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Log Periodic Implementation of Star Shaped Patch Antenna for Multiband Application Using HFSS

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Abstract:
In this paper the conventional rectangular patch has been modified and its log periodic implementation has been done . FR4 Epoxy material for the substrate has been taken into account . The star shape has been used for the higher mode excitation for the patch antenna and then its log periodic implementation has been done to operate the antenna in wideband and multiband .The substrate and the ground plane are of the size 20.8 cm × 10.4 cm. Line and coaxial feeding techniques have been implemented .The Return loss , VSWR, Gain vs Frequency etc parameters are determined from the simulation results.

Keywords — **Star Shape Patch, S_{11}, VSWR , Antenna Gain**

I. INTRODUCTION

Recently many applications have been developed to get the benefit from the newly evolved antennas which include small size and wide band .Different shapes like biconvex, crescent moon etc have been introduced for the log periodic implementation . [1][2]. The modification of Rotman Lens has been done and implemented as a patch which lead to a perturbed elliptical structure for 50 GHz application. [3] Similarly the Rotman lens has been modified to a biconcave lens structure and implemented as a patch with a circular slot for Ku Band application.[4] Some modifications has been done in biconvex patch for different applications in the year 2016.[5,6,7,8]In this paper the some perturbation to the square patch has been done which lead to the star shape .Previously the star shape patch has been implemented for higher mode excitation .[9] Some modification has been done in the conventional rectangular patch for 5G application .[10,11]

II. ANTENNA DESIGN

At first the single patch structure has been designed and the log periodic implementation has been done .RTduroid material for substrate has been taken into account . The length and the width of the ground plane are taken as 20.8 cm and 10.4 cm respectively .

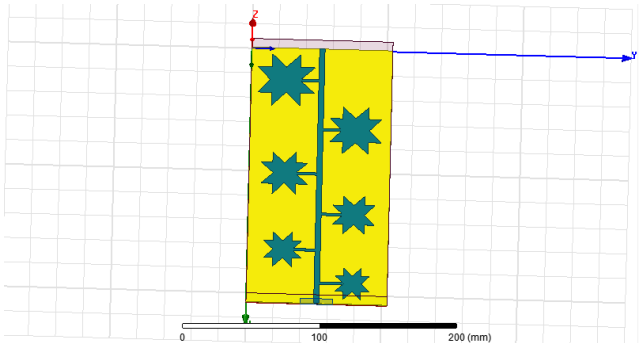

Fig 1. Proposed antenna design using HFSS

III. SIMULATION RESULTS

HFSS (High Frequency Structure Simulator) is one of the finest tool for electromagnetic simulation . The finite element method has been used for the simulation purpose. The return loss has been determined by the S_{11} parameter and from the S11 plot we can measure the bandwidth as well as the resonant frequency.

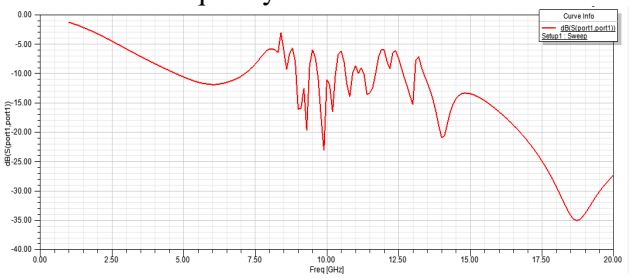

Fig 2: S_{11} plot using HFSS

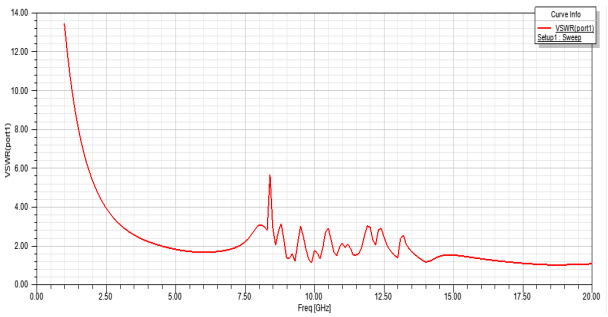

Fig 3 : VSWR using HFSS

Figure 2 shows the S11 plot in which it is quite visible that the antenna has a resonant frequency at 9.88 GHz and it has 5 bands from 6 GHz to 15 GHz. VSWR should be 1 ideally and in the plot of VSWR ,(Fig 3) the values are coming nearly equal to 1 in the desired frequency bands .

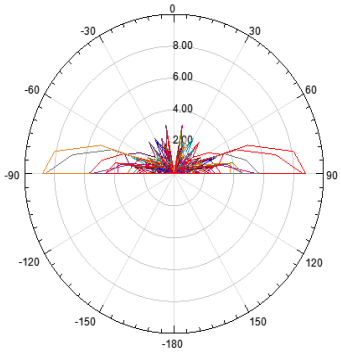

Fig 4 **:**Radiation Pattern of Gain

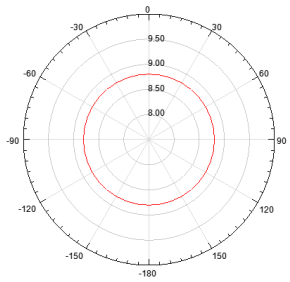

Fig 5 : Radiation Pattern of Gain

Fig 5 : Peak Gain

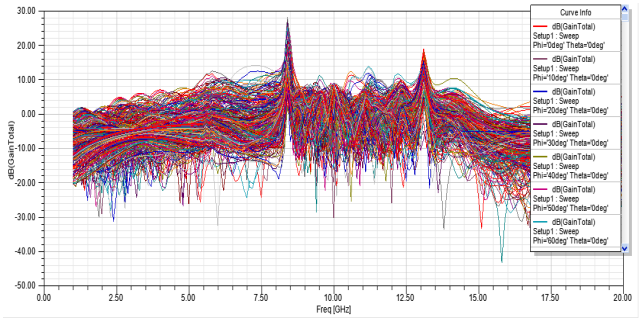

Fig 6 : Gain Vs Frequency Curve

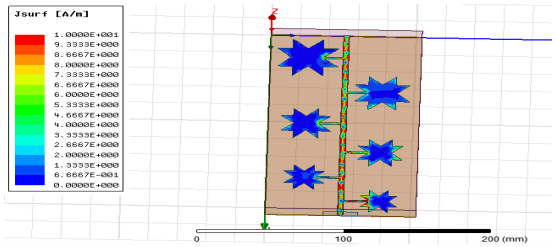

Fig 7 : Surface Current Distribution of proposed antenna

TABLE I

Parameter	Band 1	Band 2	Band 3	Band 4	Band 5
Resonant Frequency	9.275 GHz	9.88 GHz	10.76GHz	11.39 GHz	12.97 GHz
Range	8.88 GHz-9.35 GHz	9.66 GHz-10.28 GHz	10.62GHz-10.86GHz	11.27 GHz-11.66 GHz	12.6 GHz-13.05 GHz
Bandwidth	470 MHz	620 MHz	240 MHz	390 MHz	450 MHz
Return Loss	-19.43 dB	-22.59 dB	-13.89 dB	-13.22 dB	-15.14
VSWR	1.34	1.18	1.54	1.54	1.4

IV. CONCLUSIONS

From the simulation results it can be concluded that the proposed antenna is suitable for the operation in different frequency bands from 9 GHz to 13 GHz .

It is suitable for X band Applications such as amateur radio and satellite communication.[12]

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