Linear Wire Dipole Antennas: Practical Approach

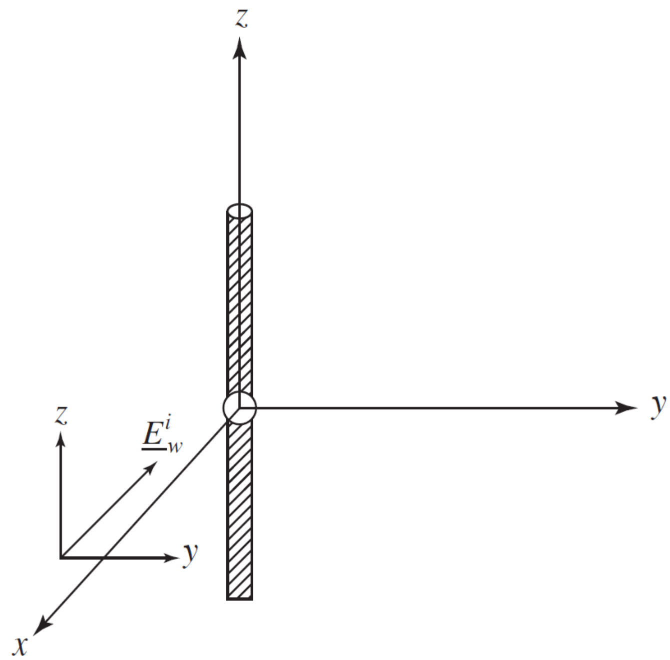
Antenna Polarization

A half-wavelength dipole is positioned symmetrically about the origin along the z-axis and is used as a receiving antenna. A $300\ \mathrm{MHz}$ plane wave traveling along the – x-axis towards the antenna, has a power density of $2\mu\mathrm{W/m^2}$, and its electric field is given by

$$E_w^i = (3\hat{\mathbf{z}} + j\hat{\mathbf{y}})E_0 e^{jkx}$$

where E_0 is a constant. Determine the following:

(a) Polarization of the incident Wave (include axial ratio and handedness if applicable)
(b) Polarization of the antenna toward the x-axis (include axial ratio and handedness if applicable)
(c) Polarization loss (both dB and dimensionless) between the antenna and the incoming wave



Hint: For part (b), help yourself with the diagram and recall the electric field for a half-wave dipole.

Dipole Antenna Impedance

A lossless, resonant, center-fed $\frac{3\lambda}{4}$ linear dipole, radiating in free-space is attached to a balanced, lossless transmission line whose characteristic impedance is $300\ \Omega$. Assuming $a = 0.03\ \lambda$, calculate:

(a) Approximate Radiation Resistance
(b) Approximate Input Resistance
(c) VSWR on the transmission line

For part (a) use the diagrams shown in figs. 4.9(a) and 4.9(b)

Dipole Antenna Impedance and Resonance

A linear half-wavelength dipole is operating at a frequency of 1 GHz. Determine the capacitance or inductance that must be placed *across* (in parallel) the input terminals of the dipole so that the antenna becomes *resonant* (make the total input impedance real).
What is the VSWR of the resonant half-wave dipole when it is connected to a $50\ \Omega$ transmission line?

Antenna Communications

A ground-based, resonant, lossless linear vertical half-wavelength $\left(\frac{\lambda}{2}\right)$ dipole is used to communicate with a space-borne, lossless, resonant linear half-wavelength $\left(\frac{\lambda}{2}\right)$ dipole. Both dipoles are oriented along the z-axis. While one dipole is assumed to be at ground level, the other is elevated at a height of $1{,}000$ m and separated by a distance of $1{,}000$ m, as shown in the diagram below.
Assuming the input power (in the $50\ \Omega$ transmission line) feeding the dipole at the ground level is 100 mW, determine, at a frequency of 3 GHz, the power received in the $50\ \Omega$ transmission line connected to the space-borne dipole.
Assume both dipoles are radiating in unbounded free-space and each is in the far-field of the other.