EE5801 Tutorial 2

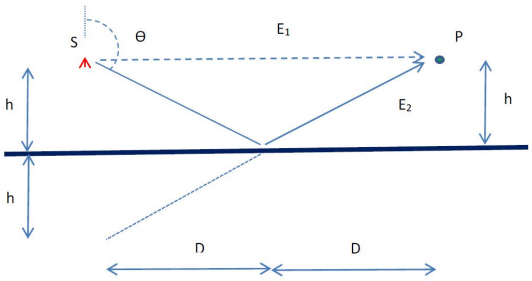
Q1

A small vertical dipole antenna has the following associated radiated fields:

$$E_\theta = j\frac{\eta k I_0 l}{4\pi}\sin\theta\left(\frac{e^{-jkr}}{r}\right)$$

$$H_\phi = j\frac{k I_0 l}{4\pi}\sin\theta\left(\frac{e^{-jkr}}{r}\right)$$

Note: $E_r = H_r = E_\phi =$ $H_\theta = 0$



Find the received signal amplitude ($E_1 + E_2$) at the field point P with respected to the small vertical dipole at point S, as a function of height h and distance D, where D >> h as shown in the above Figure.

Repeat the solution if the dipole is horizontally polarized.

Q2

A 10GHz microwave antenna radiating at 100W from an antenna of gain 6dBi is detected from a distance of 10km. Assuming no other losses, what would be the electric field intensity at this distance? What would be the power received by an antenna of gain 20dBi?

Q3 (Very good and important problem, optional for not being marked!)

A 4GHz microwave radio link is set up over flat terrain with a distance of 20km between the two antennas and the antennas are mounted on towers 40m high. Assume that the ground reflection coefficient is given by $\Gamma = 0.4\angle 0^o$. Show that the received signal is approximately 2.3dB above that for free space transmission. Also show that if the receiving antenna is raised or lowered, the ratio of maximum to minimum signal strength of about 7dB is expected. Briefly explain the origin of the signal variations.