

**Problem 9.34** Consider the two-element dipole array of Fig. 9-29(a). If the two dipoles are excited with identical feeding coefficients ( $a_0 = a_1 = 1$  and  $\psi_0 = \psi_1 = 0$ ), choose  $(d/\lambda)$  such that the array factor has a maximum at  $\theta = 45^\circ$ .

**Solution:** With  $a_0 = a_1 = 1$  and  $\psi_0 = \psi_1 = 0$ ,

$$F_a(\theta) = |1 + e^{j(2\pi d/\lambda)\cos\theta}|^2 = 4\cos^2\left(\frac{\pi d}{\lambda}\cos\theta\right).$$

$F_a(\theta)$  is a maximum when the argument of the cosine function is zero or a multiple of  $\pi$ . Hence, for a maximum at  $\theta = 45^\circ$ ,

$$\frac{\pi d}{\lambda}\cos 45^\circ = n\pi, \quad n = 0, 1, 2, \dots$$

The first value of  $n$ , namely  $n = 0$ , does not provide a useful solution because it requires  $d$  to be zero, which means that the two elements are at the same location. While this gives a maximum at  $\theta = 45^\circ$ , it also gives the same maximum at all angles  $\theta$  in the  $y$ - $z$  plane because the two-element array will have become a single element with an azimuthally symmetric pattern. The value  $n = 1$  leads to

$$\frac{d}{\lambda} = \frac{1}{\cos 45^\circ} = 1.414.$$

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