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Design and Simulation of Micro strip Patch Antenna on RT DUROID 5880 Substrate for Object Detection Using RADAR.

Anup V Patel, Manish Kumar, Ravikiran P Pawar, Vikas M Dev, Mahalakshmi M N

Abstract— The area of micro strip antennas has seen some inventive work in recent years and is currently one of the most dynamic fields in antenna research. Today antenna has become a necessity for many applications in recent wireless communications, such as Radar, Microwave and space communication. In this paper we have designed micro strip patch antenna for 8GHz. The proposed antenna is designed on optimum patch length and the analyzed results at 8GHz are listed. The resulted obtained are Return loss = -15.76dB, VSWR = 1.38, Directivity = 8.591dBi, Gain = 7.752dBi, 3 dB, Beam width = 73 degrees.
Index Terms*:* Micro strip antenna, CST SIMULATOR, Dielectric, Patch width, Patch Length, Losses, strip width, strip length

1 INTRODUCTION

Micro strip Patch antenna has several well-known advantages, such as low profile, low cost, light weight, ease of fabrication and conformity However, the micro strip antenna inherently has a low gain and a narrow bandwidth. To overcome its inherent limitation of narrow impedance bandwidth and low gain, many techniques have been suggested e.g., for probe fed, stacked antenna, micro strip patch antennas on electrically thick substrate, slotted patch antenna and stacked shorted patches have been proposed and investigated.

R. Garg and A. Ittipiboon, "Micro strip Antenna Design Handbook, Artech House" Micro strip Patch Antenna increase the bandwidth of proposed antenna obtained is 27% (2.14-2.81GHz) at -10 dB Return Loss. D. M. Pozar and D. H. Schaubert[3], Micro strip Antennas shows in increase bandwidth up to 13.7%. Z MaChen [3] further increase bandwidth of this antenna up to 23.7% - 24.43%. Ahmed H. Reja [4] proposed Study of Micro Strip Feed Line Patch Antenna experimentally increase the Return Loss -33.6dB at 2.5GHz frequency and VSWR is 1.5aby using CST(Computer Simulation Technology) for RT DUROID 5880.Santanu Kumar Behera and Y. Choukiker [5] proposed Design and Optimization of Dual Band Micro Strip Antenna using Practical Swarm Optimization maximize the return loss for dual band Frequency at 2.4GHz is -43.95dBaand at 3.08GHz is -27.4dB. K F Lee [6] proposed U Shape slot shorting post small size Micro strip Antenna and increase bandwidth up to 42%. S C Gao [7] used uniplanar photonic band gap structure for enhancing band width and gain. MaKhodiera [8] New wideband stacked micro strip antennas for enhancing band width. athe resulting antenna using the proposed structure has an ultra-wide bandwidth of 35%, compared to 21.8% for the conventional stacked antenna structure. Major issue for micro strip antenna is narrow Bandwidth.

2 MATHEMATICAL ANALYSIS

The width of the patch element (W) is given by

$$W = \frac{c}{2fo\sqrt{\frac{(\varepsilon r+1)}{2}}}$$

Substituting c = 3x108 m/s, ε r = 2.2, and f o = 8 GHz, then W =14.82mm.

The effective dielectric constant (ε_{reff}) depending on the same geometry (W, h) but is surrounded by a homogeneous dielectric of effective permittivity ε_{reff}, whose value is determined by evaluating the capacitance of the fringing field.

$$\varepsilon reff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left[1+12\frac{h}{W}\right]^{-\frac{1}{2}}$$

Substituting εr = 2.2, W=14.82mm, h =1.575mm, then ε_{reff} = 1.997. The effective length (L_{eff}) is given by Substituting c = 3x108 m/s, εreff = 1.997, fo = 8 GHz, then L_{eff} = 13.26mm.

$$Leff = \frac{c}{2f0\sqrt{\varepsilon reff}}$$

Substituting W=14.82mm, and h=1.575mm, then ΔL=0.81mm.

$$\Delta L = 0.412h\frac{(\varepsilon reff+0.3)(\frac{W}{h}+0.264)}{(\varepsilon reff-0.258)(\frac{W}{h}+0.8)}$$

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The actual length (L) of patch is obtained by:

$L_{eff}=L-2\Delta L$

Substituting $\Delta L=$ 0.08224cm, and Leff = 2.0965cm, then L=21.0915mm.

3 ANTENNA DESCRIPTION

The *Proposed Antenna* at 8GHz *on 62mil RT DUROID 5880 substrate are:-*

Proposed Patch length = 458miles
Proposed Patch Width= 583miles
Strip Path Length= 370miles
Strip Path Width= 182miles
Cut width=60miles
Cut depth= 60 miles

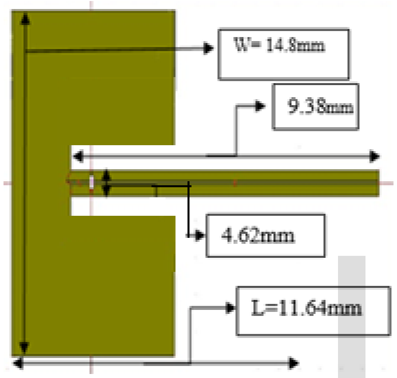

Figure 1: Patch Dimensions

4 RESULT AND OBSERVATIONS

A. Comparison of Micro strip Patch Antenna with Different Patch Length in Simulator for 62mil RT DUROID 5880 Substrate with Patch length, L= 11.64mm

a) VSWR PLOT

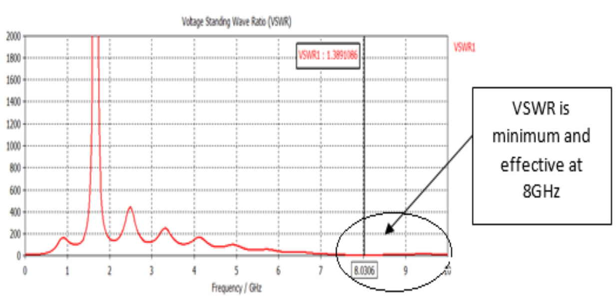

Figure 2: VSWR Vs Frequency

b) Return loss

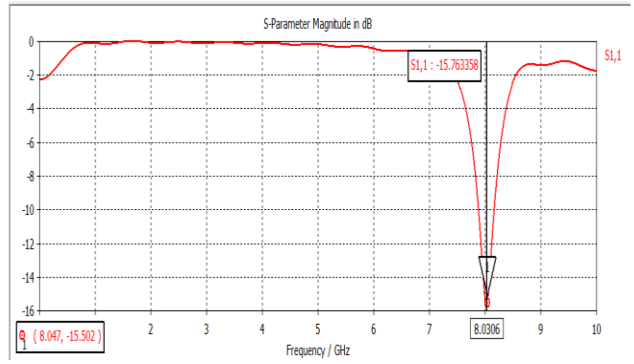

Figure 3: Return Loss Vs Frequency (in GHz)

For frequency at 8GHz the return loss obtained is around - 15.76dB as shown in Figure 3.

c) Impedance Characteristics

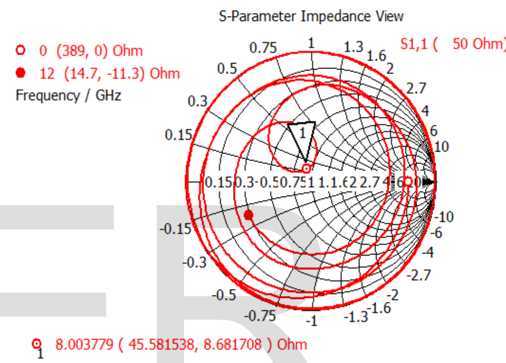

Figure 4: Pole and zero plot

The Figure 4 shows well matched port and transmission line with impedance around 45.58Ω.

d) Radiation Pattern

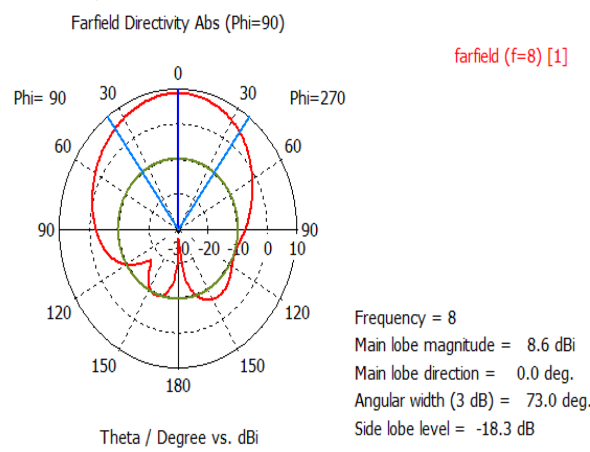

Figure 5: Radiation pattern

The radiation pattern for the designed patch antenna is as

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shown in Figure 5. The directivity for the designed antenna is 8.591dBi.

e) Gain plot for the micro strip patch antenna.

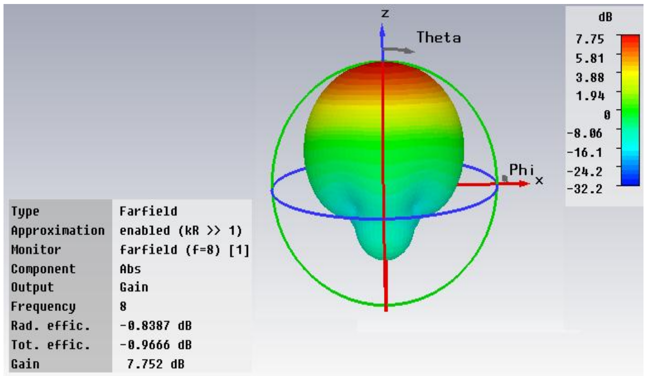

Figure 6: 3D view for gain

Figure 6 shows the gain of 7.752dB at the frequency 8GHz.

f) Directivity plot

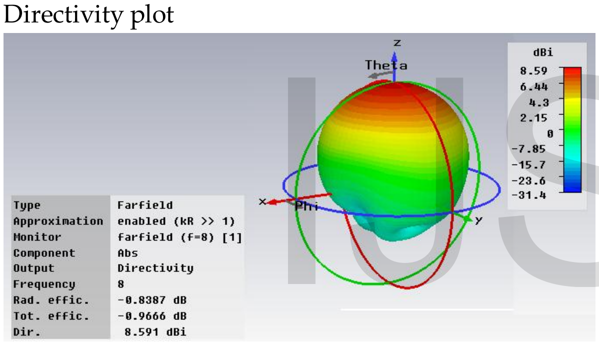

Figure 7: 3D view for Directivity

5 CONCLUSION

Micro strip antennas have become a rapidly growing area of research. Their potential applications are limitless, because of their light weight, compact size, and ease of manufacturing. One limitation is their inherently narrow bandwidth. However, recent studies and experiments have found ways of overcoming this obstacle. Most notable studies is related to mobile communication systems where many frequency ranges could be accommodated in a single antenna. We have designed a simple and low cost patch antenna for pervasive wireless communication by using different patch length. The proposed antenna is designed on a 62 mil RT DUROID 5880 substrate from Rogers-Corp with dielectric constant of 2.2 and loss tangent of 0.0004. The results of proposed design are effective between 1GHz-10GHz simulated in CST Simulator.

The optimum results of proposed antenna are verified and tested in CST SIMULATOR. The achievable bandwidth of the proposed antenna is 100MHz. The simulated results of CST at 8 GHz is as follows, Return loss = -15.76dB, VSWR = 1.38, Directivity = 8.591dBi, Gain= 7.752dBia, 3 dB beam width= 73 degrees, Efficiency= 96%, Total Radiated Power= 39 W and Input Radiated Power at ports= 43.65W.The proposed 62mil RT DUROID 5880 substrate micro strip antenna at 8GHz(x band) is very effectively for pervasive wireless communication.

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- *Anup V Patel is currently pursuing bachelor degree program in telecommunication engineering in R V College of Engineering(Autonomous Institution Affiliated to VTU, Belagavi)Bangalore 560059, India,* E-mail: panup21091993@gmail.com
- *Manish kummar is currently pursuing bachelor degree program in telecommunication engineering in R V College of Engineering(Autonomous Institution Affiliated to VTU, Belagavi)Bangalore 560059, India,* E-mail: manish.kummar21@gmail.com
- *Ravikiran P Pawar is currently pursuing bachelor degree program in telecommunication engineering in R V College of Engineering(Autonomous Institution Affiliated to VTU, Belagavi)Bangalore 560059, India,* E-mail: rkpawar786687@gmail.com
- *Vikas M Dev is currently pursuing bachelor degree program in telecommunication engineering in R V College of Engineering(Autonomous Institution Affiliated to VTU, Belagavi)Bangalore 560059, India,* E-mail: vikasmdev14@gmail.com
- *Mahalakshmi M N is an Assistant Professor in department of telecommunication engineering in R V College of Engineering (Autonomous Institution Affiliated to VTU, Belagavi) Bangalore 560059, India.*