# EE4580 - Quasi Optical Systems - Free Space Spectral Green's Function (SGF)

Question 1 (2 points):

Write a Matlab routine to calculate the free space *Spectral Green's Function* (SGF) of an elementary electric source oriented along x and placed at the origin.

1) Plot a figure with the variation of the x- and z-electric field components of the SGF (real and imaginary parts) at 15GHz as a function of k_x from 0 to $5k_0$ for $k_y=0$. Ensure that the radiation condition is verified.
2) In which region of the spectrum is the x-component imaginary?
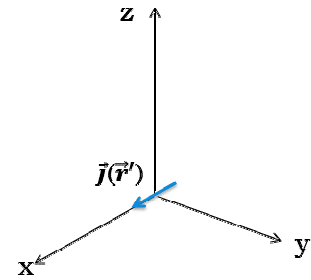
Question 2 (4 points):

Write a Matlab program to calculate far field radiated by the printed dipole shown in the figure using the free space SGF.

- Write a routine to calculate the FT of the current distribution in a dipole antenna (assume a single PWS as the current distribution).
- Write a routine to calculate the far field in spherical coordinates starting form the SGF and the FT of the current distribution
- Write a routine to calculate the directivity of the antenna starting from the far field.
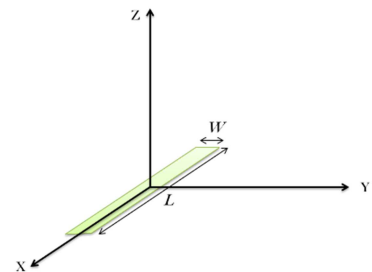
To check the program, provide the following plots

1) A 1D plot of the far field versus θ for $\phi = 0$ and $\phi = 90$. Consider a half-wavelength dipole with w=*λ/20* at 15GHz
2) A 2D plot (use the *surface* command) of the far field in the upper medium (z>0) as a function of $sin\theta cos\phi$ and $sin\theta sin\phi$ for the same case.
3) Provide a plot of the directivity at broadside $\theta = 0$ as a function of the frequency, f=5GHz to 30GHz, for a dipole of *10mm* long and *1mm* wide.

Question 3 (2 points):

The same dipole, than in previous question, of length L=*λ/2* a and width W=*λ/20* at 15GHz is now radiating in the presence of an infinite PEC plane as shown in the figure. Modify the FT of the current distribution to include the PEC plane.
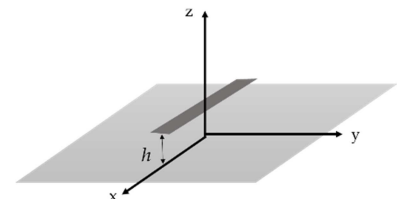
Provide the following plots:

1) Compare in a 1D elevation plot (i.e. versus θ) the far field radiated by the dipole in free space and in the presence of a PEC plane at a distance of $h = 15mm$.
2) Provide a plot of the directivity at broadside $\theta = 0$ as a function of the distance to the PEC plane. Consider $h = 1mm\ to\ 20mm$