

DESIGN OF OPTIMIZED HIGH FREQUENCY ANTENNAS

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Abstract: The paper presents the simulation design of monopole, dipole and folded dipole, Yagi-Uda and Rectangular patch antenna for different frequencies. Those three antennas are fabricated by using silicon substrate. The characteristics of the designed structure are investigated by using CST STUDIO SUITE software. The low profile nature of the antenna leads to very easy fabrication method and used to make it suitable for the application in wireless systems. It is developed to operate in the WLAN, Wimax & RADAR application. This paper presents the s-parametric analysis of all these mentioned antennas for wireless communication applications. Also the design involves reduction in the antenna size and increasing the overall performance of the antenna system.

Keywords: Monopole, dipole, folded dipole, Yagi-Uda, microstrip patch, s-parameter, radiation pattern.

1. Introduction

The high frequency monopole, dipole and micro strip antennas are very interesting because of their low profile, less weight, conformer to the surface of objects and easy production. Design of WLAN antennas also got popularity with the development of monopole and micro strip antennas. Wireless local area network (WLAN) involve three band of frequencies namely 2.4GHz (2400-2484MHz), 5.2GHz (5150-5350MHz) and 5.8GHz (5725-5825MHz). WiMax has three allocated frequency bands. The low band (2.5-2.69GHz), the middle band (3.2-3.8 GHz) and the upper band (5.2-5.8GHz). Telecommunication via satellite and RADAR use the 4-8GHz band of frequency [1]. The size of antenna is effectively reduced by cutting slot in proper position on the micro strip patch. The use of DGS for size reduction of micro strip antenna, although its application has been reported for harmonic reduction cross-polarization suppression and mutual coupling reduction in antenna arrays. In this paper size optimization of monopole, dipole and

microstrip antennas are simulated and the s-parametric analysis is plotted using CST software.

2. Monopole Antenna

Monopole antenna is the group of radio antenna and it consist of straight rod shape conductor and often mounted perpendicularly over some other type of conductive surface is called as ground plane. Monopole antenna is also called as resonant antenna. The signal transmitter is applied to the receiver antenna and the output is taken from the receiver, between the lower and monopole and ground plane. Monopole antenna is printed on the dielectric substrate to make less fragile. It is used for RFID, WLAN applications.

3. Dipole Antenna

Dipole antenna is the uncomplicated and most generally used group of antennas. It produces the radiation pattern approximating that elementary electric dipole with the radiating structure supporting the line current. The dividing current of transmitter is applied to receiver antenna and the output is taken from receiver antenna. Each side of feed line of the transmitter or receiver is connected with one of the conductors. Several different types of antenna are used such as folded dipole, cage dipole, bow-tie, batwing. The dipole antenna is formed as two straight rods or wires are connected end to end on the same axis.

4. Folded Dipole Antenna

Folded dipole is consisting of basic dipole antenna and the ends are curl back to the all over and connected with each other and it forming a loop. Normally, the width d of the folded dipole antenna is very much shorter than length L [2]. So the folded dipole antenna forms the closed loop, one should expect the input impedance of

the short-circuited transmission line of the length L . All combined combination of monopole, dipole and folded dipole for a single combined high frequency application is the Yagi-Uda antenna.

5. Rectangular Patch Antenna

A rectangular patch antenna is a high frequency antenna meant for radio frequency applications [3]. This antenna basically will have a low profile specifications mounted on a flat rectangular surface called as patch which is a flat rectangular piece of metal mounted over a larger metal sheet usually called as a ground plane.

6. Simulation Results

1. Monopole Antenna

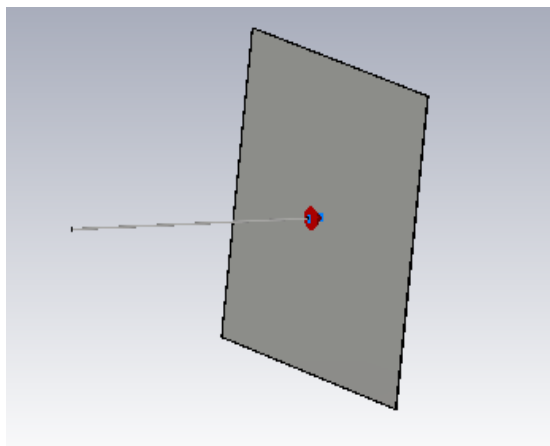


Figure 1. Simulation of monopole antenna

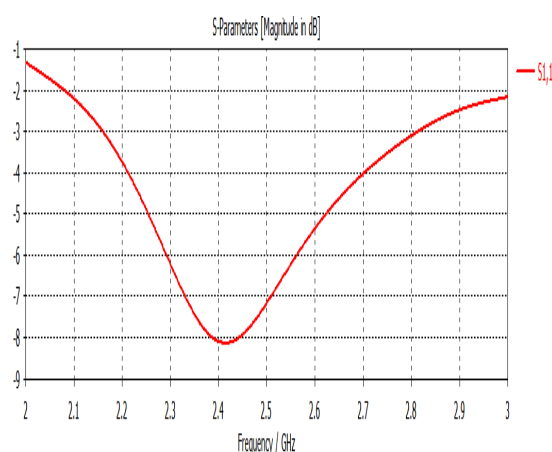


Figure 2. s-parameter of monopole antenna

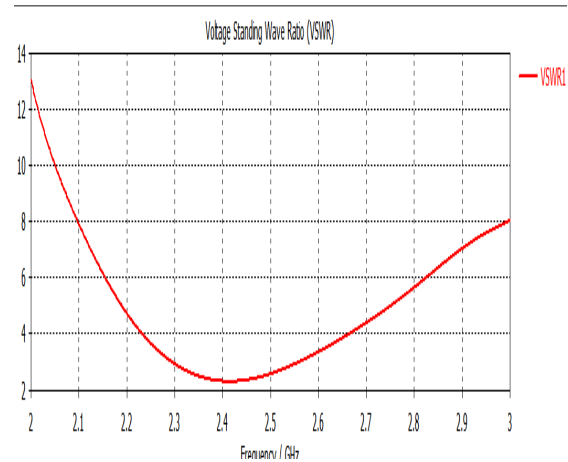


Figure 3. VSWR plot of monopole antenna

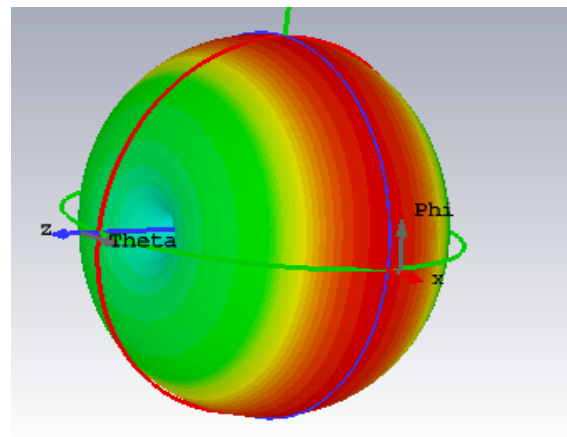


Figure 4. farfield of monopole antenna [4]

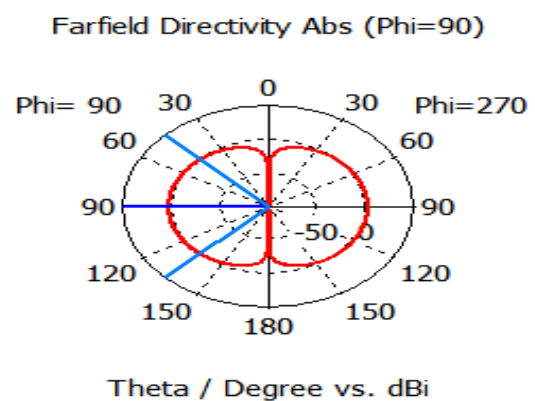


Figure 5. Radiation pattern of monopole antenna [5]

2. Dipole Antenna

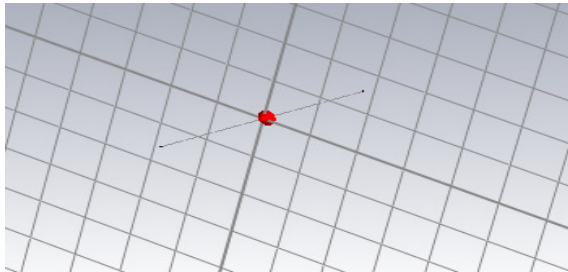


Figure 6. Simulation of dipole antenna

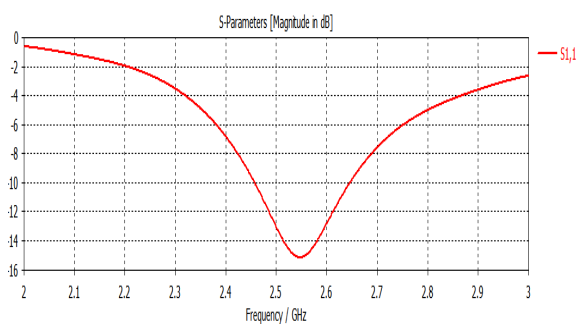


Figure 7. s-parameter of dipole antenna

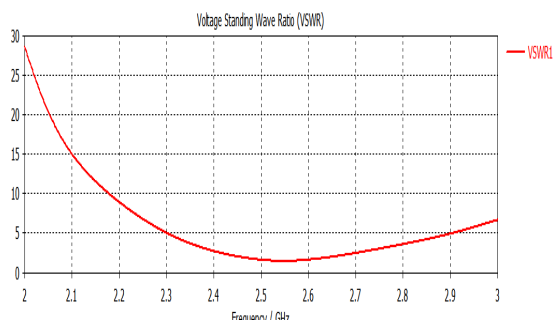


Figure 8. VSWR plot of dipole antenna

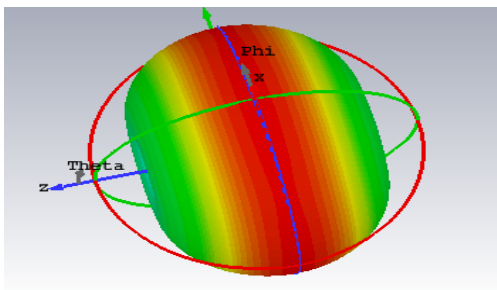


Figure 9. Farfield of dipole antenna

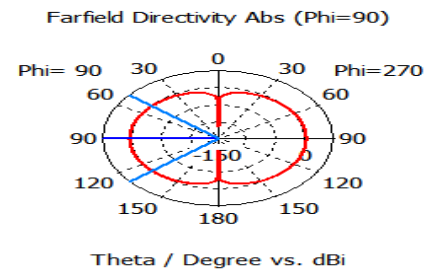


Figure 10. Radiation pattern of dipole antenna

3. Folded Dipole Antenna

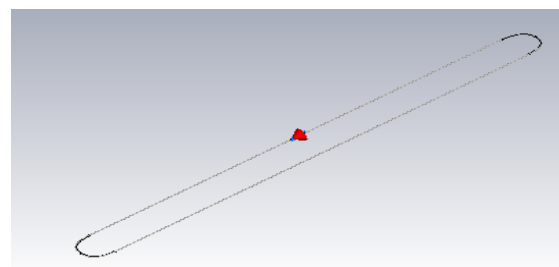


Figure 11. Simulation of folded dipole antenna[6]

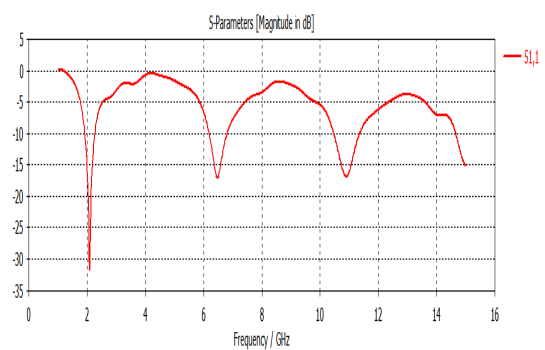


Figure 12. s-parameter of folded dipole antenna

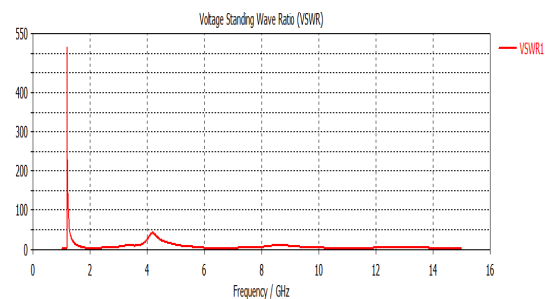


Figure 13. VSWR plot of folded dipole antenna

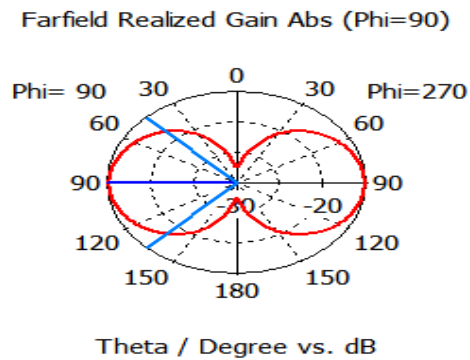


Figure 14. Radiation pattern($f=1$)[1] of folded dipole antenna

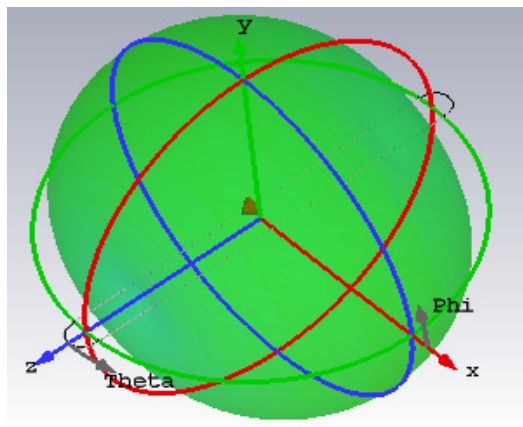


Figure 15. Farfield ($f=1\text{GHz}$) of folded dipole antenna

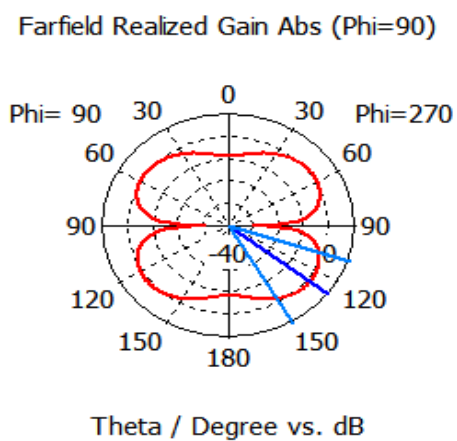


Figure 16. Radiation pattern (f=8GHz) of folded dipole antenna

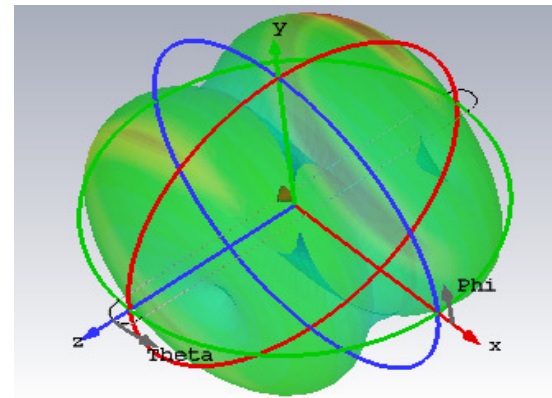


Figure 17. Farfield (f=8GHz) of folded dipole antenna

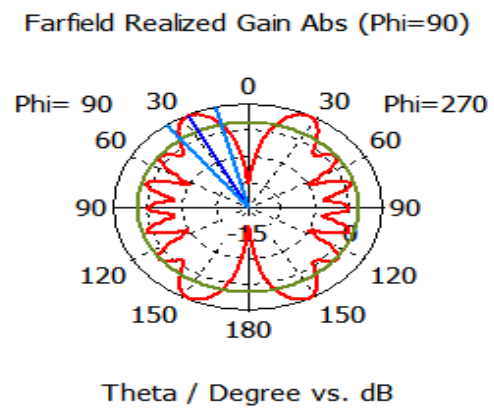


Figure 18. Radiation pattern (f=15GHz) of folded dipole antenna

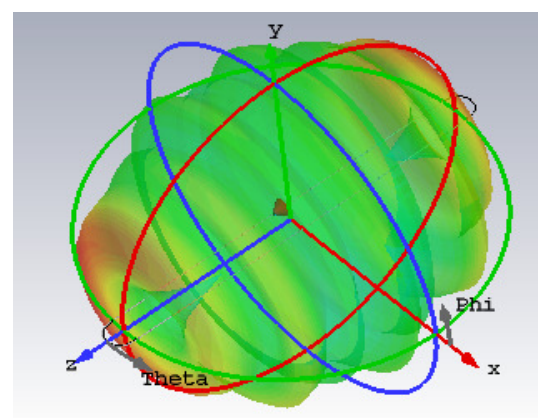


Figure 19. Farfield (f=15GHz) of folded dipole antenna

4. Rectangular Patch Antenna

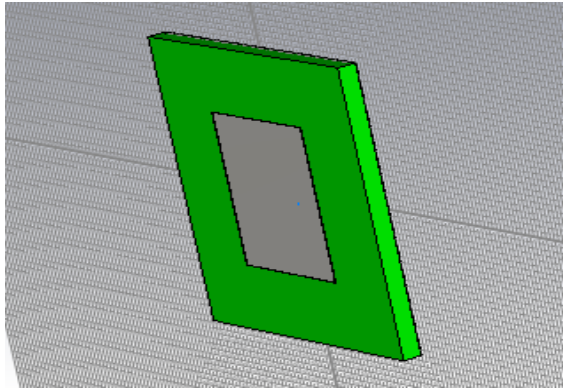


Figure 20. Simulation of rectangular patch antenna

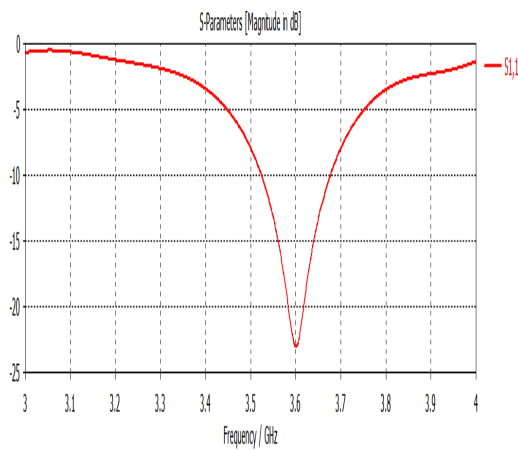


Figure 21. S-parameter of rectangular patch antenna

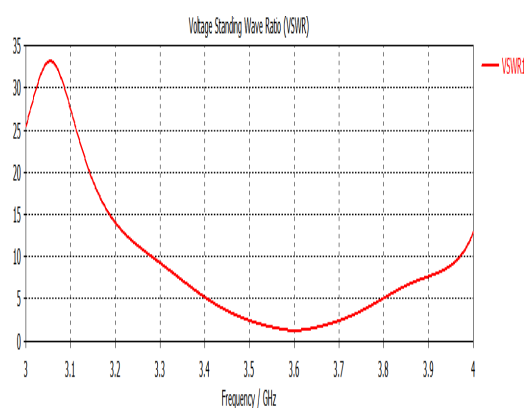
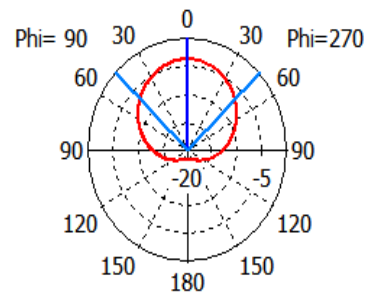


Figure 22. VSWR plot of rectangular patch antenna

Farfield Realized Gain Abs (Phi=90)



Theta / Degree vs. dB

Figure 23. Radiation pattern (f=3GHz) of rectangular patch

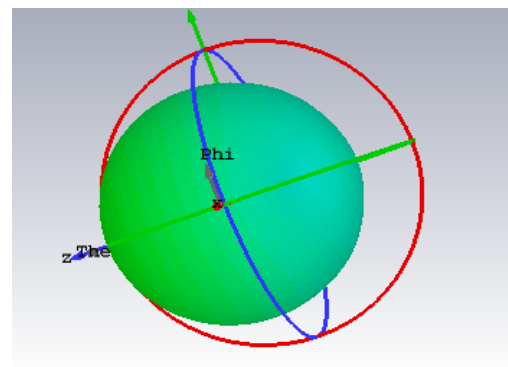
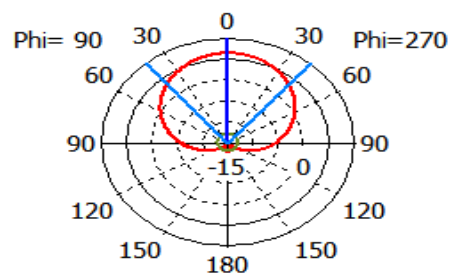


Figure 24. Farfield (f=3GHz) of rectangular patch antenna

Farfield Realized Gain Abs (Phi=90)



Theta / Degree vs. dB

Figure 25. Radiation pattern (f=3.5GHz) of rectangular patch

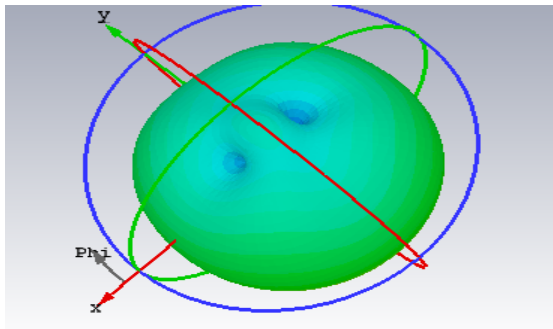


Figure 26. Farfield ($f=3.5\text{GHz}$) of rectangular patch antenna

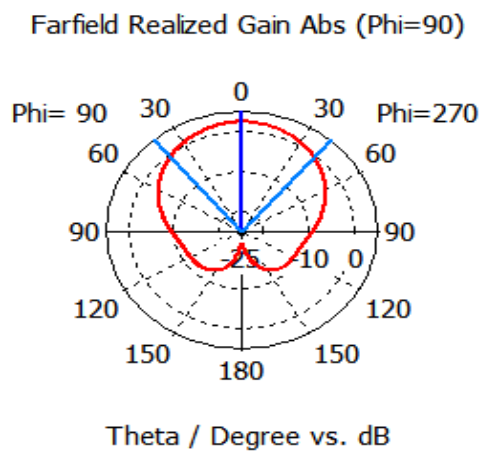


Figure 27. Radiation pattern ($f=4\text{GHz}$) of rectangular patch

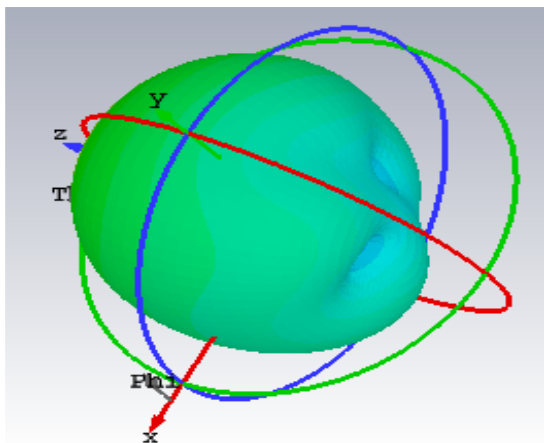


Figure 28. Farfield ($f=4\text{GHz}$) of rectangular patch antenna

5. YAGI -UDA Antenna

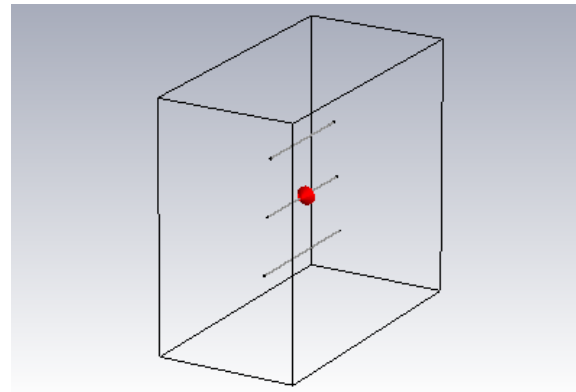


Figure 29. Simulation of Yagi - Uda antenna

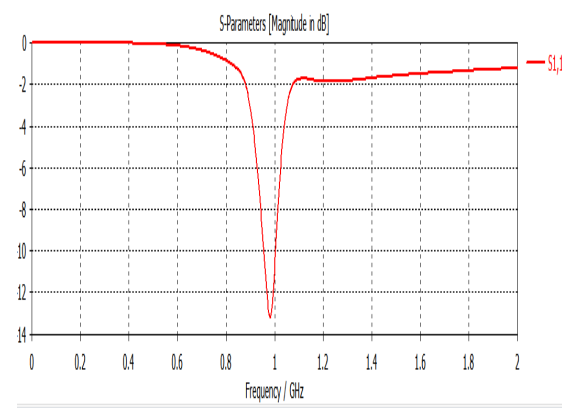


Figure 30. s-parameter of Yagi - Uda antenna

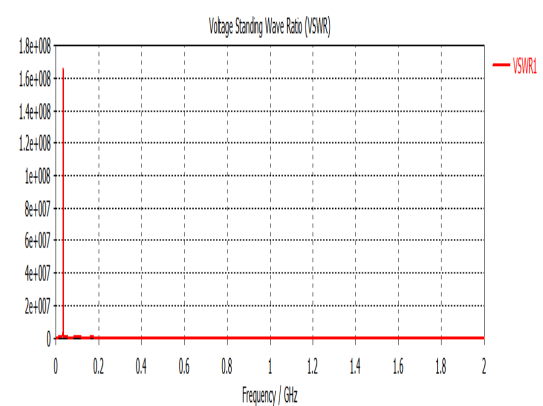


Figure 31. VSWR plot of Yagi - Uda antenna

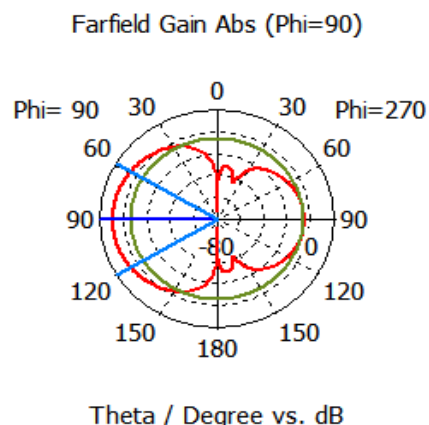


Figure 32. Radiation pattern of Yagi - Uda antenna

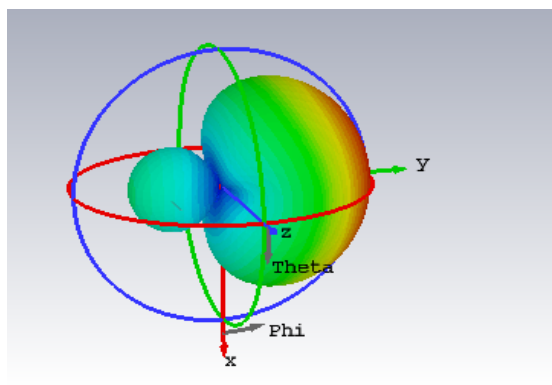


Figure 33. Farfield (f=4GHz) of Yagi - Uda antenna

7. Conclusion

Thus the s-parameter and farfield simulation results of monopole, dipole, folded dipole, and Yagi-Uda and Patch antenna were studied and analyzed using CST simulation software in this paper. The s-parametric graphical result shows the increase in the efficiency and wide radiation patterns. Detailed experimental studies can be taken up at a later stage to find out a design procedure for balanced amplifying antennas.

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