

Problem 9.15 For a dipole antenna of length $l = 3\lambda/2$,

- (a) Determine the directions of maximum radiation.
- (b) Obtain an expression for S_{\max}
- (c) Generate a plot of the normalized radiation pattern $F(\theta)$.
- (d) Compare your pattern with that shown in Fig. 9-17(c).

Solution:

- (a) From Eq. (9.56), $S(\theta)$ for an arbitrary length dipole is given by

$$S(\theta) = \frac{15I_0^2}{\pi R^2} \left[\frac{\cos\left(\frac{\pi l}{\lambda} \cos \theta\right) - \cos\left(\frac{\pi l}{\lambda}\right)}{\sin \theta} \right]^2.$$

For $l = 3\lambda/2$, $S(\theta)$ becomes

$$S(\theta) = \frac{15I_0^2}{\pi R^2} \left[\frac{\cos\left(\frac{3\pi}{2} \cos \theta\right)}{\sin \theta} \right]^2.$$

Solving for the directions of maximum radiation numerically yields two maximum directions of radiation given by

$$\theta_{\max_1} = 42.6^\circ, \quad \theta_{\max_2} = 137.4^\circ.$$

- (b) From the numerical results, it was found that $S(\theta) = 15I_0^2/(\pi R^2)(1.96)$ at θ_{\max} . Thus,

$$S_{\max} = \frac{15I_0^2}{\pi R^2} (1.96).$$

- (c) The normalized radiation pattern is given by Eq. (9.13) as

$$F(\theta) = \frac{S(\theta)}{S_{\max}}.$$

Using the expression for $S(\theta)$ from part (a) with the value of S_{\max} found in part (b),

$$F(\theta) = \frac{1}{1.96} \left[\frac{\cos\left(\frac{3\pi}{2} \cos \theta\right)}{\sin \theta} \right]^2.$$

The normalized radiation pattern is shown in Fig. P9.15, which is identical to that shown in Fig. 9.17(c).

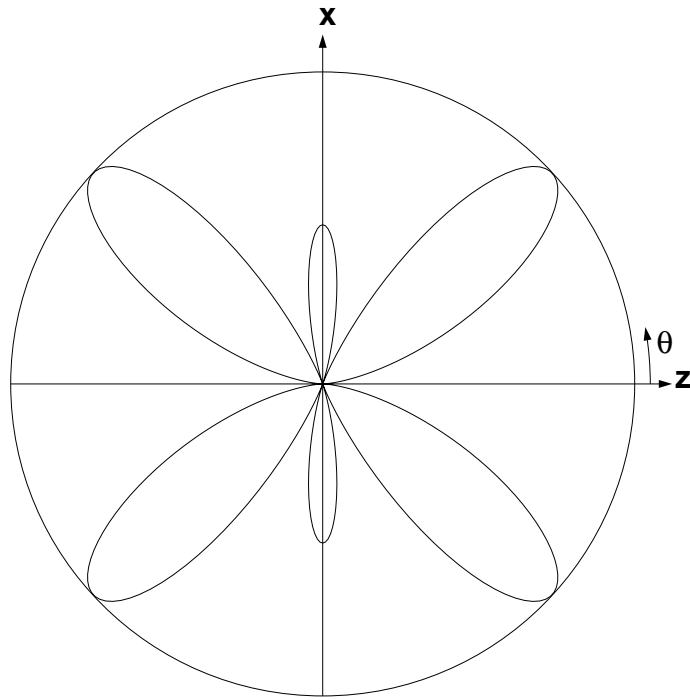


Figure P9.15: Radiation pattern of dipole of length $3\lambda/2$.
