EECS 725 – Introduction to Radar

Homework Assignment #3 (40 points)

A nadir-looking, pulse radar altimeter is positioned at a height H above a flat Earth. The system has the following parameters:

Altitude, H	3 km
Radar operating wavelength, λ	10 cm
Antenna beamwidth, $\beta_\theta = \beta_\phi$	25° (assume a Gaussian beamshape)
Antenna peak gain, G_o	16 dB
Transmitted pulse duration, τ	1 ns
Terrain backscattering coefficient	$\sigma^o(\theta) = \sigma^o(0)\cos^9(\theta)$ where θ is the incident angle
$\sigma°(0)$	0.1

In addressing the problems listed below, use as a time reference (t = 0) the time when the first echo from the nadir point arrives at the receiver (i.e., it represents the time when the pulse fully engages the surface). Consider the time interval from 0 to 1.3 μs.

Problem 1. Plot the area (expressed in m^2) of the pulse-illuminated ground as a function of time.

Problem 2. Plot the incidence angle (θ expressed in degrees) to the middle of the pulse-illuminated area as a function of time.

Problem 3. Plot (on a decibel scale) the ratio of P_r/P_t as a function of time.

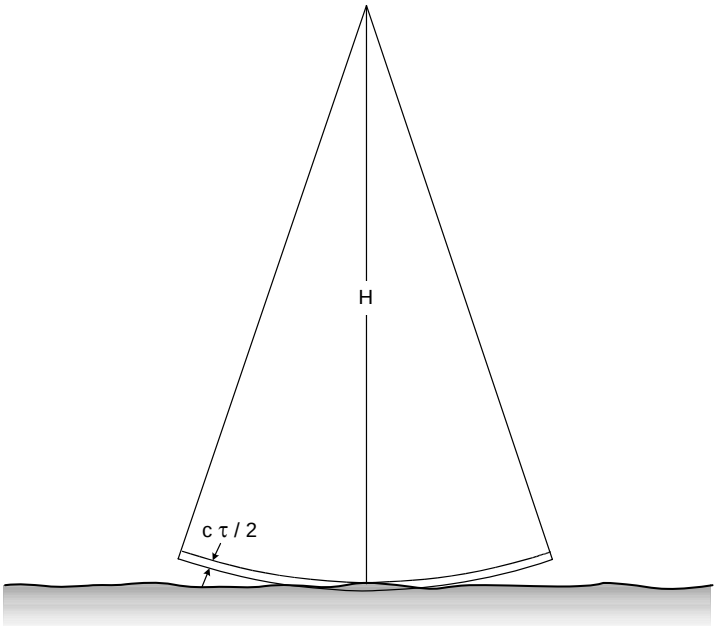
Problem 4. What should be the radar receiver's dynamic range to operate in this configuration? Identify the contribution of each of the following components to this variation of P_r/P_t with time:

R^{-4},

σ^o

illuminated area

antenna gain



Altimeter geometry