Normal Incidence Reflection

Reading assignment
Ulaby, 8-1
Connor and Salon, Unit X (On Waves & Materials)

Problem 1 - Normal incidence reflection - conductors
A 10 GHz plane wave has an electric field magnitude of 100 V/m and propagates in the $\mathbf{a}_z$ direction through a perfect dielectric with $\varepsilon_r = 9$. **E** is in the $\mathbf{a}_x$ direction.

a. What are the incident **E** and **H** phasors?

b. At z = 0, the wave strikes a perfect conductor. What are the reflected **E** and **H** phasors?

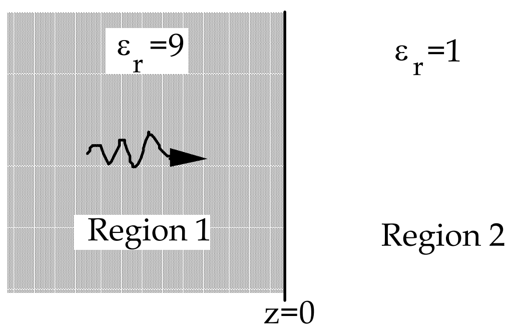
c. Use the boundary conditions to find the surface current density in the conductor.

d. Draw the standing wave pattern for **E** and **H** (include numbers for amplitude and position).

e. Simulate this case with sing_bnd.m by using a large imaginary dielectric for region 2.

f. Calculate the total **E** and **H**. (phasor & time domain form).

Problem 2 - Normal incidence reflection - dielectrics
The same wave as in problem 1 strikes a dielectric-air boundary at z=0 as shown below.



a. Find the reflection and transmission coefficients.

b. What are the reflected and transmitted electric field phasors?

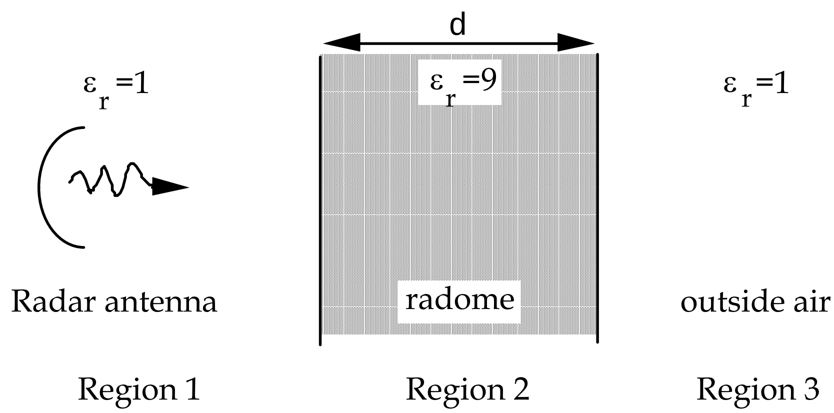
c. What are the reflected and transmitted H phasors? What is H_t/H_i?

d. What is the standing wave ratio in the dielectric? Sketch the standing wave pattern for **E** and **H**. Run sing_bnd.m for this problem.

e. What is the average power density of the incident, reflected, and transmitted waves?

Problem 3 - Normal incidence - multiple boundaries

A 10 GHz radar transmitter is used in the configuration shown below. Note that the radome-outside air boundary is identical to the boundary examined in Problem 2.



a. What is |**E**|/|**H**| at the z=0 boundary of Problem 2? (equivalent to the region 2-3 boundary in this problem). Compare it with the value in air.

b. Now refer to the full radome problem. Where can you put the left boundary so that |**E**|/|**H**| in the radome matches that in the air on the left? For mechanical reasons, the radome must be more than 2 cm thick.

c. What is Γ for this value of d?

d. What is Γ if d is 0.2 mm thinner than designed?