Quiz #5
ECE 816 Spring Quarter 2007
May 30th, 2007

A 1 GHz horizontally polarized plane wave is incident from free space upon a perfectly conducting rough surface $z = \zeta(x, y)$. The surface is described as a Gaussian stochastic process, with a Gaussian correlation function, rms height 5 m, and correlation length 50 m. The plane wave is incident at polar angle θ_i, and the backscattered field is observed. The geometrical optics approximation can be used in this problem.

(a) Find the slope variance of this surface s^2.

For a surface with a Gaussian correlation function, $s^2 = 2\left(\frac{h}{l}\right)^2 = 0.02$.

(b) Write the backscattering cross section σ_{hh} as a function of θ_i. Give a numerical value for σ_{hh} in dB for $\theta_i = 0°$.

Under the geometrical optics approximation and for backscattering

$$\sigma_{hh} = \frac{k^2}{\pi(\cos\theta_i)^2} D_I = \frac{k^2}{\pi(\cos\theta_i)^2} \frac{2\pi}{4k^2(\cos\theta_i)^2 s^2} e^{-\frac{(\tan\theta_i)^2}{2s^2}} = \frac{1}{2s^2(\cos\theta_i)^4} e^{-\frac{(\tan\theta_i)^2}{2s^2}}$$

with $s^2 = \frac{1}{50}$. For $\theta_i = 0°$, $\sigma_{hh} = 25$ or 14 dB.

(c) Write the backscattering cross section section σ_{vh} as a function of θ_i.

In the GO theory, σ_{vh} is always zero for backscattering.