LINEAR ANTENNAS:
ROLE OF CONDUCTORS

Vertical Electric Dipole above Infinite Perfect Electric Conductor (PEC)

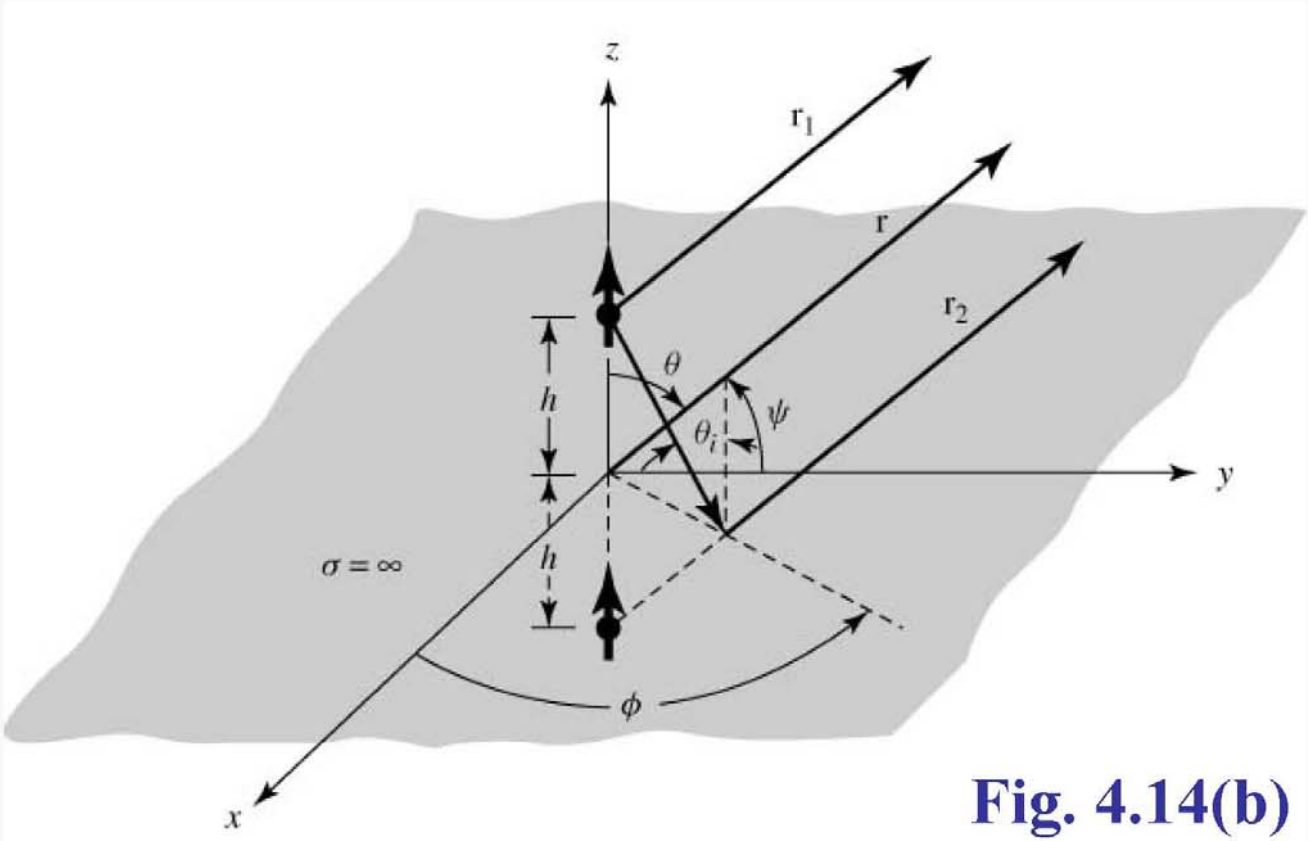

Fig. 4.14(b)

$$E_\theta = \underbrace{j\eta \frac{kI_o \ell e^{-jkr}}{4\pi r} \sin\theta}_{Element\ \ Factor} \underbrace{\{2\cos(kh\cos\theta)\}}_{Array\ \ Factor} \qquad z \geq 0$$

$$E_\theta = 0 \qquad z < 0$$

(4-99)

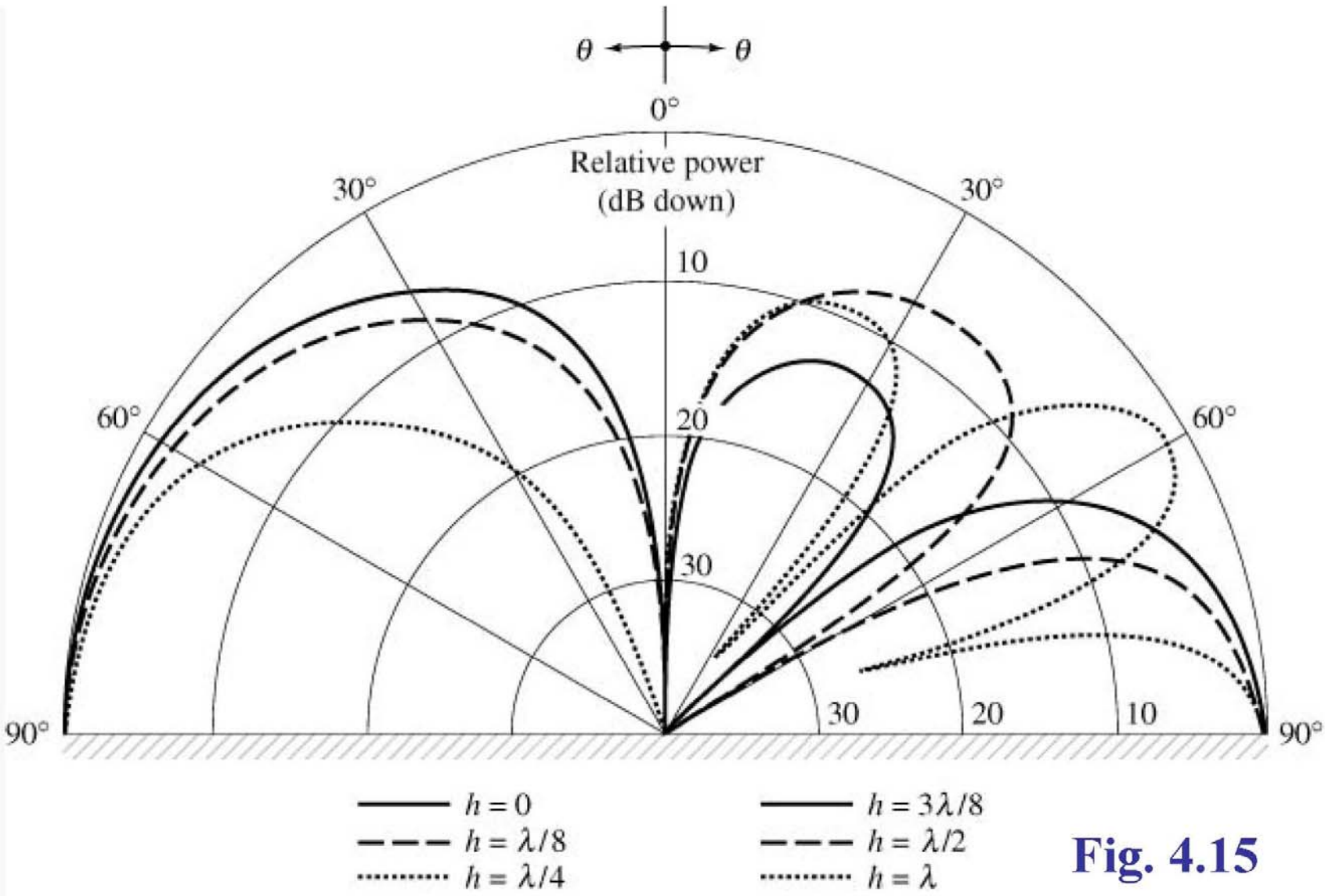

Fig. 4.15

Scalloping of Amplitude Pattern of Vertical Dipole

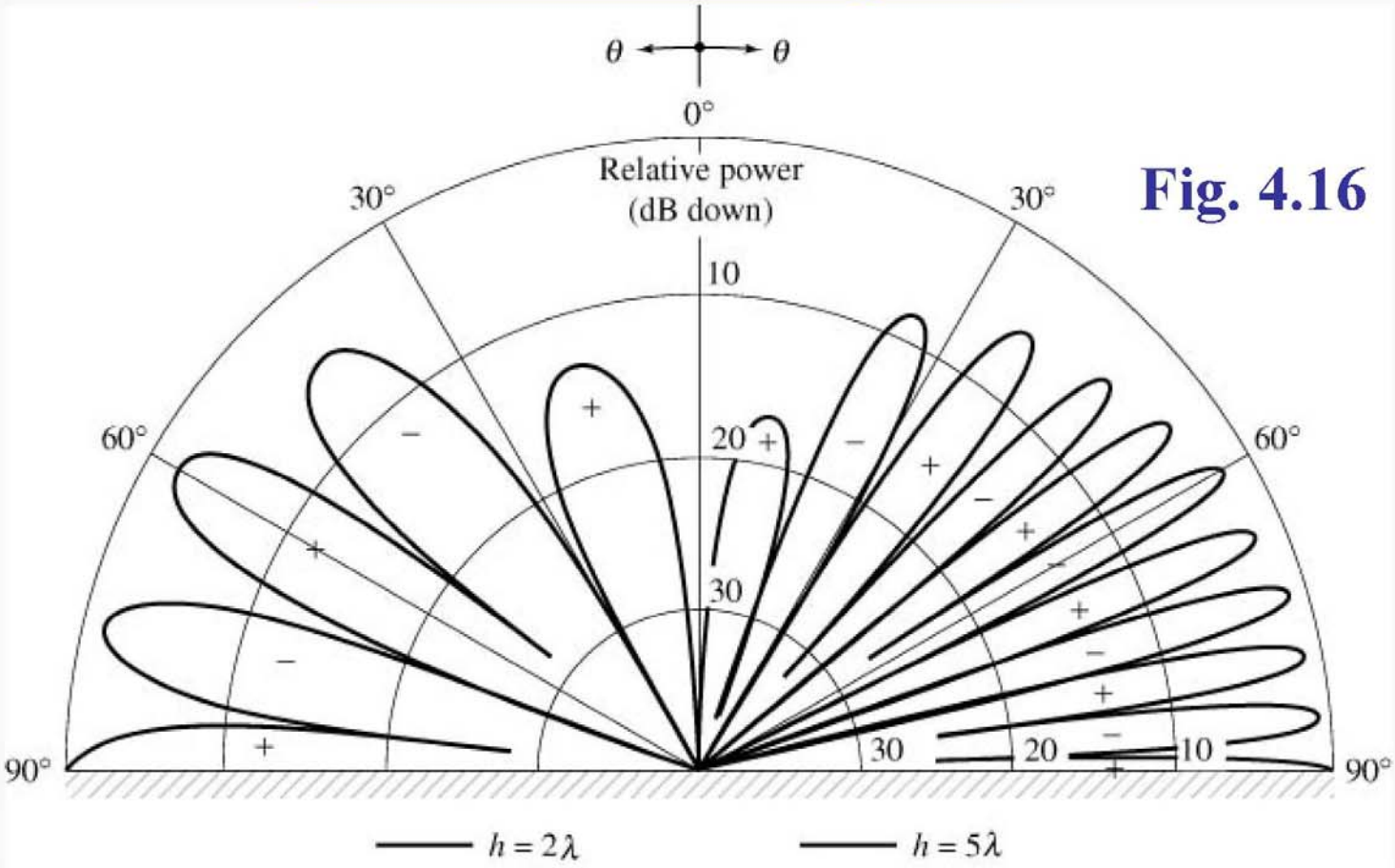

Fig. 4.16

LINEAR ANTENNAS NEAR CONDUCTORS: P_{RAD}, R_R, U,D

$$P_{rad} = \frac{1}{2\eta}\int_0^{2\pi}\int_0^{\pi/2}\left|E_\theta\right|^2 r^2 \sin\theta d\theta d\phi \qquad (4\text{-}101)$$

$$P_{rad} = \pi\eta\left|\frac{I_o\ell}{\lambda}\right|^2\left\{\frac{1}{3} - \frac{\cos(2kh)}{(2kh)^2} + \frac{\sin(2kh)}{(2kh)^3}\right\} \qquad (4\text{-}102)$$

$$U = r^2 W_{av} = r^2\frac{1}{2\eta}\left|E_\theta\right|^2 \qquad (4\text{-}103)$$

$$= \frac{\eta}{2}\left|\frac{I_o\ell}{\lambda}\right|^2 \sin^2\theta\cos^2(kh\cos\theta)$$

Directivity and Radiation Resistance of Vertical Element Above a Ground Plane

$$D_0 = \frac{4\pi U_{\max}}{P_{rad}} = \frac{2}{\left[\frac{1}{3} - \frac{\cos(2kh)}{(2kh)^2} + \frac{\sin(2kh)}{(2kh)^3}\right]}$$

$$R_r = \frac{2P_{rad}}{|I_0|^2} = 2\pi\eta\left(\frac{l}{\lambda}\right)^2\left[\frac{1}{3} - \frac{\cos(2kh)}{(2kh)^2} + \frac{\sin(2kh)}{(2kh)^3}\right]$$

Directivity and Radiation Resistance of a Vertical Infinitesimal Electric Pole as a Function of Its Height above an Infinite Perfect Electric Conductor

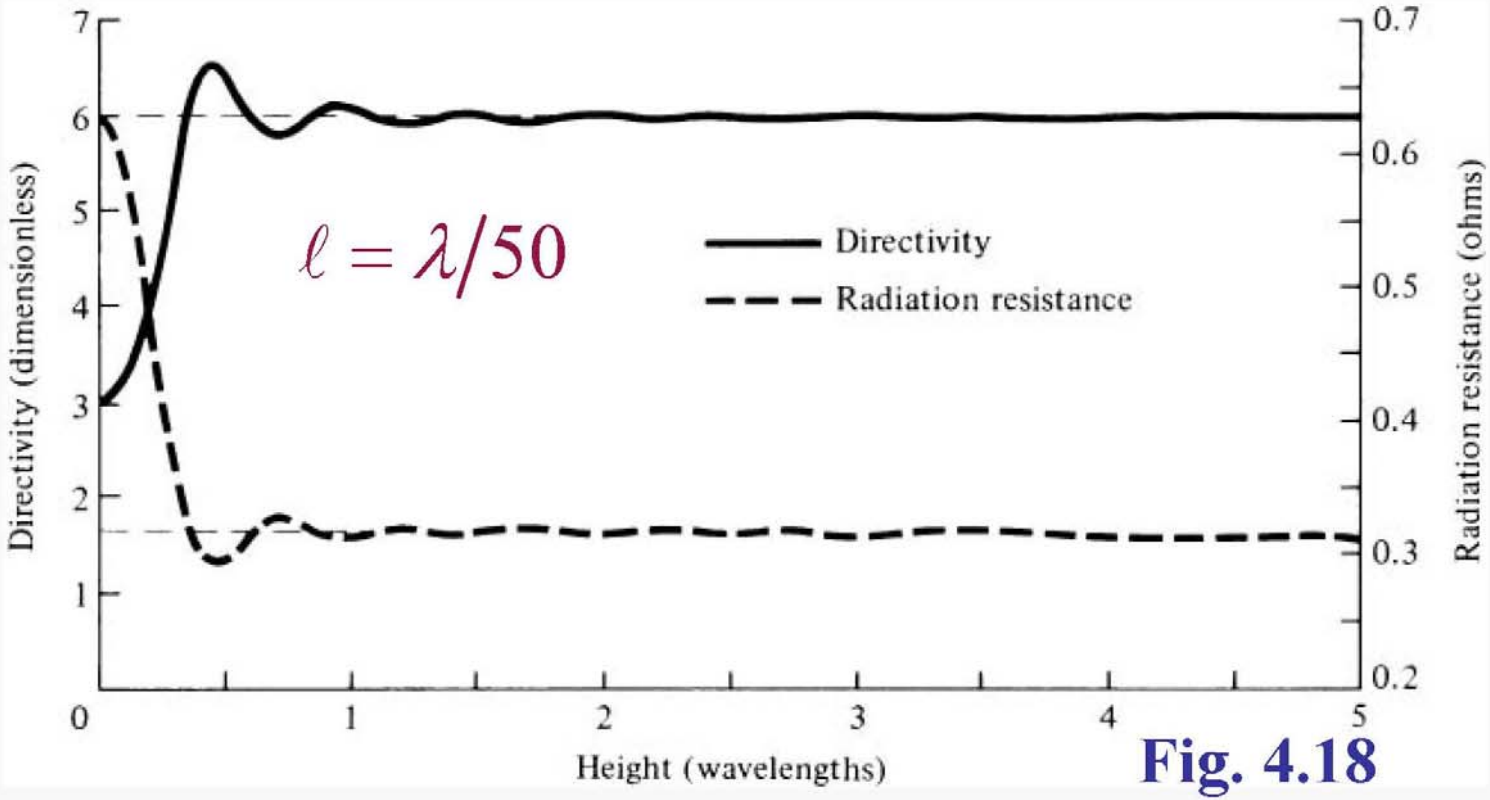

Fig. 4.18

Maximum Directivity Occurs When:

$$kh = 2.881$$

$$h = \frac{2.881}{k} = \frac{2.881}{2\pi / \lambda} = 0.4585\lambda$$

$$D_o = 6.566 = 8.173(dB)$$