9.39 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/λ) such that the array factor has a maximum at $\theta = 45°$.

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

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

$F_{\mathrm{a}}(\theta)$ is a maximum when the argument of the cosine function is zero or a multiple of π. Hence, for a maximum at $\theta = 45°$,

$$\frac{\pi d}{\lambda}\cos 45° = n\pi, \qquad n = 0, 1, 2, \ldots \;.$$

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 $\theta = 45°$, it also gives the same maximum at all angles θ 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

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