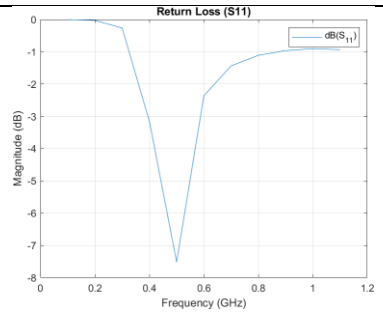
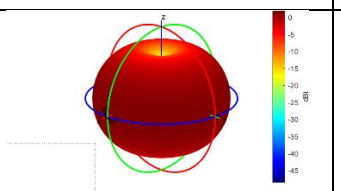
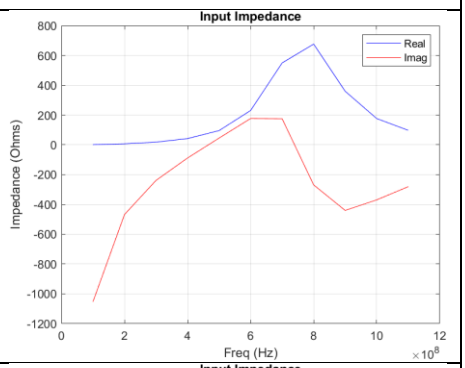
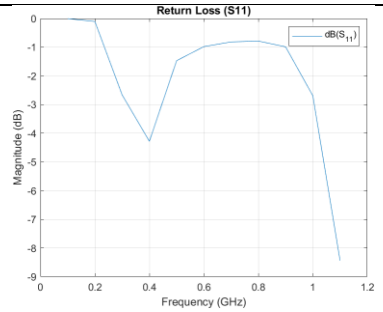
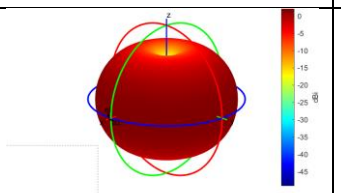
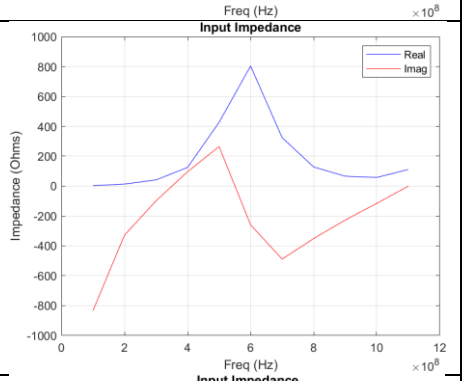
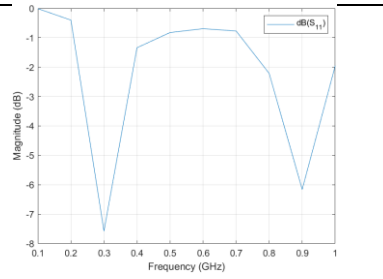
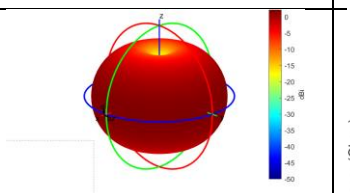
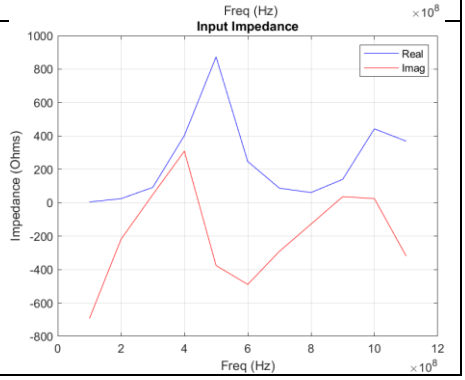
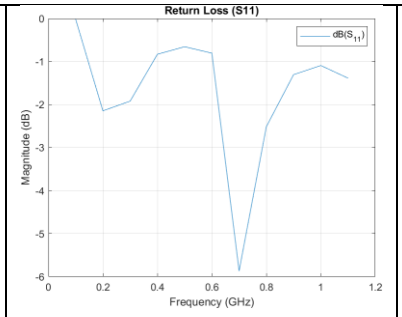
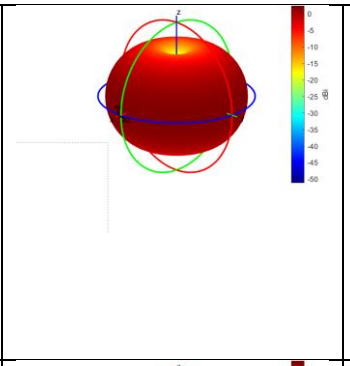
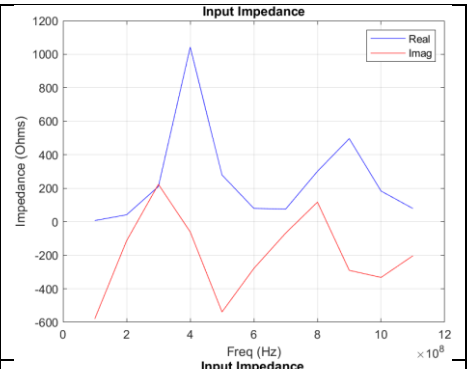
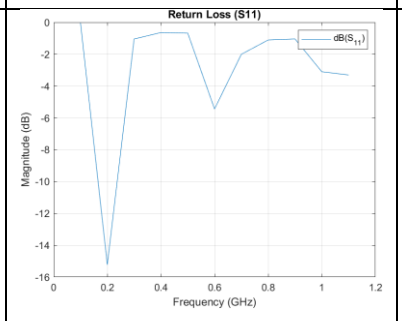
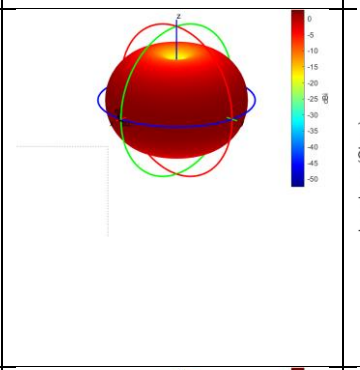
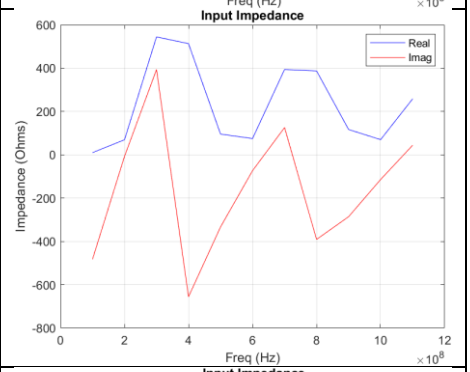
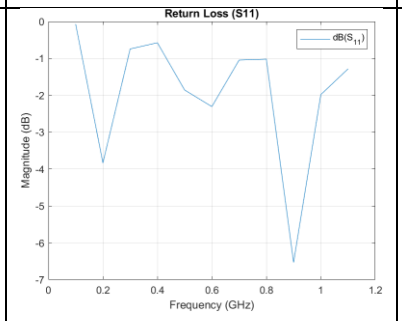
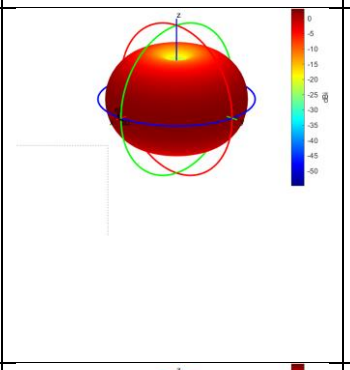
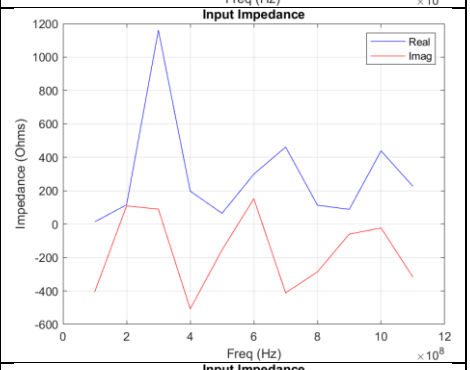
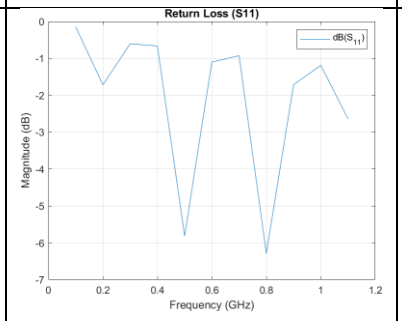
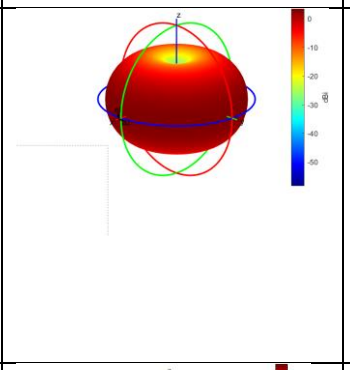
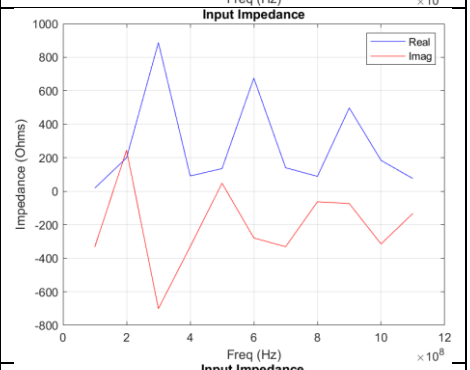
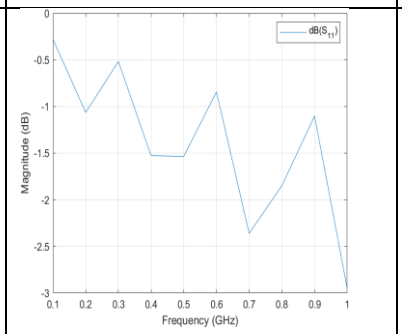
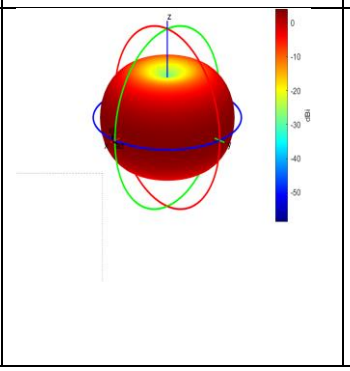
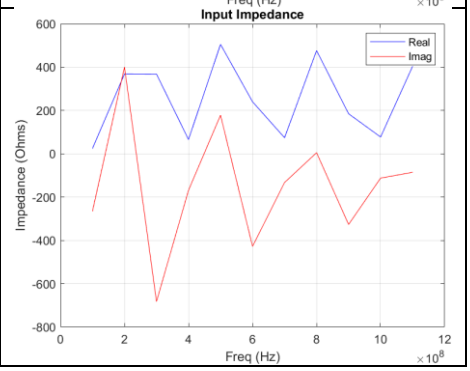
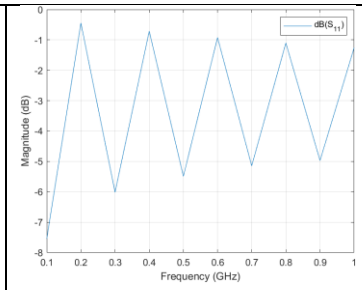
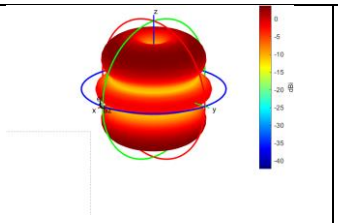
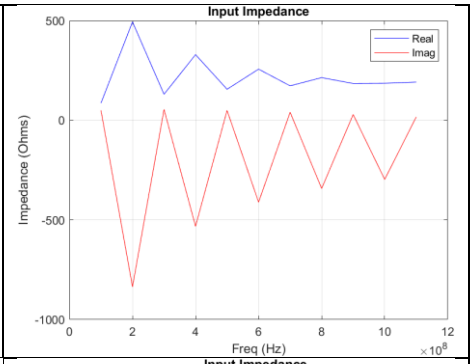
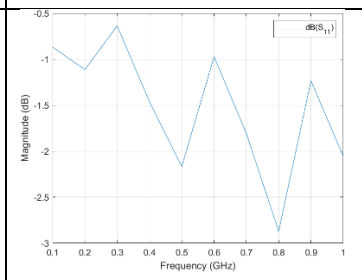
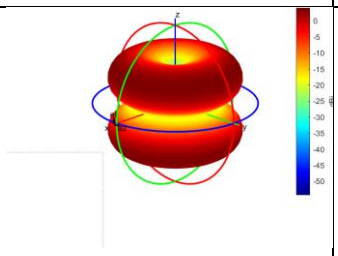
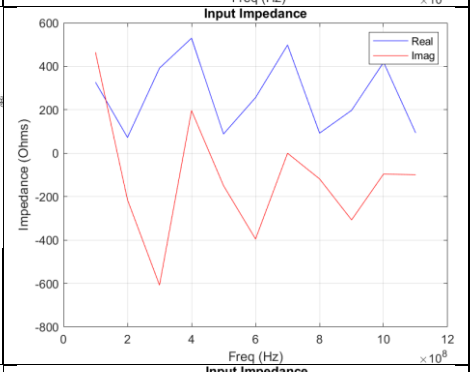
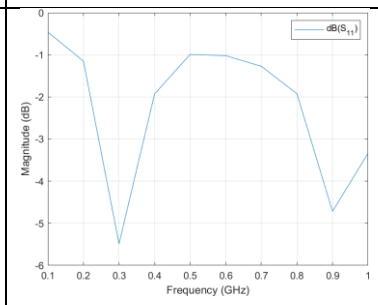
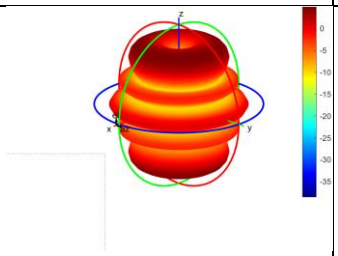
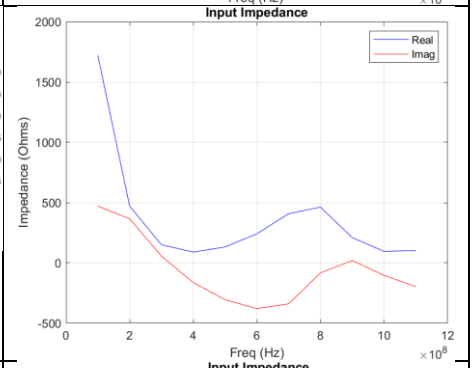
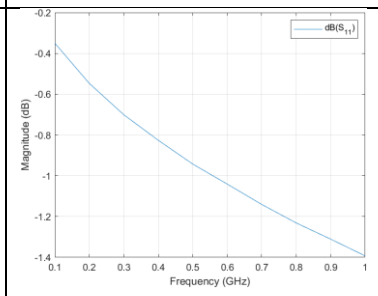
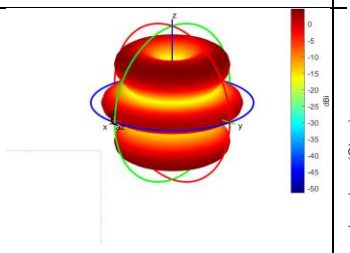
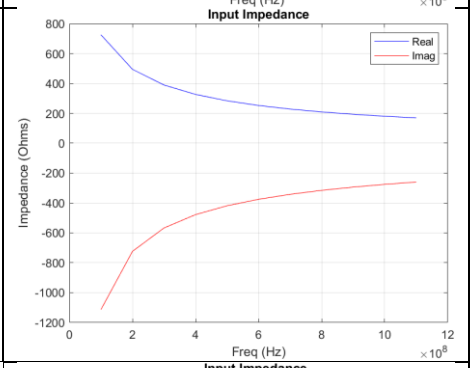
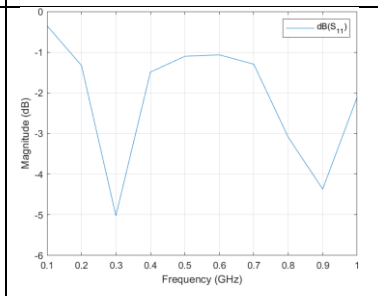
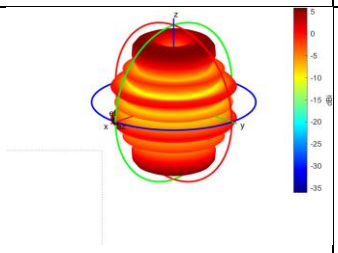
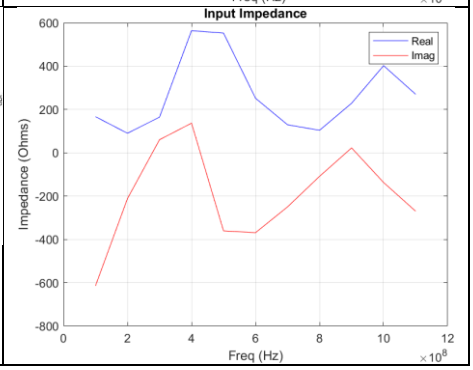
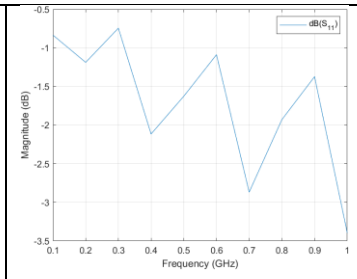
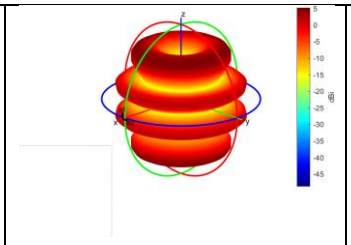
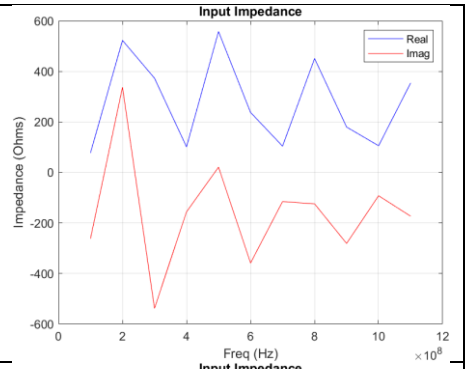
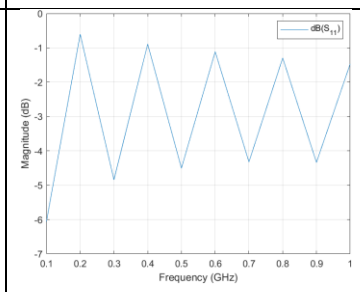
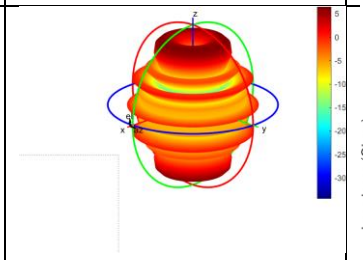
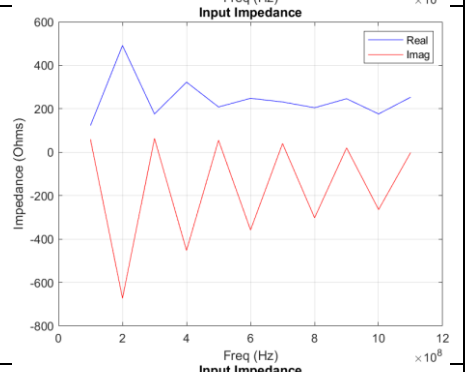
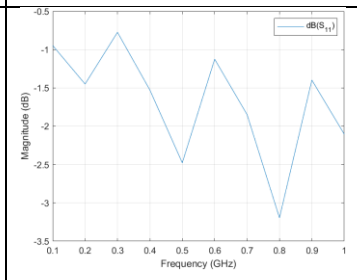
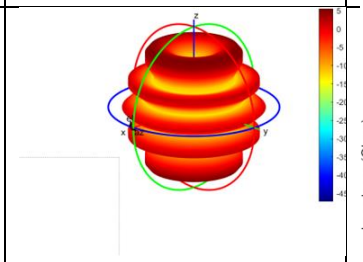
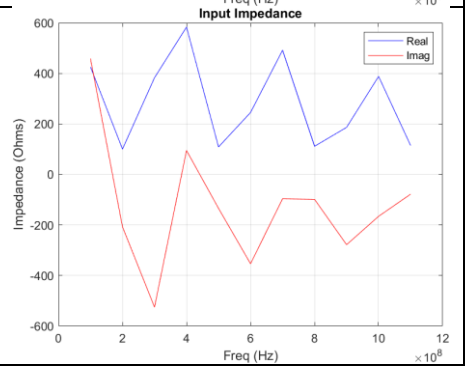
Antenna Optimization

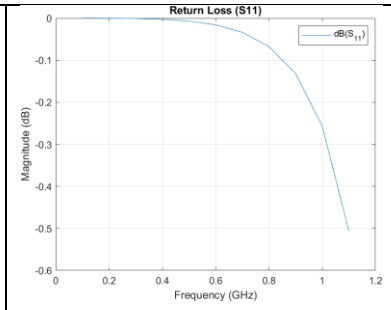
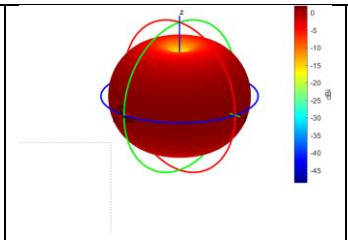
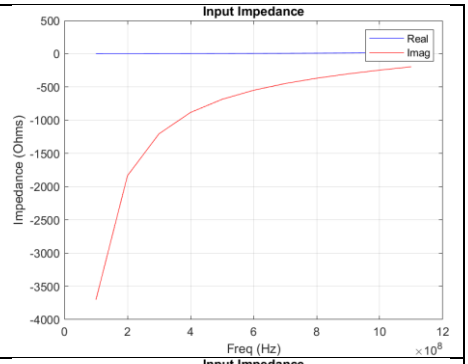
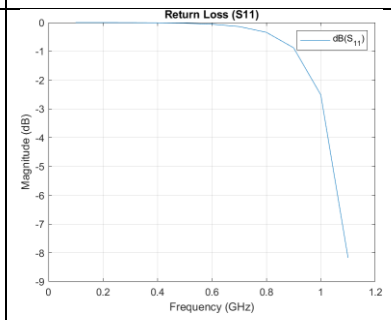
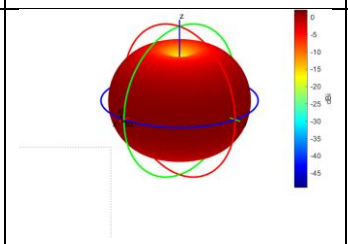
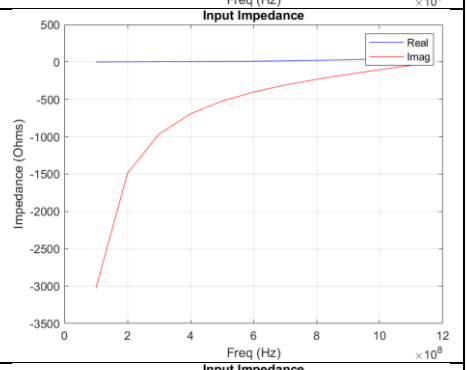
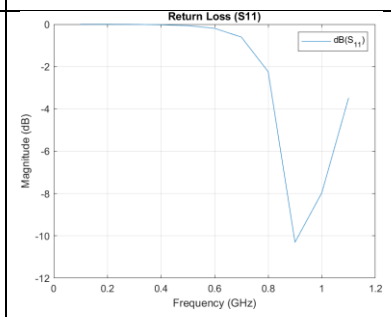
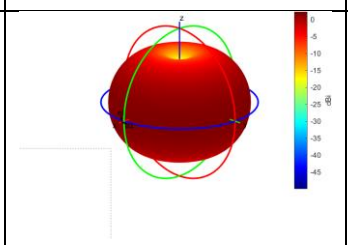
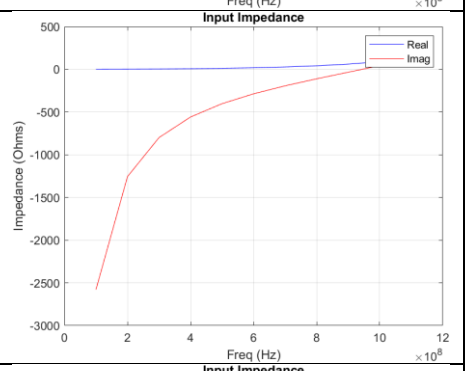
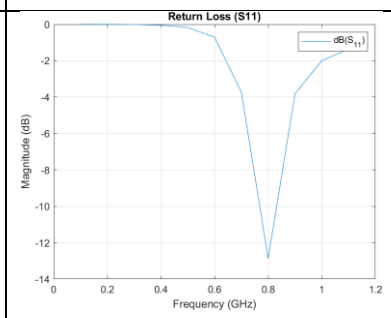
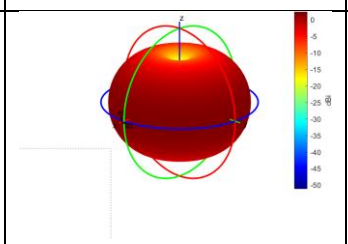
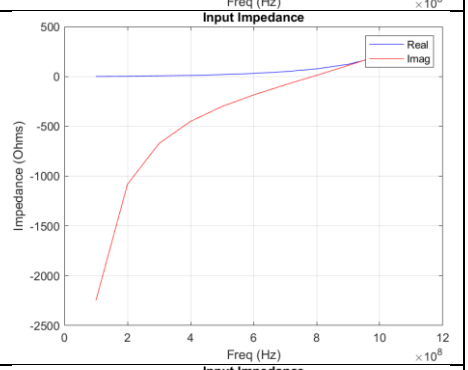
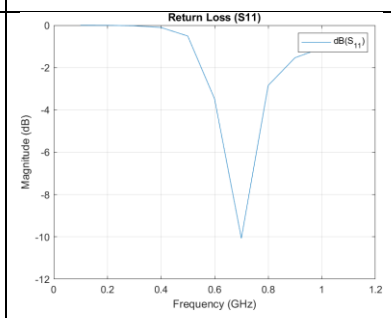
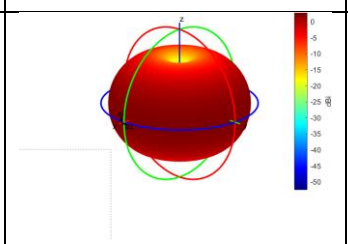
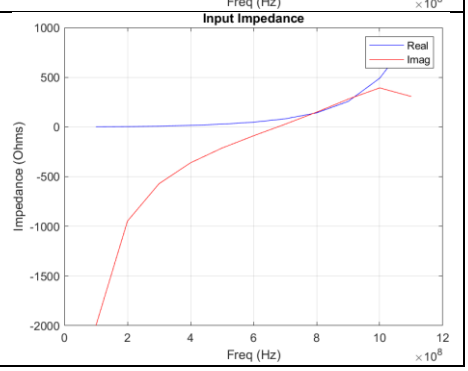
Dipole	W=0.01 S11	Fc=300MHz	Impedance
L=0.3 1.87 -48.5			
L=0.4 1.99 -49.2			
L=0.5 2.16 db - 50db			

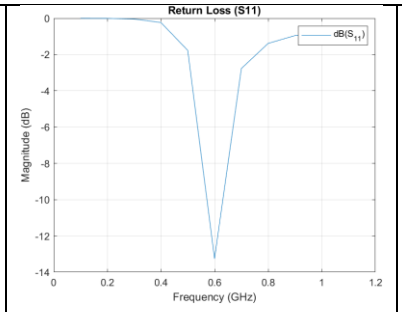
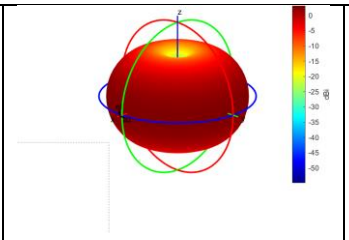
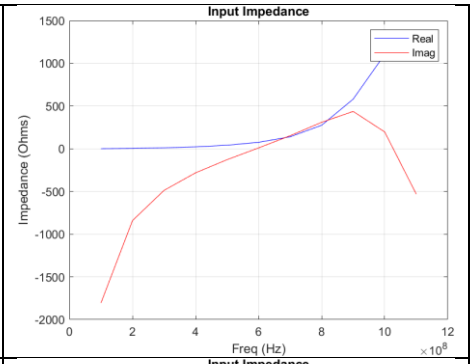
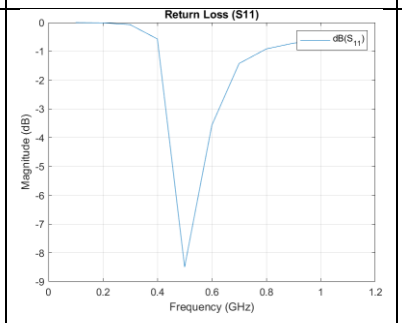
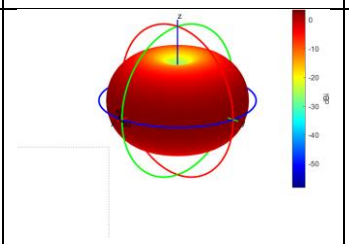
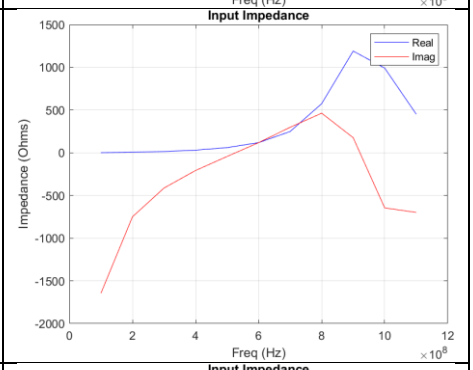
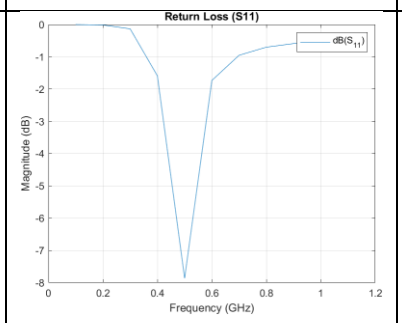
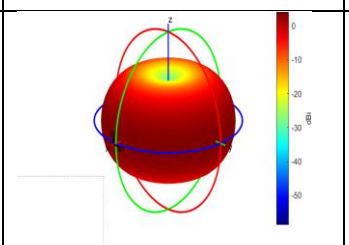
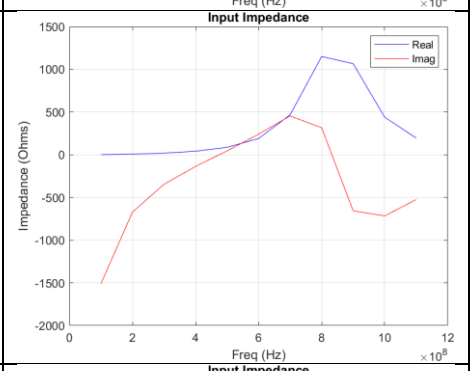
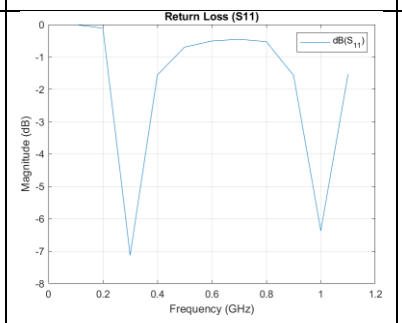
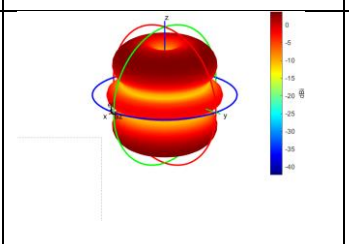
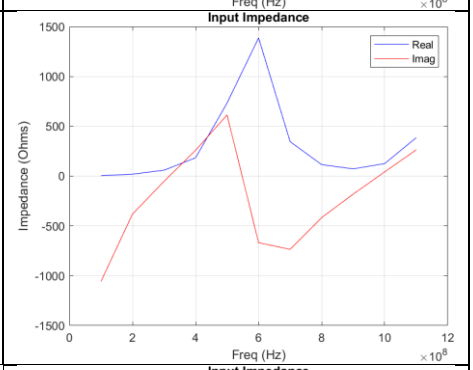
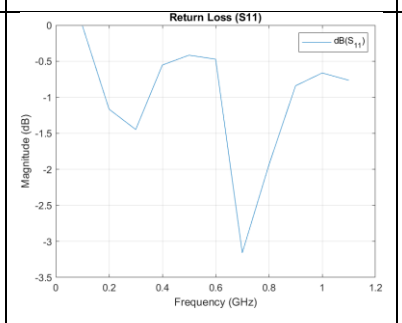
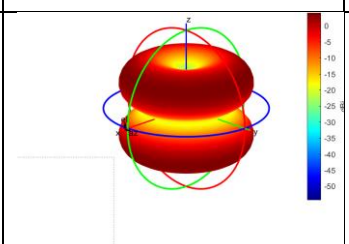
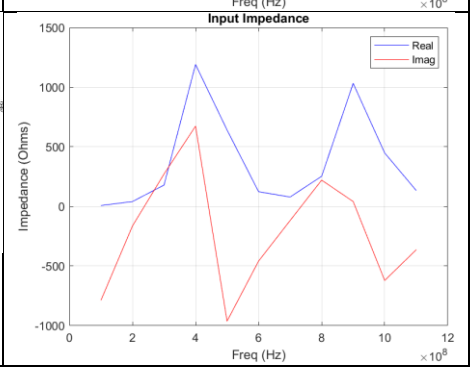
L=0.6 2.37 -51.1			
L=0.7 2.65 -52.5			
L=0.8 3 -54.9			
L=0.9 3.43 -58.3			
L=1 3.94 -58.7			

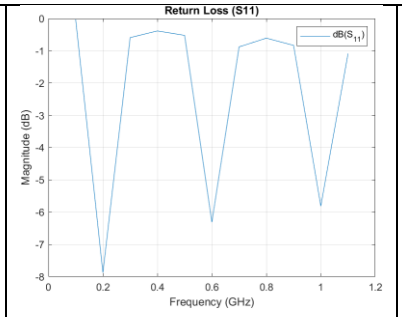
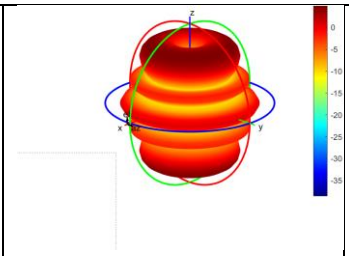
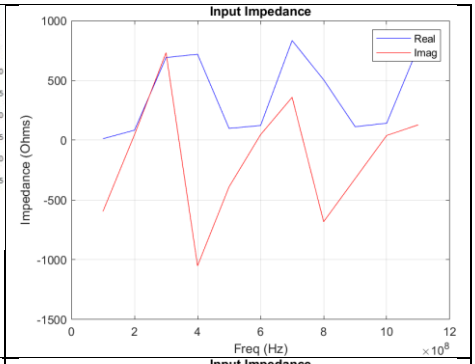
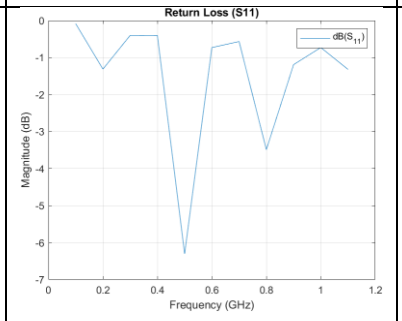
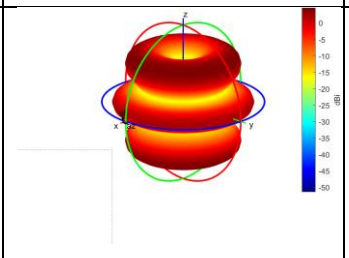
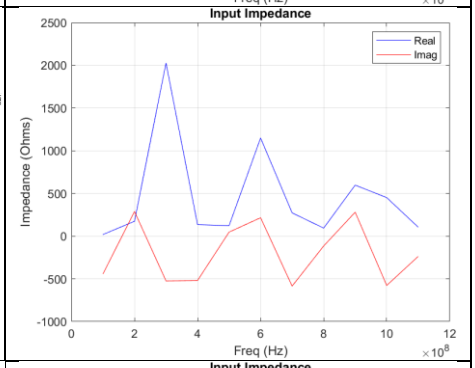
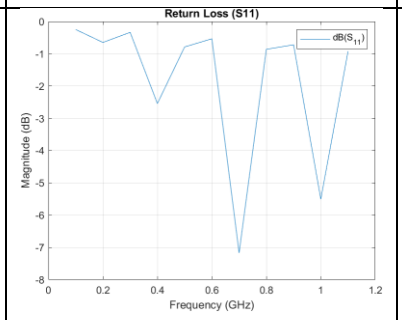
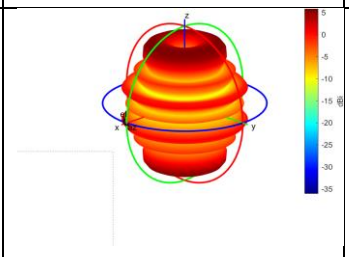
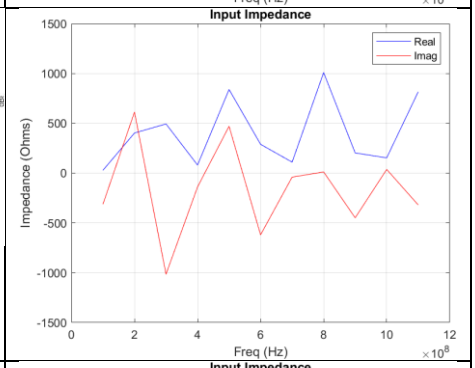
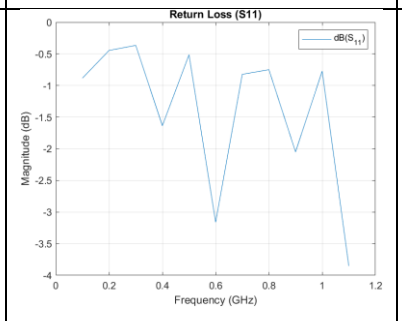
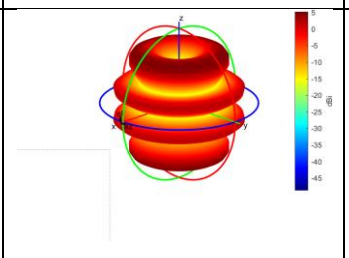
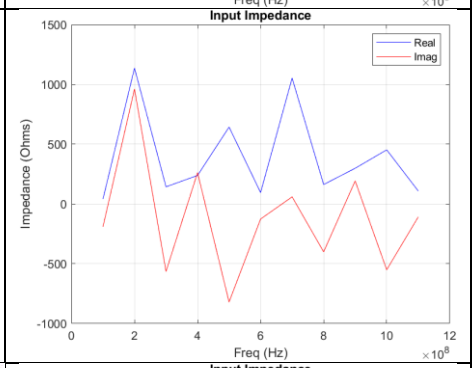
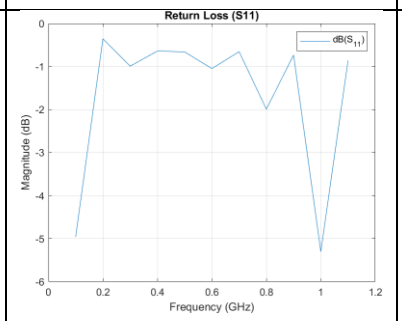
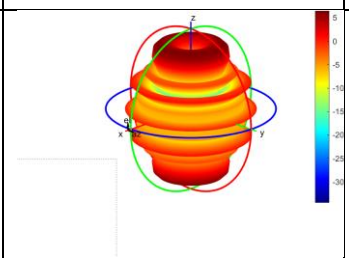
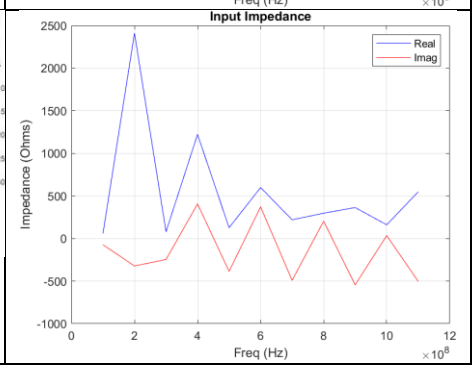
L = 1.5 3.59 -42.3			
L=2 3.97 -54.3			
L=2.5 4.86 -38.6			
L=3 4.57 -51.4			
L=3.5 5.76 -36.1			

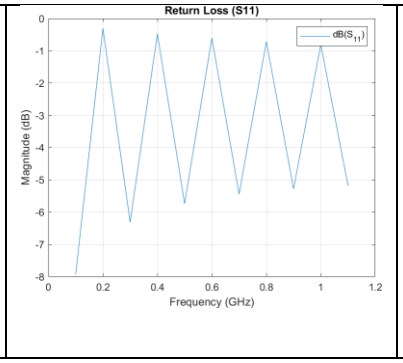
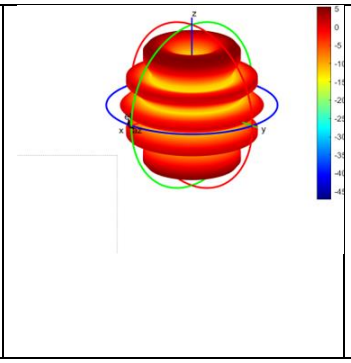
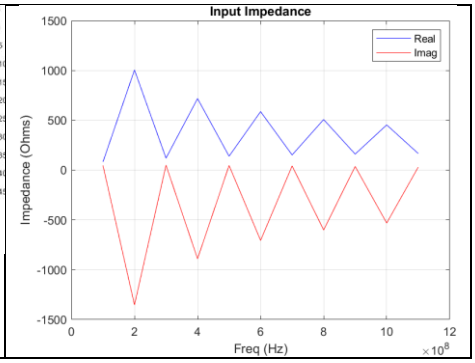
L=4 5.15 -48.7			
L=4.5 6.37 -34.5			
L=5 Gain 5.49 dB - 47.2 dB			

Dipole	W=0.01 S11	Fc=1000MHz	Impedance
Lambda (y)=0.3			

L=0.09 1.87 -48.5			
L=0.12 1.99 -49.2			
L=0.15 2.16 db - 50db			
L=0.18 2.37 -51.1			
L=0.21 2.65 -52.5			

L=0.24 =3 -54.9			
L=0.27 3.43 -58.3			
L=0.33 3.94 -58.7			
L = 0.45 3.59 -42.3			
L=0.63 3.97 -54.3			

L=0.75 4.86 -38.6			
L=0.94.57 -51.4			
L=1.05 5.76 -36.1			
L=1.25.15 -48.7			
L=4.56.37 -34.5			

L=5 Gain 5.49 dB - 47.2 dB			

Reflection coefficient/ Return loss/ S11

S11 indicates the resonant frequency to be the point at which S11 is most negative, i.e. where antenna reflects the least power.

It also determines the bandwidth since BW is the range of frequencies around resonant frequency below a threshold i.e. -10dB that is VSWR = 2:1.

S11 offers the point of best match for resonant frequency.

Lengths above 0.8lambda have poorer matching indicated by shallower depths

Impedance

Impedance at resonant frequency should be close to 50ohms for real part and 0 ohms for imaginary part.

Indicates resonant frequency as the frequency where imaginary part crosses zero or the real part is at its maximum.

At longer lengths from 0.9lambda, there are multiple zero crossings by imaginary Z indicating harmonic resonances. The conclusion is, the antenna has optimal length beyond which the waves start being reflected within it, causing there to be standing waves (VSWR), hence resulting in the harmonics (sidelobes) or higher order nodes, beside the fundamental gain lobe.

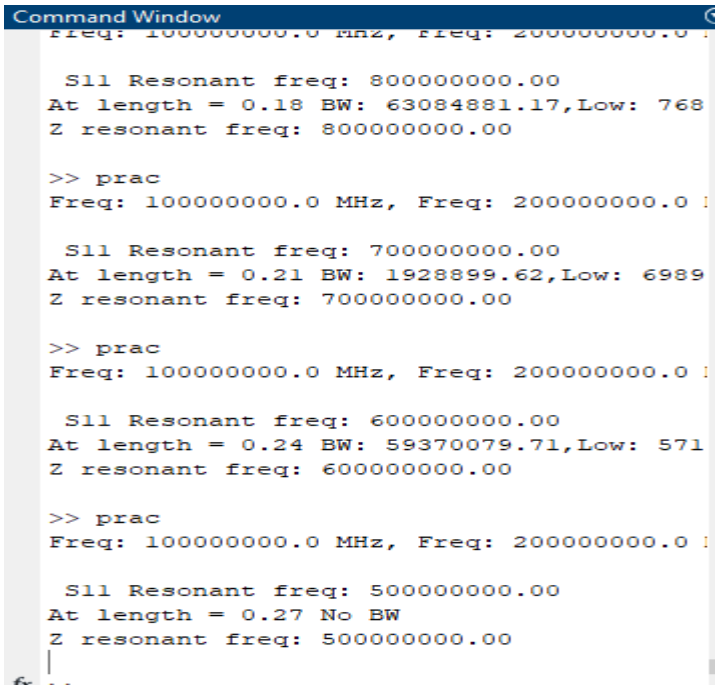
Gain/Pattern

The omnidirectional property ceases at length = 1*lambda

At lengths greater than 0.5lambda (ideal antenna height), pattern should develop side lobes and weaken amin lobe due to current distribution distortion. These reduce directivity hence length increases gain but beyond 1lambda decreases gain directivity.

The Gain and pattern does not change with frequency. 300MHz gain is equal to 1GHz gain.

The resonance frequency falls by 100MHz for every increase in length by (+)0.1lambda. The widest BW is at 0.6lambda, equaling 63MHz around resonant frequency 800MHz, then 0.8lambda, equaling 60MHz, around center frequency 600MHz. BW fluctuates and doesn't vary linearly due to Q-Factor, radiation resistance and matching.


Command Window
Freq: 100000000.0 MHz, Freq: 200000000.0
S11 Resonant freq: 800000000.00
At length = 0.18 BW: 63084881.17,Low: 768
Z resonant freq: 800000000.00
>> prac
Freq: 100000000.0 MHz, Freq: 200000000.0
S11 Resonant freq: 700000000.00
At length = 0.21 BW: 1928899.62,Low: 6989
Z resonant freq: 700000000.00
>> prac
Freq: 100000000.0 MHz, Freq: 200000000.0
S11 Resonant freq: 600000000.00
At length = 0.24 BW: 59370079.71,Low: 571
Z resonant freq: 600000000.00
>> prac
Freq: 100000000.0 MHz, Freq: 200000000.0
S11 Resonant freq: 500000000.00
At length = 0.27 No BW
Z resonant freq: 500000000.00