Ground Effects: Practical Approach

Quarter-Wavelength Monopole

A vertical $\frac{\lambda}{4}$ **monopole** is used as the antenna on a cellular phone operating at $1.9\ \mathrm{GHz}$. Even though the monopole is mounted on a box-type cellular phone, for simplicity purposes assume that it is mounted on a perfectly electric conducting (PEC) ground plane. State or determine, for the monopole's omnidirectional pattern, the maximum directivity (dimensionless and dB). Justify your answer and method you are using to find the directivity.

Microwave Radiation Exposure

A homeowner uses a CB antenna mounted on the top of his house. Assume that the operating frequency is $900\ \mathrm{MHz}$ and the radiated power is $1{,}000\ \mathrm{W}$. In order to not be exposed to microwave radiation, there have been some standards, although controversial, developed that set the maximum safe power density that humans can be exposed to and not be subject to harmful effects. Let us assume that the safe power density is $1\ \mathrm{mW/cm^2}$, or $10\ \mathrm{W/m^2}$. Assuming no losses, determine the shortest distance in meters from the CB antenna you must ben in order to not exceed the safe level of power density exposure. Assume the CB antenna is radiating into free space and is

(a) Isotropic

(b) Quarter-wave $\left(\frac{\lambda}{4}\right)$ monopole mounted on an infinite PEC and radiating towards its maximum. (Hint: remember the effect of perfect ground on the antenna and its effect on directivity)

Half-wave dipole over ground

A vertical half-wave $\left(\frac{\lambda}{2}\right)$ dipole antenna is used as ground-to-air, over-the-horizon communication antenna at the VHF band ($f = 200\ \mathrm{MHz}$). The antenna is elevated at a height h measured from its center feed to the ground. Assume the ground, to be a perfect, flat, and infinite electric conductor. In order to avoid cross-talk interference with other nearby communications systems, it is desired to place a null in the far-field amplitude of the antenna at an angle of $60°$ from the vertical. Determine the three smallest non-trivial heights in meters, at the mentioned frequency, in which the antenna can be placed to meet the specifications.