Optical Methods in Diagnosis

2nd semester, 2015-2016

Homework #4

1. Consider reflection of diffuse radiation at the surface of tissue. Assume the incident light is unpolarized.

(A) Plot the reflection coefficient against incident angles (0°~90°) when a plane wave goes from air (n = 1) into tissue (n = 1.4).

(B) For *in vivo* optical diagnostic methods, we measure photons remitted from tissues. Calculate the reflection coefficient of diffuse light, r_d, going from tissue to an outside medium of air and water (n = 1.33) respectively. Note what we can measure experimentally is proportional to $(1-r_d)$. This comparison gives you an idea of the effect of index matching at the tissue surface.

2. Now consider a mismatched boundary between the tissue and the outside medium in your Monte Carlo program. Assume a semi-infinite slab (make d at least 20 optical depths) with $\mu_a = 10\ cm^{-1}$, $\mu_s = 90\ cm^{-1}$ and isotropic scattering. Let n_1 (air) = 1, n_2 (tissue) = 1.5. Determine R using five runs of 10,000 photons. Giovanelli has reported a theoretical value of $R = 0.2600$. Use variable weight photons.