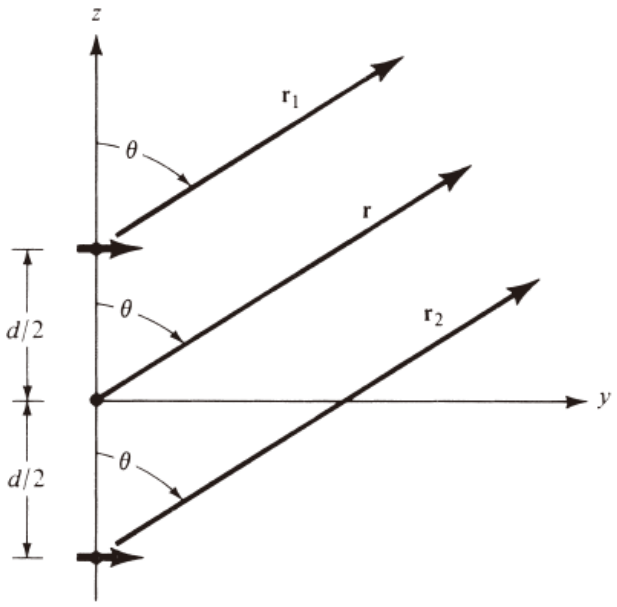
Lab 7 Simulation of Dipole Antennas and Waveguide Antennas

1. Simulate a dipole antenna with different lengths. Try 0.01 λ, 0.1 λ, 0.5 λ, 1.5 λ and 5 λ. You should use two PEC cylinders to represent the dipole and use a very tiny gap between them. Make the diameter of the cylinder much smaller than its length. Plot 2D (in two principle planes) and 3D patterns. Check the near-field fields and far-field fields to see if the former results in mainly reactive power and the latter results in real power.

2. Put a 0.5-λ dipole antenna very close to a large flat PEC plane and make the dipole parallel to the PEC. Set the distance between them to be even smaller than the cylinder radius. Check the far-field fields and compare with those of the corresponding case in topic 1, from which you can conclude if a dipole near a PEC plane radiates or not.

3. Simulate a two-dipole antenna array with 0.5-λ dipoles. Arrange them in the way shown in Figure 6.1 in the textbook. Set β = 0. Use spacing of λ/4 to observe how well the simulated 2D patterns agree with the theoretically calculated one. Plot simulated (three cases) and theoretically calculated 2D patterns together.



(b) Far-field observations

Figure 6.1 Geometry of a two-element array positioned along the *z*-axis.

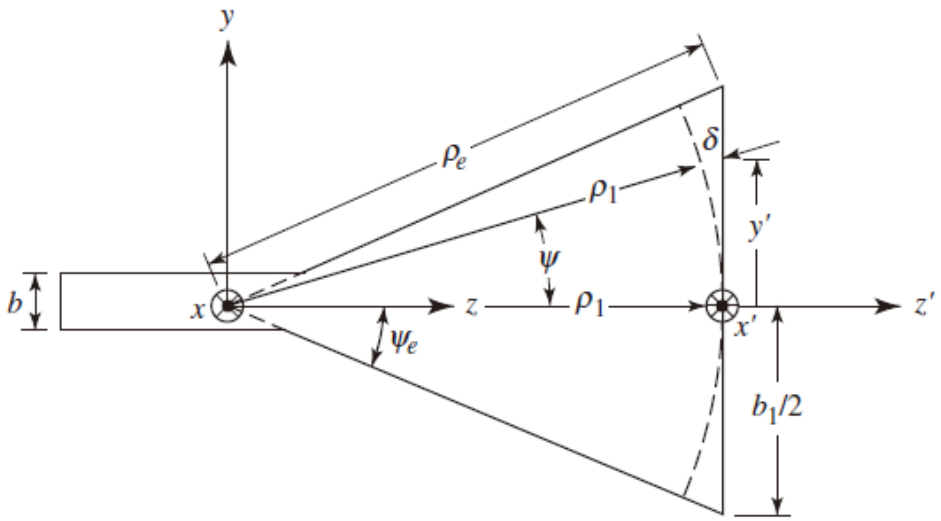
$$\beta = -kd\cos\theta_0$$

4. Use the setup of d = λ/4 in topic 3. Try different phases with β = 90°. Plot simulated and theoretically calculated 2D patterns together for each case. You can take advantage of the "Array Wizard" function of the software for some topics involving

arrays.

5. Simulate an X-band rectangular waveguide antenna with one end set as a wave port and the other open. Use the frequency of $1.5f_c$ for TE_{10} mode. Obtain its directivity and plot the 3D pattern.

6. Simulate an E-plane sectoral horn antenna fed by an X-band rectangular waveguide. Use the frequency of $1.5f_c$ for TE_{10} mode. According to the geometry shown in Figure 13.2(b), make the distance from the left end of the waveguide to the virtual line source to be $2\lambda_g$. Use $\rho_1 = 8\lambda_0$ and total flaring angle of 30°. Set up a wave port at the waveguide aperture and make the horn aperture to be radiating. Place a field monitor plane in two *xy* cross sectional planes in the waveguide and the horn part ($4\lambda_0$ to the aperture), respectively, and plot the electric fields on them. Obtain the directivity and compare it with that of a waveguide antenna working at the same frequency. Plot the 3D pattern.



(b) *E*-plane view

Figure 13.2 *E*-plane horn and coordinate system.