CSCD18F Computer Graphics, Fall 2008

Assignment 3 (10% of course grade)

Part A (programming): Due before class (9:59am) on Friday, November 14th, 2008.
Part B (written): Due 11:59pm on Friday, November 21st, 2008.

Part B [25 marks in total]

1. In class we talked about radiometry in the context of small scenes, in this question we will look at how the same concepts can be used in physics and astronomy for analysis of light transfer between planets.

   (a) [5 marks] Assume for simplicity that we can model our sun as a sphere. Given that the radius of the sun is $r = 6.955 \times 10^8$ (m) compute the formula for the surface area of the sun, by integrating differential solid angle over the sphere, parameterized in spherical coordinates. Note: it would be wise to check your final answer.

   (b) [5 marks] Recall that the radiant intensity I of a point light source is defined as the flux per solid angle: $I = \frac{d\phi}{d\omega}$. Solid angle is measured in steradians; radiant intensity is measured in Watts per steradian. Given that the power of our sun is 3.91×10^{26} Watts compute the radiant intensity of the sun.

   (c) [10 marks] Now compute the irradiance due to the sun on a 3 m^2 planar patch on Earth's surface closest to the sun (Hint: the normal of the earth at the center of the patch is pointing towards the sun). You should use the fact that Earth is $d = 1.5 \times 10^{11}$ (m) away from the sun.

   (d) [5 marks] Would irradiance on the $3\,m^2$ patch on Earth's surface be the same as the irradiance on the same size patch on the surface of Mars? If yes, why, if not, then explain why not?