# ECEN5134 HOMEWORK 1

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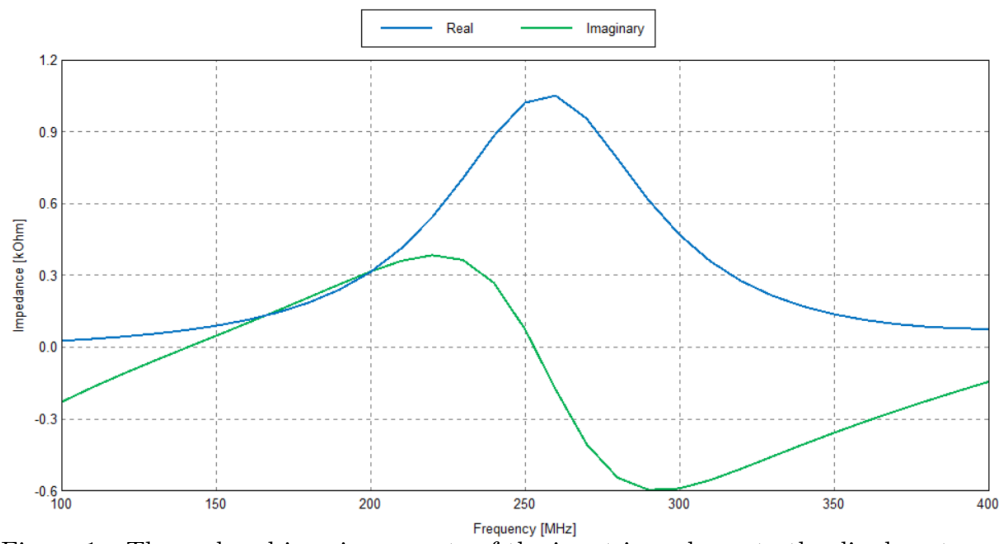# 1 FEKO Simulations

## 1.1 Impedance Plots



Figure 1: The real and imaginary parts of the input impedance to the dipole antenna.
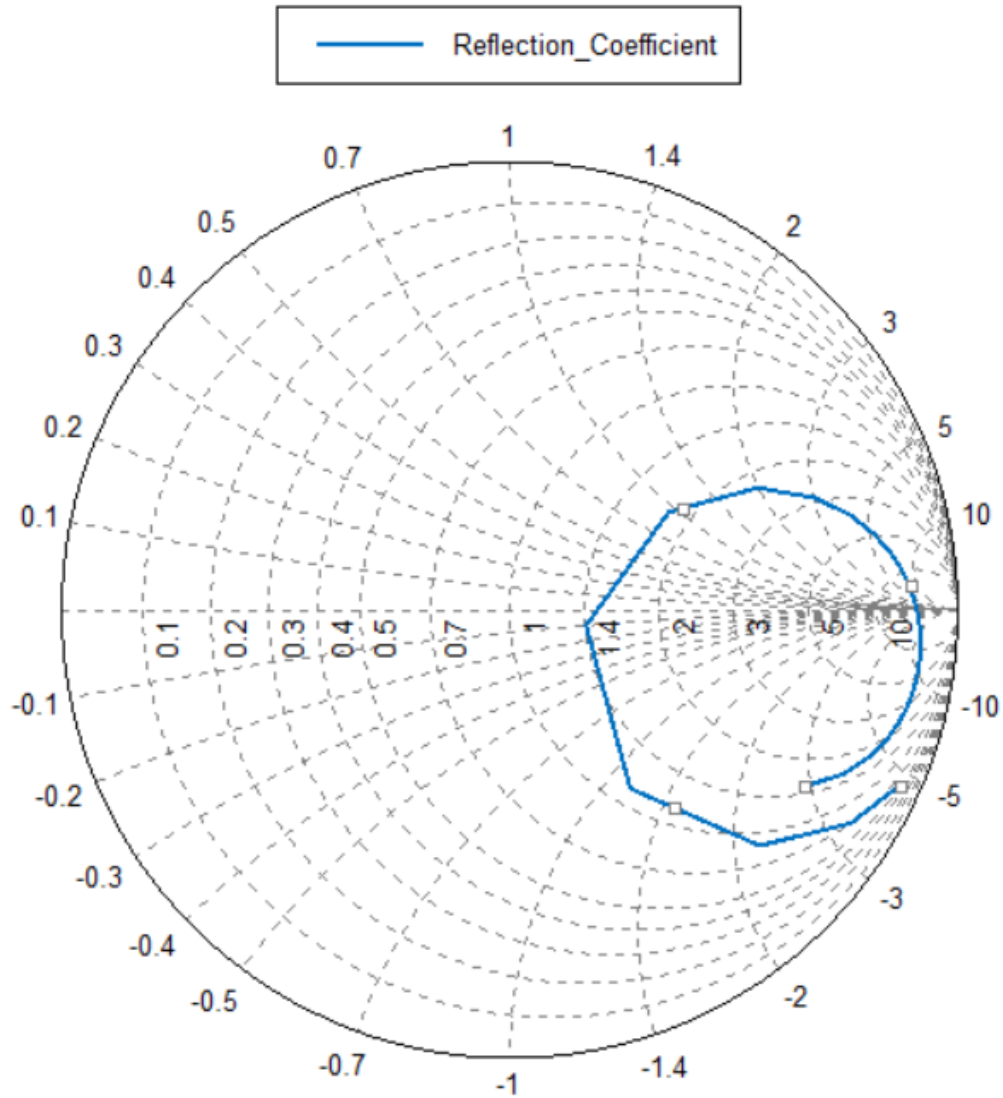
Figure 2: The smith chart showing the trend in the reflective coefficient.

## 1.2 Resonant and Anti-Resonant Frequencies

The resonant and anti-resonant frequencies are approximately marked on the graph shown in Figure 3. For greater precision, the instructions given for the second problem are followed. We denote the two frequencies of the original sweep between which the resonant and anti-resonant frequencies appear and then we re-run for those bandwidths with $1\,MHz$ step. The results are shown in Figures 4 and 5 with the resonant and anti-resonant frequencies marked.
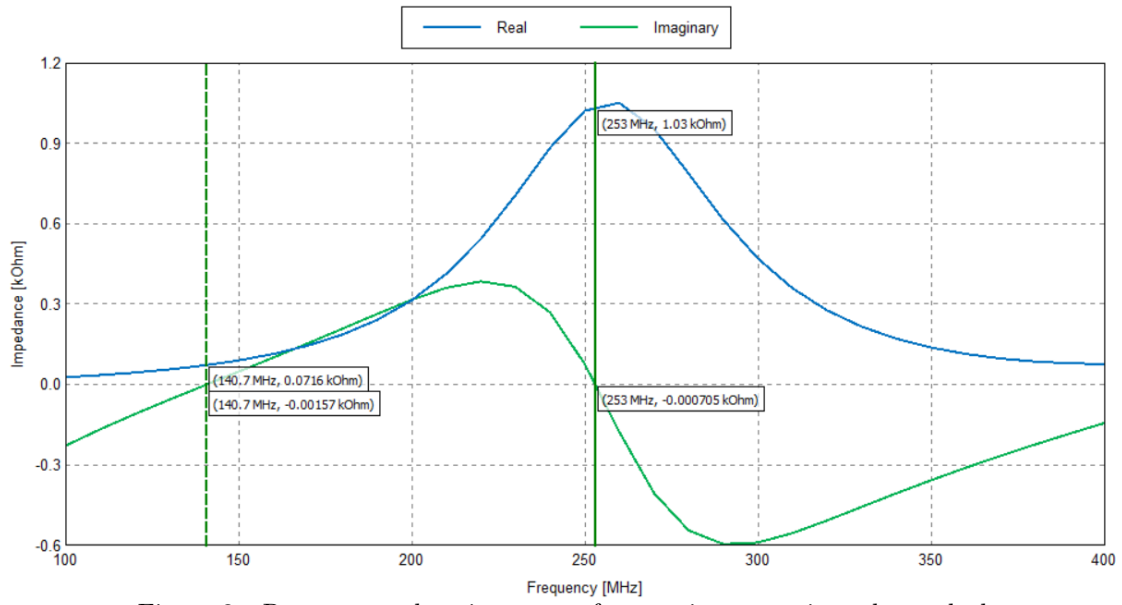
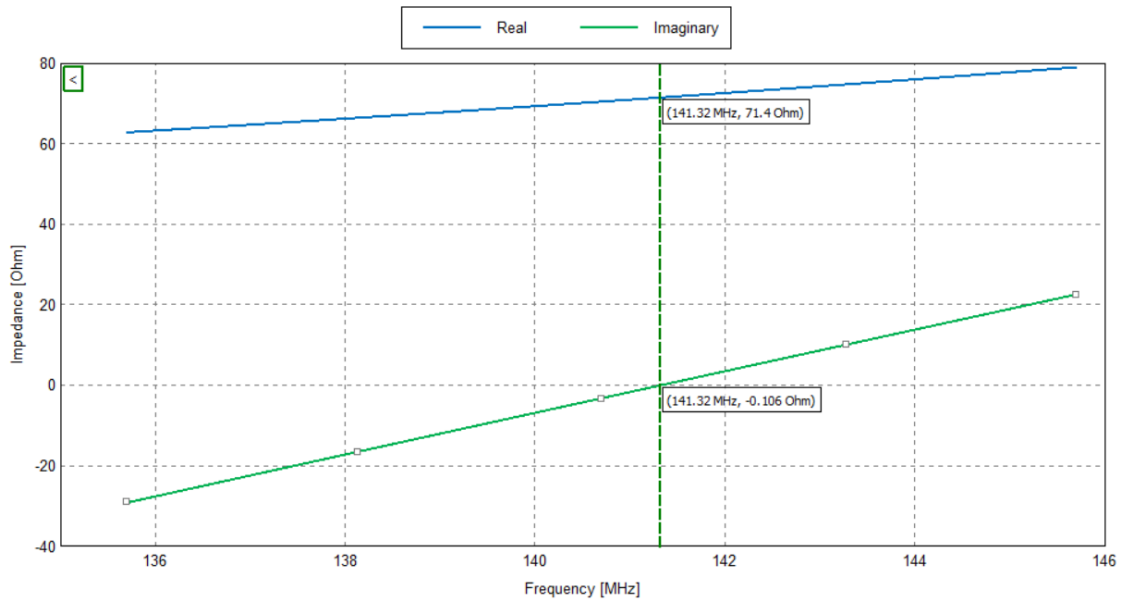Figure 3: Resonant and anti-resonant frequencies approximately marked.



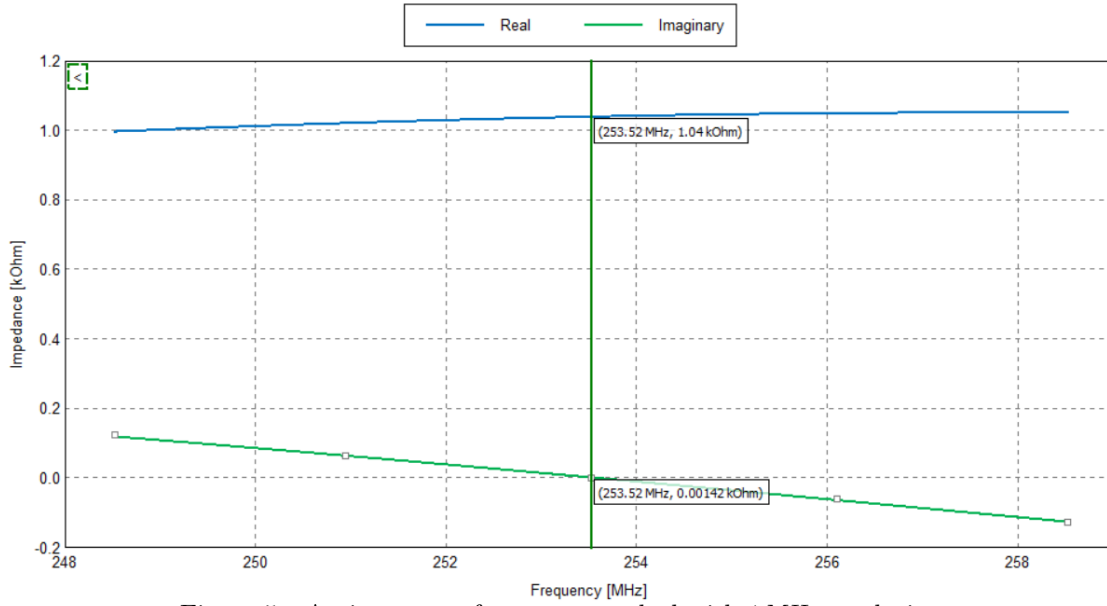Figure 4: Resonant frequency marked with $1 MHz$ resolution.

3

Figure 5: Anti-resonant frequency marked with $1MHz$ resolution.

Based on the above graphs, we can say that the resonant frequency is **141.32**$MHz$ and the anti-resonant frequency is **253.52**$MHz$.

## 1.3 Impedance at the Resonant Frequency

The impedance at the resonant frequency is approximately 71.49 $\Omega$ as shown in the Figure below.
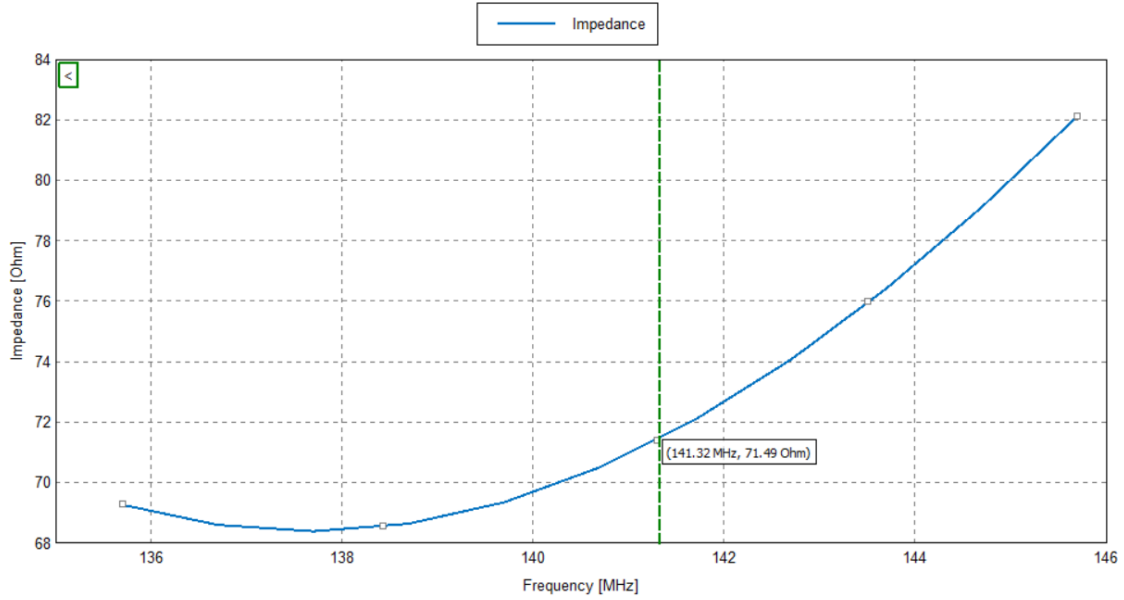


Figure 6: Impedance at the resonant frequency.
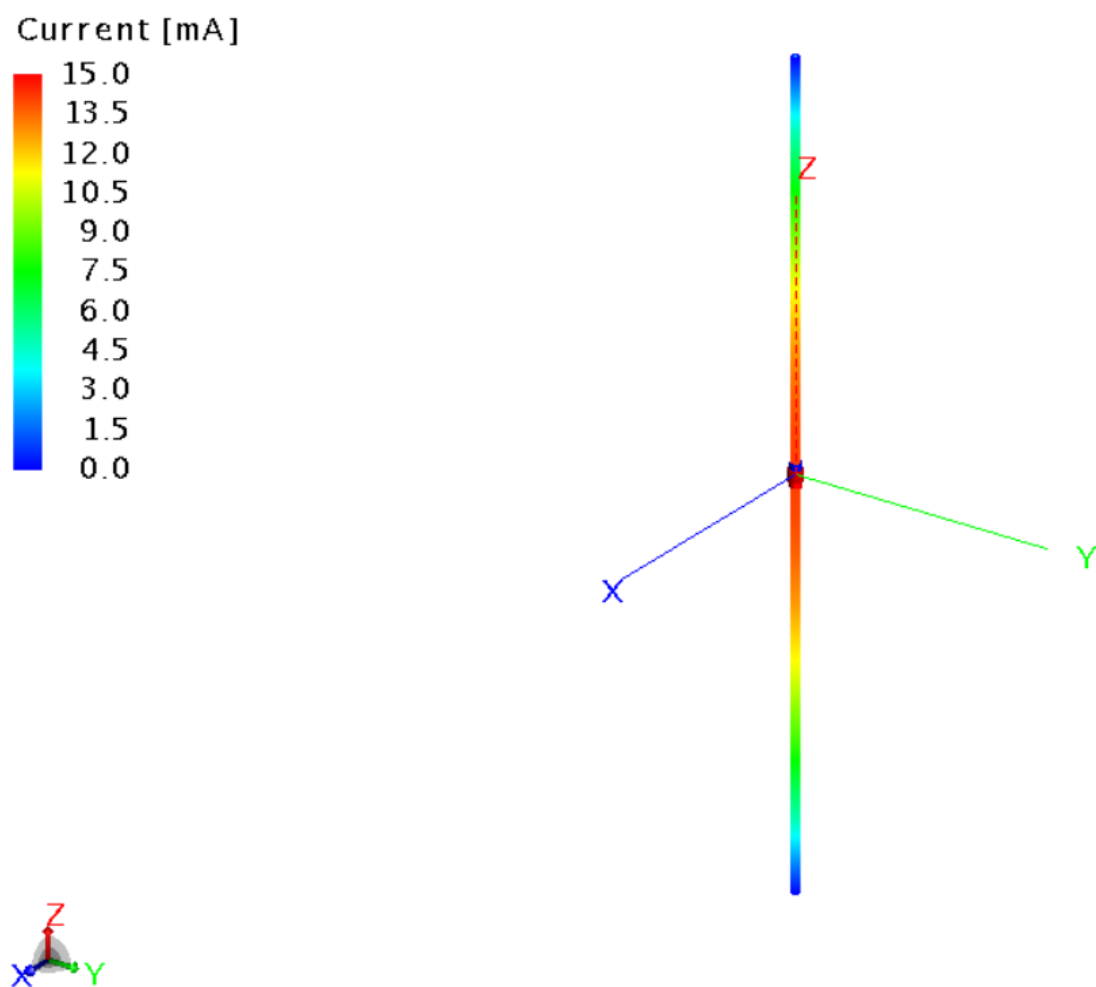
## 1.4   Current Distribution



Figure 7:   Current distribution through the dipole antenna at the resonant frequency.
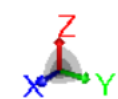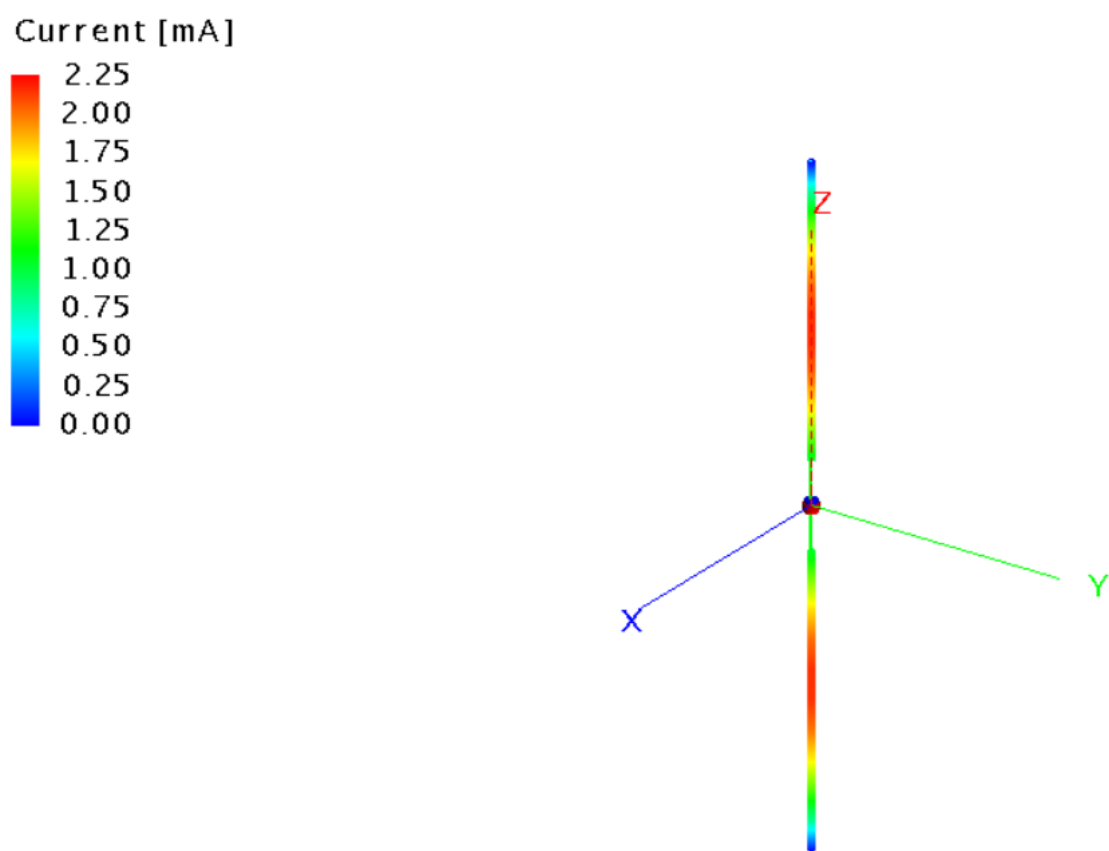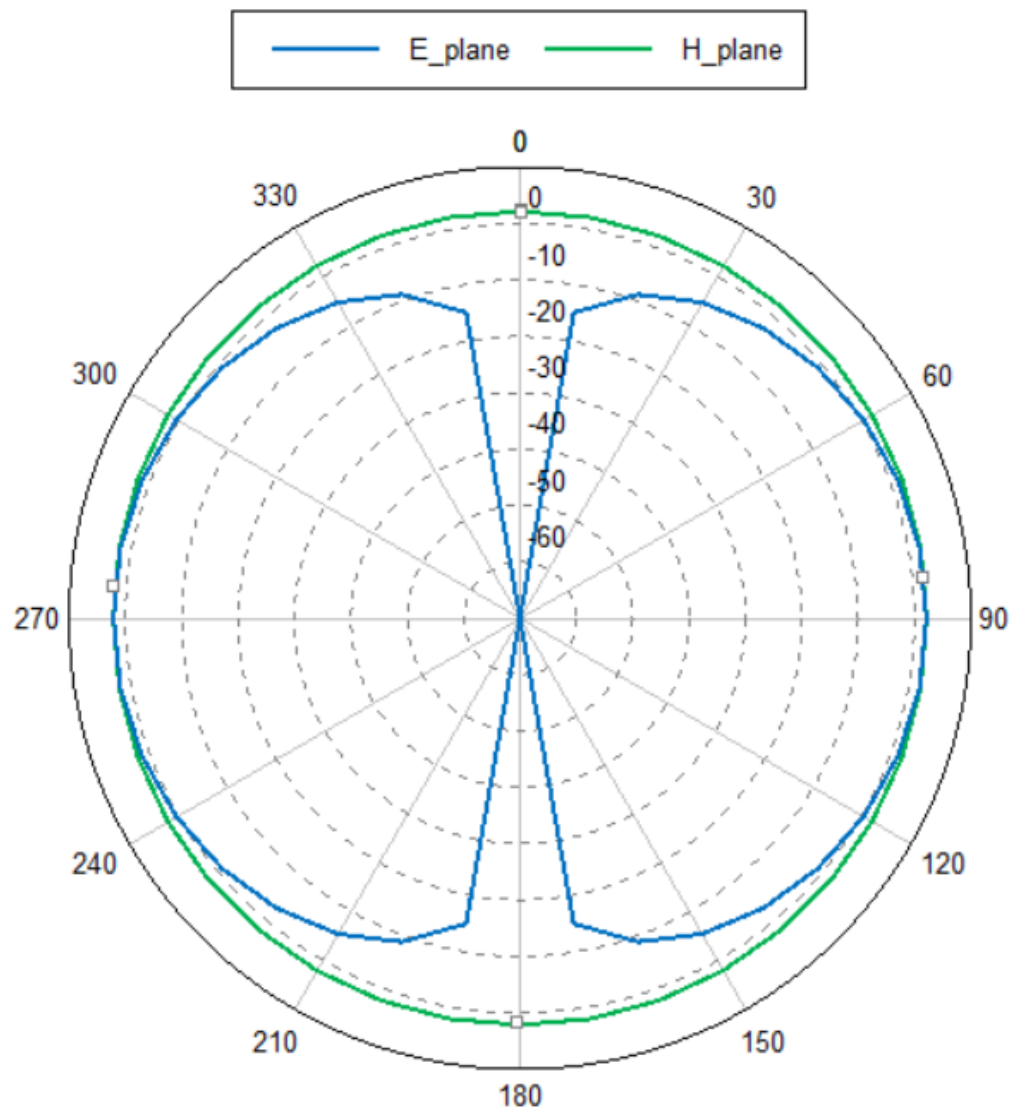
Figure 8: Current distribution through the dipole antenna at two times the resonant frequency.
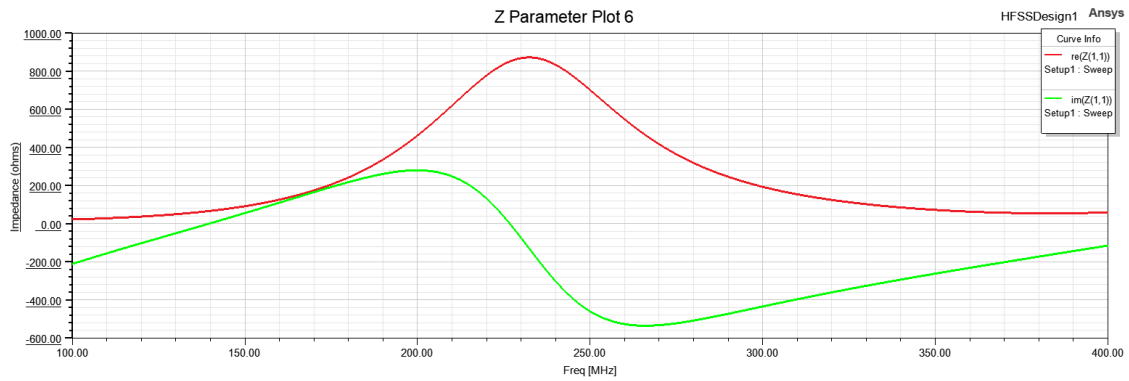
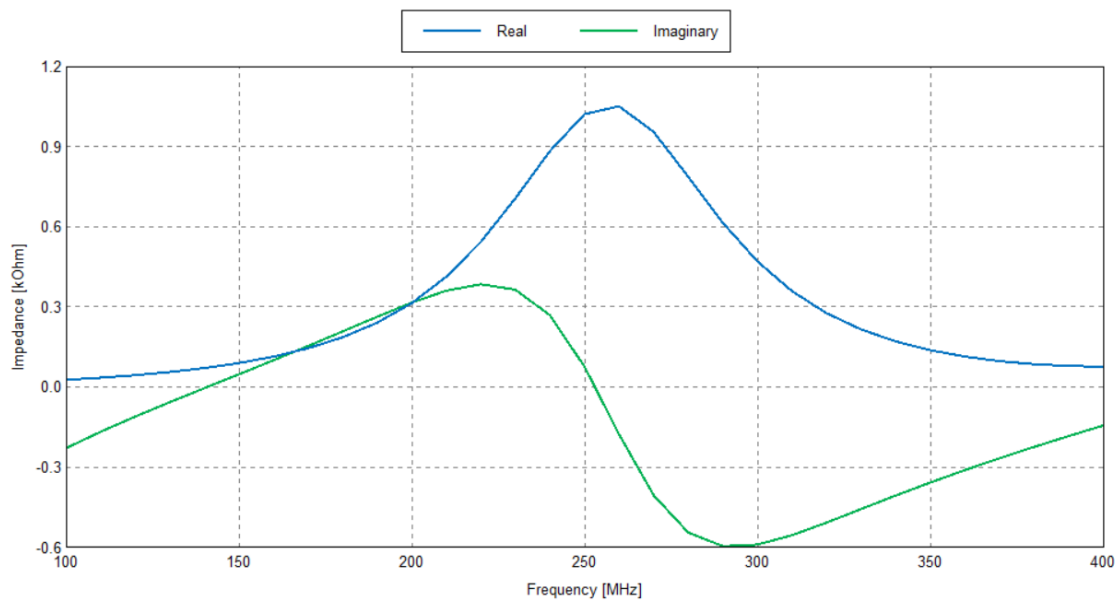## 1.5  The radiation pattern in E and H planes at resonance frequency



Total Gain (Frequency = 141.32 MHz; Theta = 90 deg; Phi = 0 deg) - dipole2_e_h_plane

Figure 9:  Radiation patterns at the resonance frequency.

# 2 Comparison with HFSS solutions



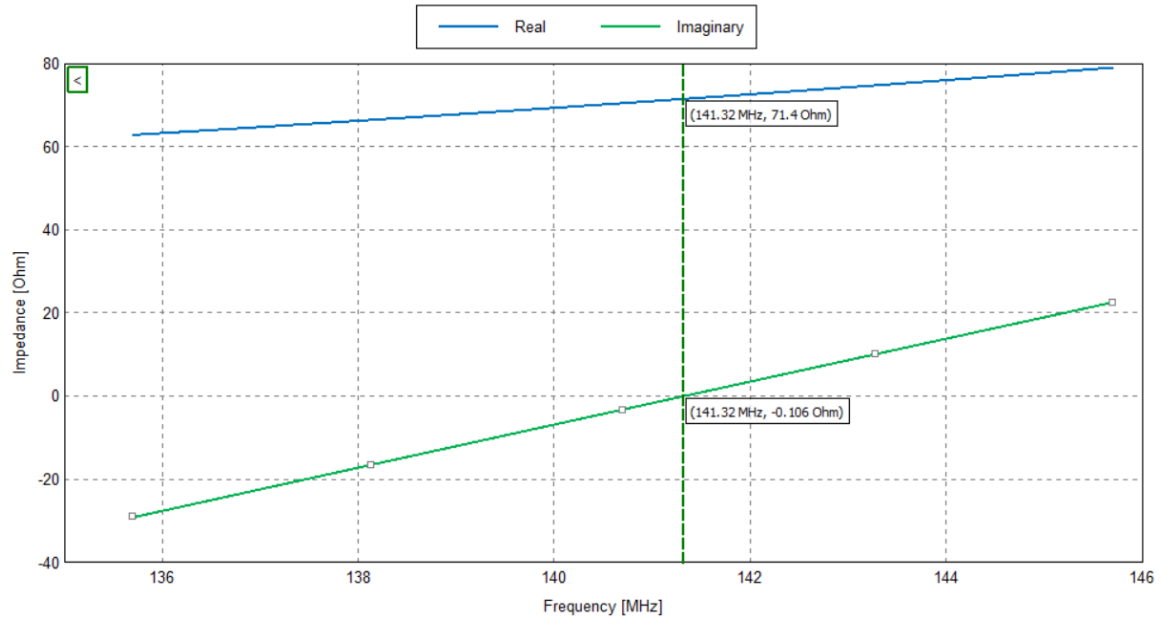(a) Impedance plot in HFSS.



(b) Impedance plot in FEKO

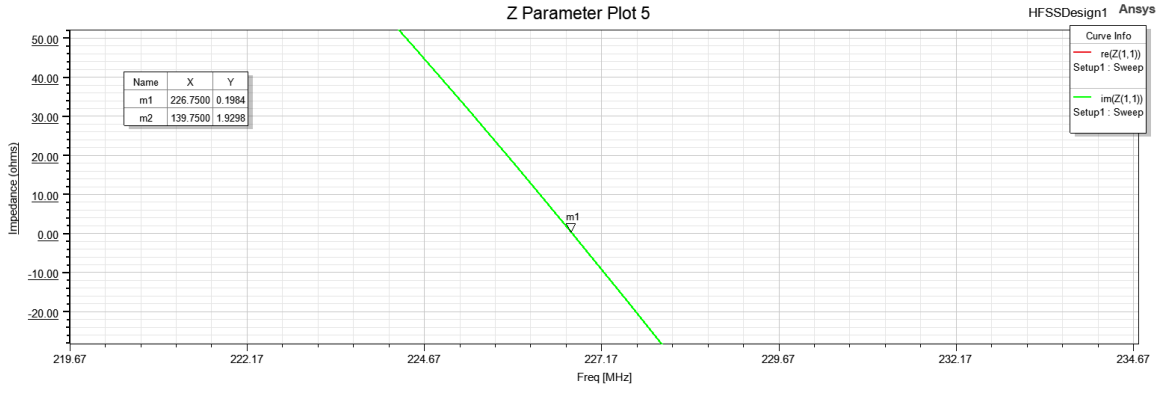Figure 10: Comparison of HFSS (top) and FEKO (bottom) simulation plots.

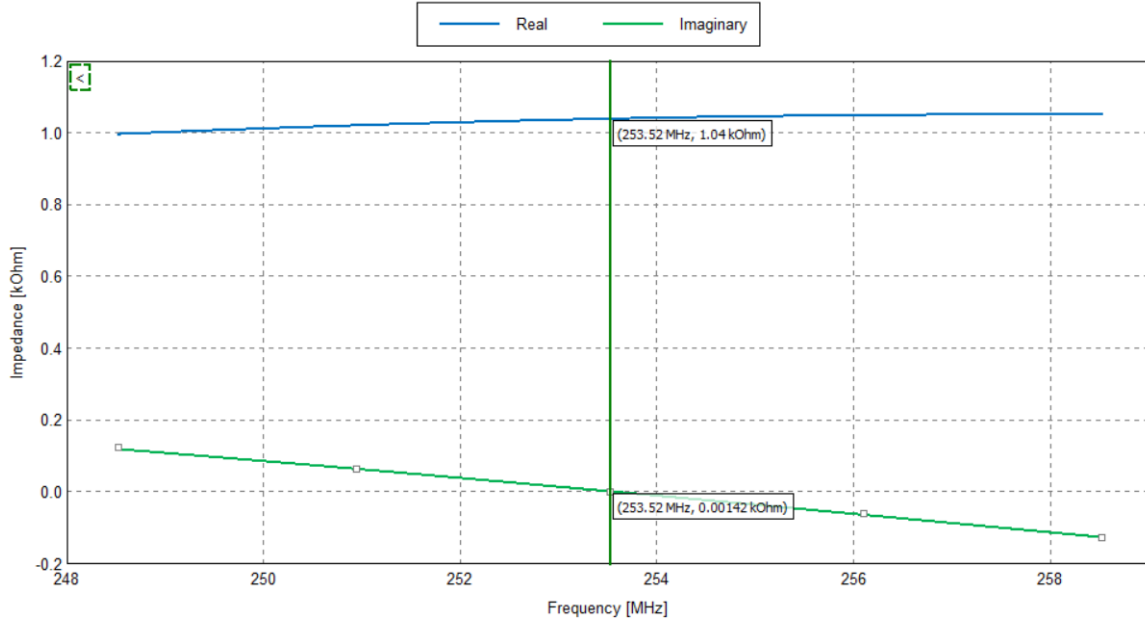(a) Impedance plot in HFSS at resonance.



(b) Impedance plot in FEKO at resonance

Figure 11: Comparison of HFSS (top) and FEKO (bottom) impedances at resonant frequency.

(a) Impedance plot in HFSS at anti-resonance.



(b) Impedance plot in FEKO at anti-resonance

Figure 12: Comparison of HFSS (top) and FEKO (bottom) impedances at anti-resonant frequency.

From the above figures, we can see that in HFSS the resonant and anti-resonant frequencies are $139.75 MHz$ and $226.75 MHz$ respectively. We compare this with the readings in FEKO which has resonant and anti-resonant frequencies of $141.32 MHz$ and $253.52 MHz$ respectively.From these readings we can notice that while the resonant frequencies from the two software are close, but the anti-resonant frequencies are quite different.

## Gain Plot 6
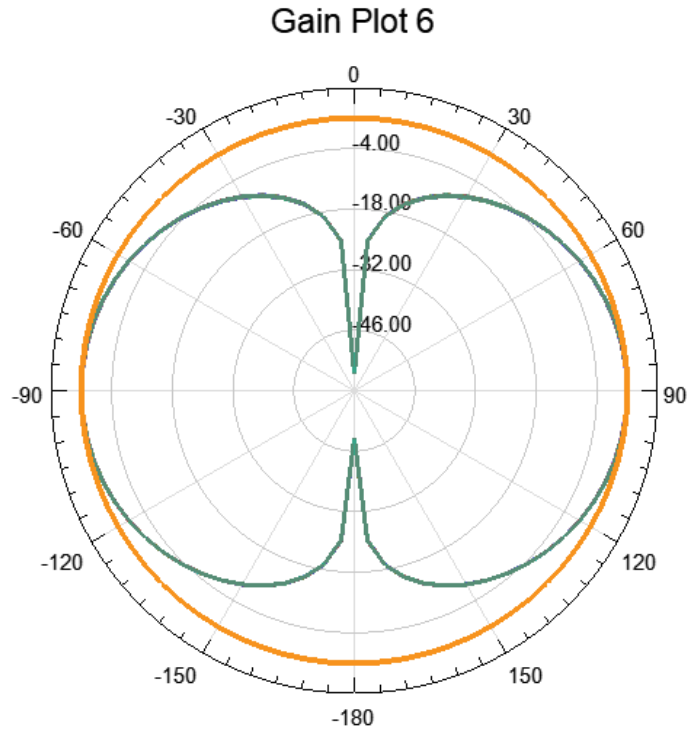


(a) E-plane (green) and H-plane (orange) in HFSS.
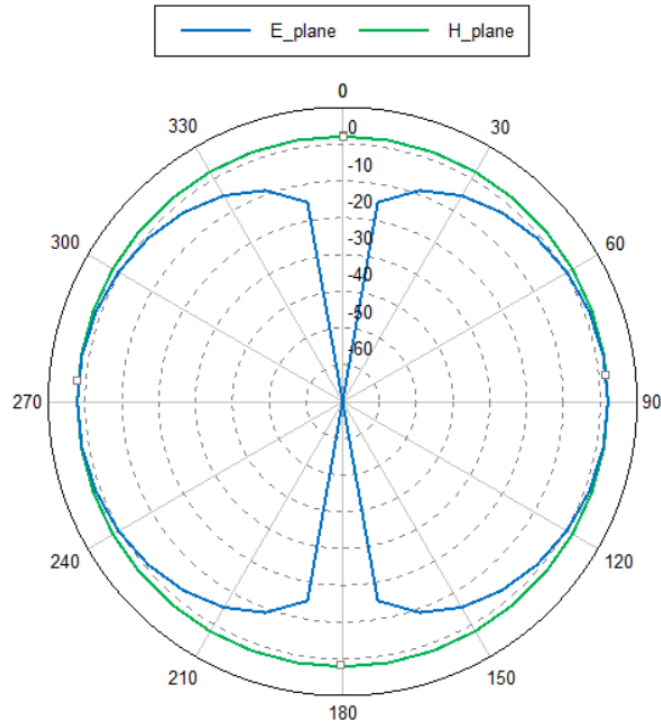


Total Gain (Frequency = 141.32 MHz; Theta = 90 deg; Phi = 0 deg) - dipole2_e_h_plane

(b) E-plane (blue) and H-plane (green) in FEKO.

Figure 13: Radiation patterns in HFSS (top) and FEKO (bottom).