Wireless Systems Lab

Exercise One: Dipole and Monopole (CST)

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UNIVERSITÀ DEGLI STUDI DI BRESCIA

EMIMEO Programme

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Contents

1 Half-Wavelength Dipole Antenna

My Matriculation number is 740239 (an odd number) and as such my central frequency is 1.5GHz (it was originally 5.58GHz, but as the student licence cannot process the mesh density required for that frequency a new, alternative was presented by Prof. Modotto).

1.1 Question One

First I used CST Studio's built in wavelength calculator to obtain an initial value for the wavelength of 199.86mm and made this a parameter for the design of the dipole. I obtained an initial set of S(1,1) parameters as shown on the left in Figure 1. Afterwards I ran two parameter sweeping simulations changing the value of lambda broadly initially, then changing the calculate more precisely; the S(1,1) parameters for these sweeps are shown in the middle and the left of Figure 1.

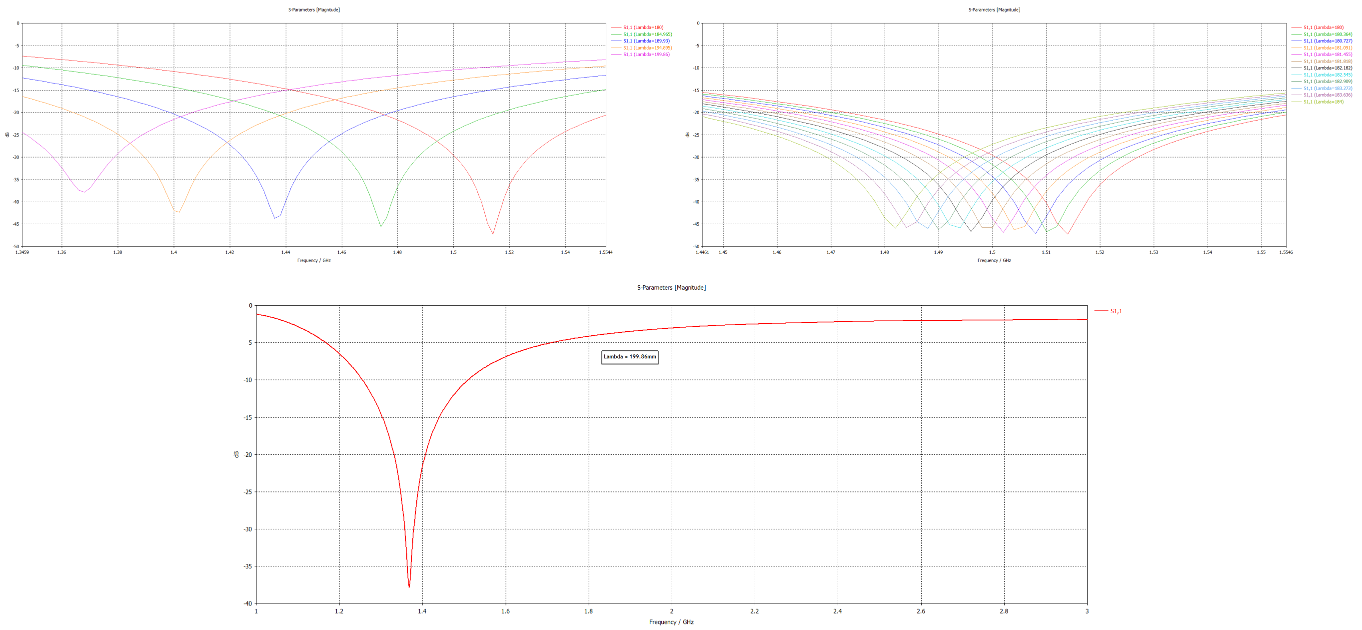

Figure 1: S1,1 Parameters for initially calculated wavelength (bottom) and the broad and narrow parameter sweeps (top left and right respectively)

Using the parameter sweeps I obtained the final value for lambda as 181.75mm this subsequently allowed me to set the dimensions as shown on the left in Figure 2 and simulated the S(1,1) results, again in Figure 2.

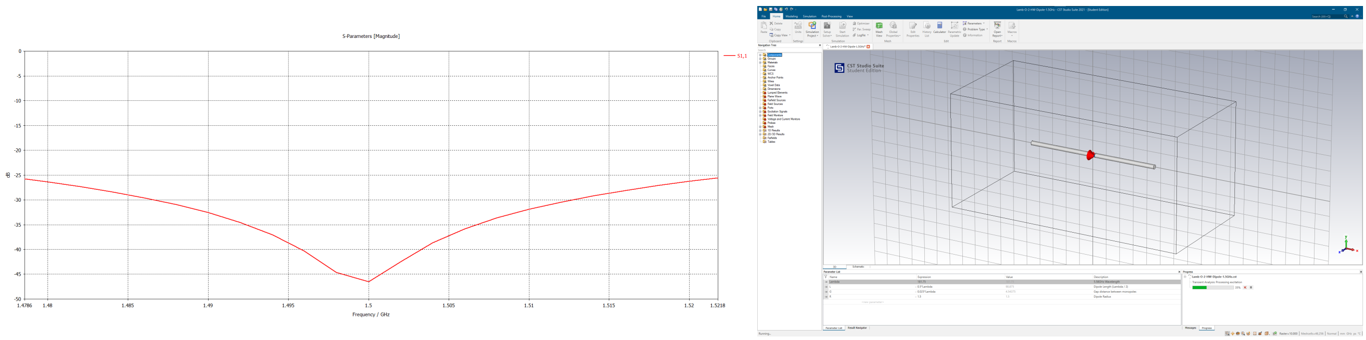

Figure 2: The final S(1,1) parameters (left) and the final dimensions and design of the dipole (right)

1.2 Question Two

Plotting the E and H fields shows, as one would expect from a half wave dipole, the E-field in the X-Y plane is shown in Figure 3, one can see that the electric field is moving in the same direction as the port excitation, with the left hand side acting as the cathode of the antenna and the right hand side the anode. Additionally one can see that the E-field is strongest at the edges of the antenna.

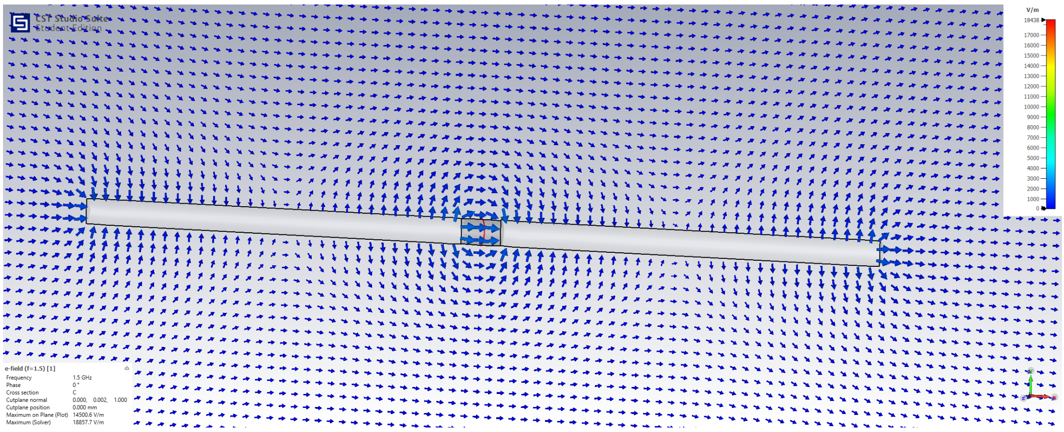

Figure 3: E-Field as shown from the X-Y plane

The H-Field, shown in Figure 4, shows a similarly expected story. The field curls around the antennas circumference, being most strongest near the port excitation.

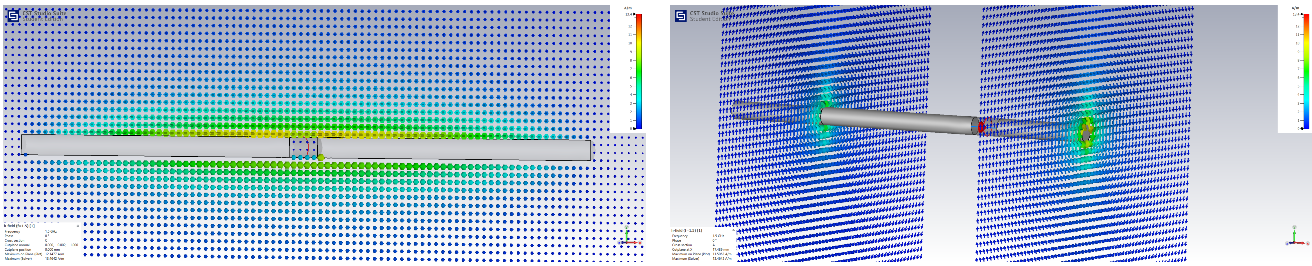

Figure 4: H-Field as shown from the X-Y plane (left) and the Y-Z plane (right)

1.3 Question Three

The far-field analysis is shown in Figures 5 and 6. The 3D far-field displaying the field attenuation at distance is a "spherical-torus" shape.

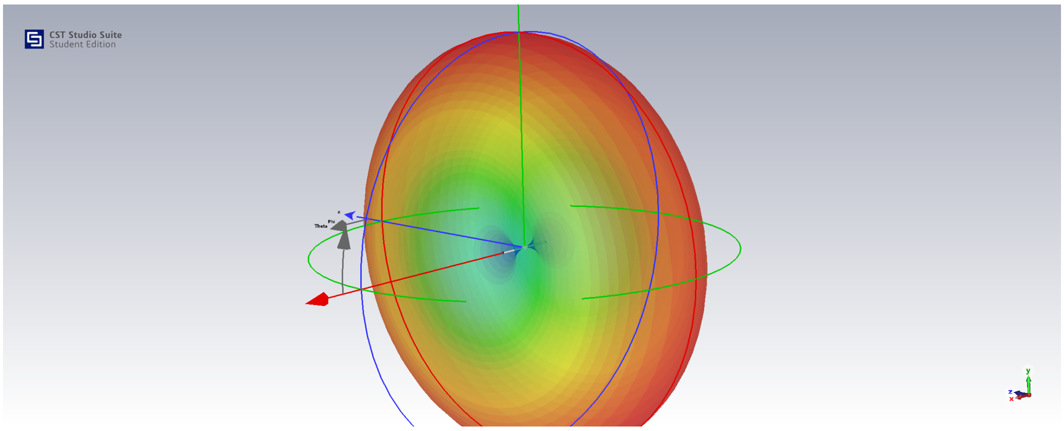

Figure 5: the 3D far-field analysis showing the "spherical torus" radiation pattern

The X-Y view shows that the antenna is highly attenuated in the X plane compared to the Y and Z planes, where it is significantly stronger.

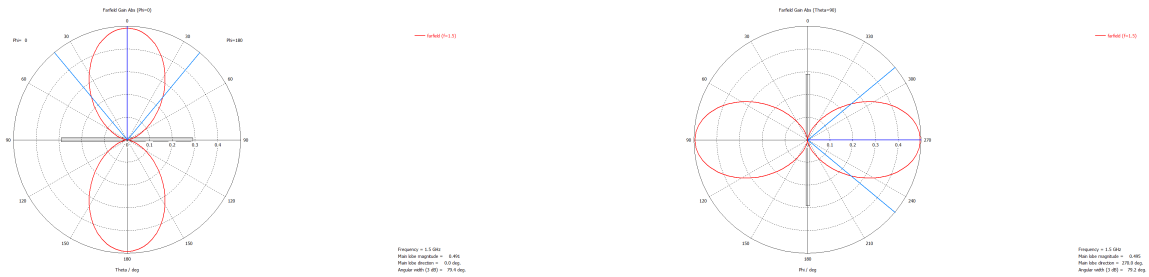

Figure 6: Far-Field in 2D shown from the X-Y plane (left) and the X-Z plane (right)

2 Quarter-Wavelength Monopole Antenna

2.1 Question Four

Repeating the steps I carried out in the first question, I designed and simulated the results for the monopole antenna, the final S(1,1) parameters, dimensions, and real/complex impedance values are shown below in Figures 7, 8, and 9.

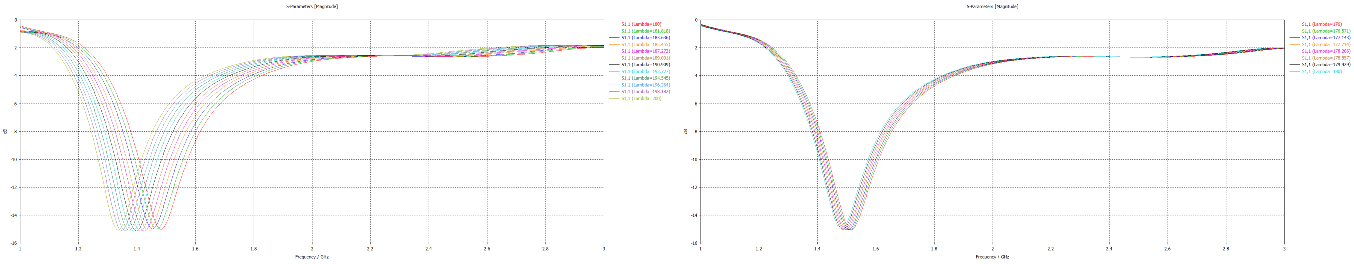

Figure 7: The monopole's S1,1 Parameters for initially calculated wavelength (bottom) and the broad and narrow parameter sweeps (top left and right respectively)

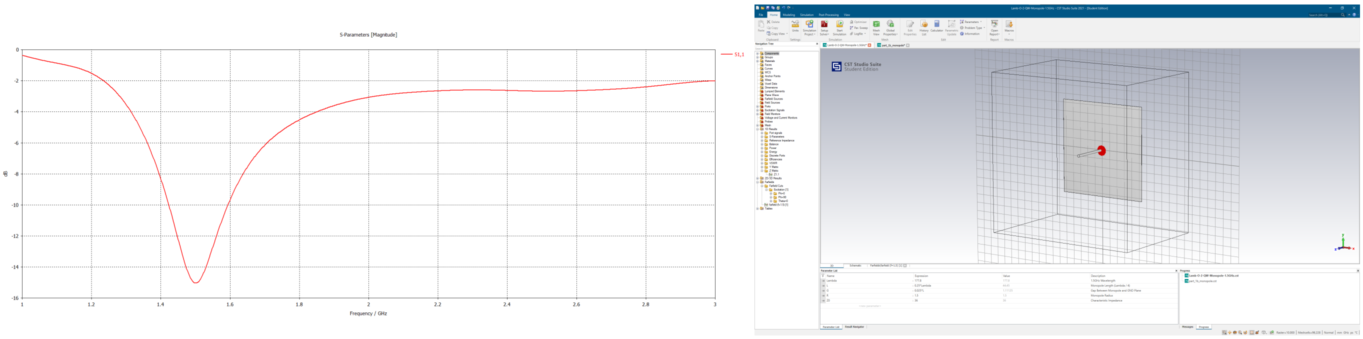

Figure 8: The final S(1,1) parameters (left) and the final dimensions and design of the monopole (right)

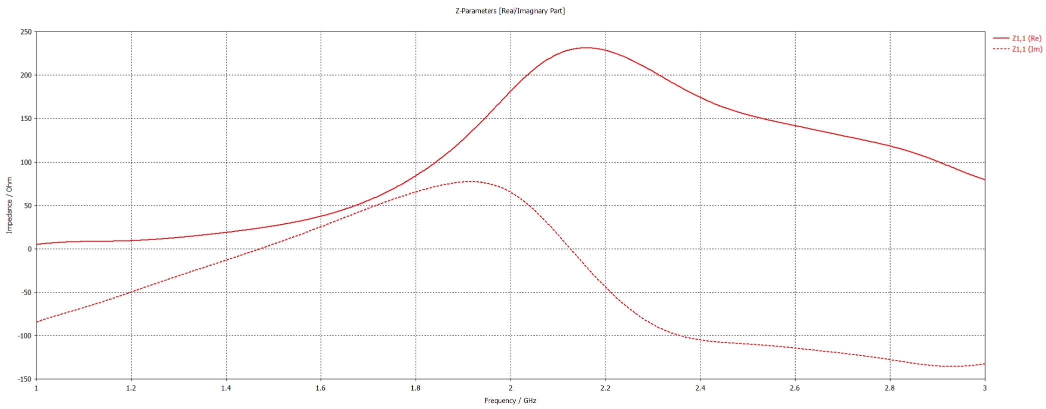

Figure 9: The impedance graph across frequency for the monopole antenna

2.2 Question Five

The far-field analysis of the monopole antenna is shown in Figures 10 and 11. One can see that it's field is far more limited than that of the dipole.

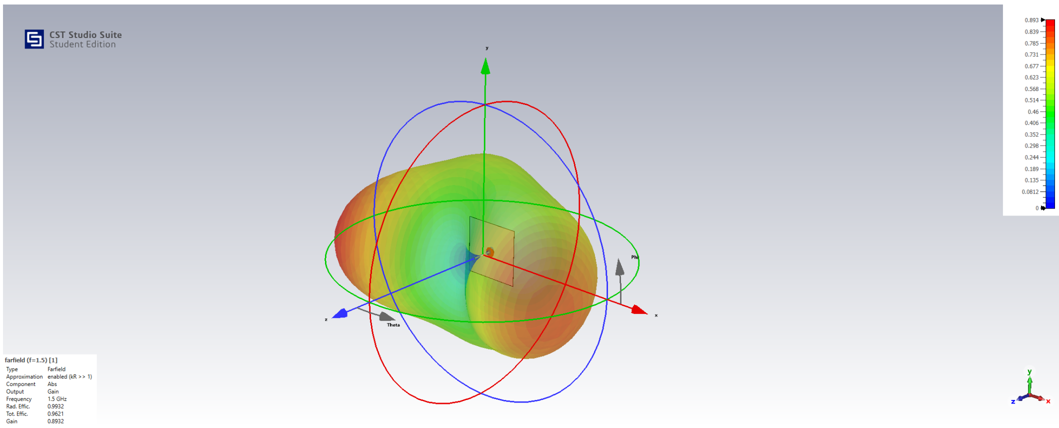

Figure 10: The 3D far-field analysis showing the radiation pattern of the monopole

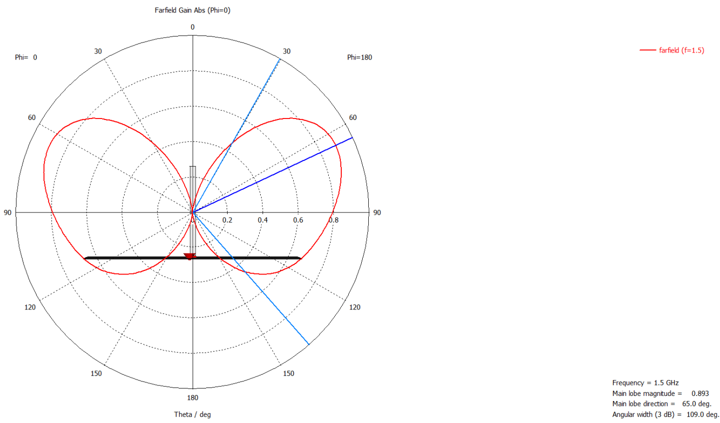

Figure 11: The monopole's far-field in 2D shown from the X-Z plane