_1)+n\omega\sin(n\omega p_1))$$

$$-e^{ap_2}(a\cos(n\omega p_2)+n\omega\sin(n\omega p_2)))]\}$$

Where h¯(x ') represents boundary function of the serration ,C_{01} , C_{n1} represents coefficients of the serration and P_1, P_2 and t_1 ,t_2 corresponds to width and height modulation factors of the serrations respectively.

III.RESULTS AND ANALYSIS

Fig.2.shows the return loss versus frequency curve for the proposed antenna. The antenna is resonating at dual frequency with return loss of -17,-26.5dB at 4.3 and 6.6 GHz respectively. The return loss curve shows the amount of energy that is lost at the resonating frequencies when load is connected.

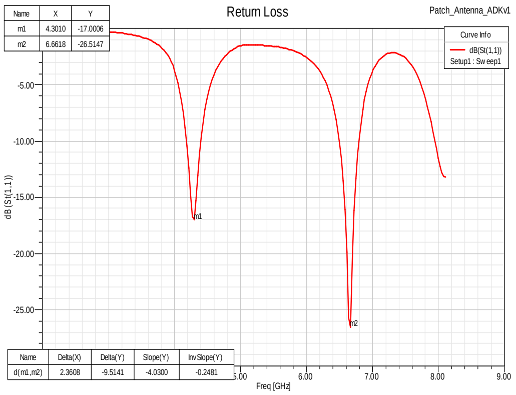

Fig .2 .Return loss versus frequency

Fig.3.indicates the input impedance smithchart.The rms obtained from the smith chart is about 0.7129 and the bandwidth enhancement is attained up to 0.80 %.

The other parameters like gain margin of 16.98 and phase margin of 258.72 and gain crossover of 2.7 is obtained from the smith chart curve.

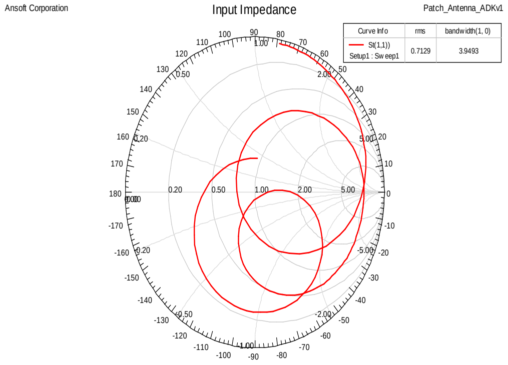

Fig.3. input impedance smithchart

Fig.4. and Fig.5. indicates the 3 dimensional and 2 dimensional gain plots for the current antenna. Gain of 7.44dB is attained at the desired frequency.

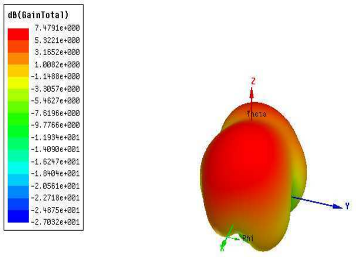

Fig.4. 3 dimensional gain plot

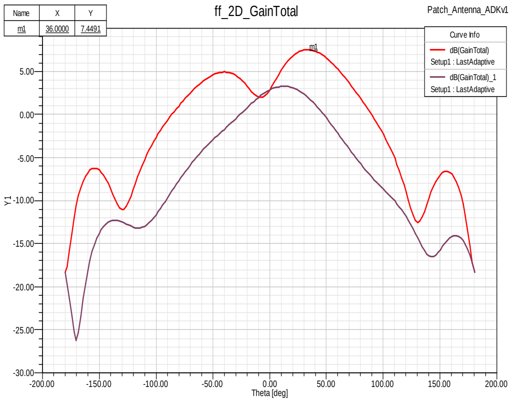

Fig.5. 2D gain plot

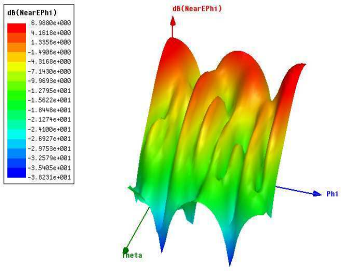

Fig.6. Near field rE–phi

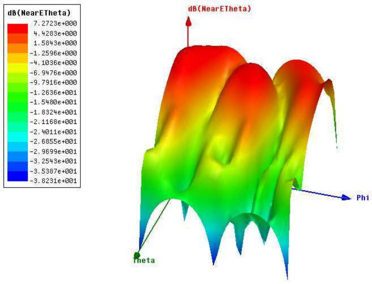

Fig.7. Near field rE-theta.

Fig. 8 and Fig. 9 shows the far filed radiation for E theta and E phi in 3 dimensional plot

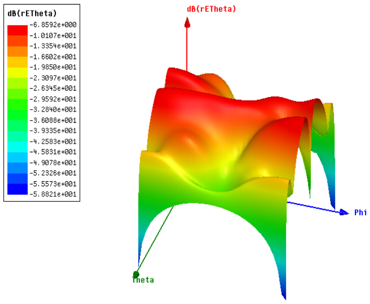

Fig.8. far field rEtheta 3 dimensional plot

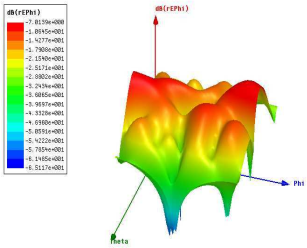

Fig.9. far field rEphi 3 dimensional plot

The radiation pattern of the antenna can be defined as the spatial distribution of a quantity that characterizes the electromagnetic field generated by an antenna. Figure (6), (7) and (8), (9) shows near and far fields radiation pattern of the antenna in phi and theta directions. The polar plots represent the radiation pattern in elevation and azimuthal angles. The radiation pattern represents the energy radiated from the antenna in each direction, often pictorially.

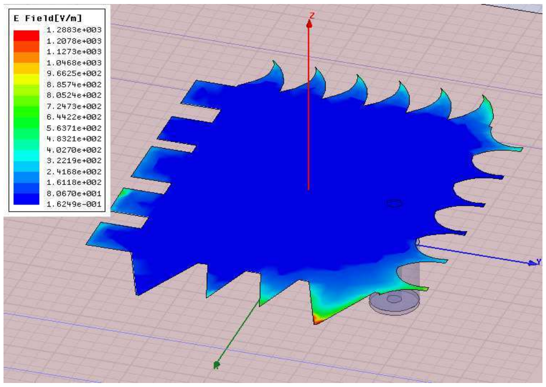

Figure 10. E-Field Distribution

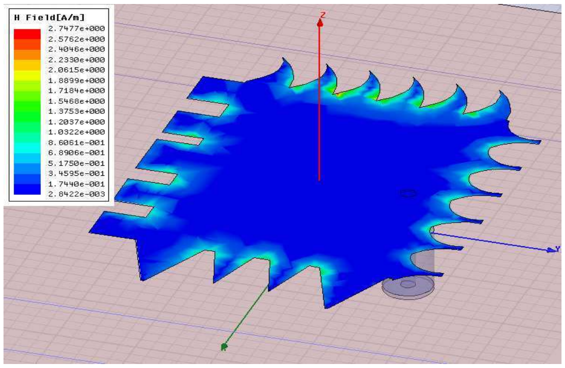

Figure 11. H-Field Distribution

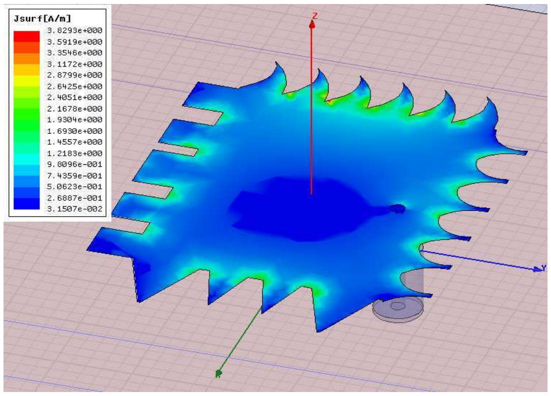

Figure (10), (11) and (12) shows the E-field, H-field and current distribution of the antenna.

Quantity	Value
Max U	0.00041138W/sr
Peak directivity	5.6809
Peak gain	5.5964
Peak realized gain	1.7116
Radiated power	0.00091001W
Accepted power	0.00092375W
Incident power	0.0030204W
Radiation efficiency	0.98513
Front to back ratio	28.496
Decay factor	0

TABLE I Antenna simulated parameters

rEField	Value	At phi(deg)	At Theta(deg)
Total	0.55694V	180	-34
X	0.34463V	10	-32
Y	0.42389V	170	-26
Z	0.33012V	20	-56
Phi	0.44597V	165	-30
Theta	0.45398V	20	38
LHCP	0.33522V	25	-38
RHCP	0.54185V	175	-34
Ludwig3/x dominant	0.41963V	10	-40
Ludwig3/Y dominant	0.42284V	170	-26

TABLE III simulated Maximum field data

IV.CONCLUSION

A super hybrid microstrip patch antenna is designed and simulated. The main theme behind this paper is to give near and far field radiation characterization of super hybrid shaped serrated microstrip patch antenna. The results are giving moral encouragement to design serrated antennas in our future work. The results got in this paper are excellently suits for wireless communications in all aspects including high gain and high bandwidth.

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