Vision Science II – Monocular Sensory Aspects of Vision

Lab 3 – Photometry, V(λ) function

Part 1. Luminance and illuminance

Using the Minolta **luminance** meter (nit picker) measure the luminance of a sheet of white paper on your tabletop. Then compute the **illuminance** on the table. Summarize your procedure, record your data and show your calculations. (Hint: Lecture 8, Figs. 3, 4, Schwartz Fig. 4-6)

Luminance = 80 nits = 80*π apostilbs = 251.3 apostilbs   Illuminance = 251.3 lux

Principle: For a 100% reflecting Lambertian surface an illuminance measured in lux will produce a luminance in apostilbs equal to the number of lux. Note that lux ≠ apostilbs like cm^3 ≠ grams. They describe different things, but they are related. This allows us to work backwards and compute the illuminance in lux that produces a certain amount of luminance in apostilbs, by using a 100% reflecting Lambertian surface.
Procedure: Put the 100% reflecting Lambertian surface in the place where you want to determine illuminance. Measure the *luminance* in nits, then convert to apostilbs. This will equal the number of lux of *illumination* falling on the surface *at that place*.

- What are two ways to increase illumination on the tabletop?

1) Move the light closer to the surface or 2) increase the brightness (power) of the light.

- Assume that you have a white sheet of paper on the table, and a black sheet on the table. How will the illuminance falling on the two sheets compare and why?

Illuminance will be the same, since the amount of light falling on both papers is the same.

- How would the luminance of the two sheets compare?

The white sheet would have greater luminance since it reflects more light.

Part 2. Retinal illuminance

Calculate the retinal illumination for the white sheet of paper (100% Lambertian reflector) used in Part 1. Record your computations and results. (Reference: Lecture 8, p. 3-)

Luminance = 80 nits. Pupil diameter = 5 mm.
Pupil area = $\pi r^2 = \pi(2.5)^2 = 19.64$
Retinal illumination in trolands = nits*pupil area = 80 * 19.64 = 1,570.8.

Part 3. The CIE V(λ) function

A. <u>HFP demo</u>

B. <u>Luminance matching without HFP</u>: Select the red circle and adjust its brightness to match the green circle. Measure and record their actual luminances to see how closely you were able to match the different colors.

C. <u>HFP exercise</u>: Adjust the radiance values for each wavelength, except 555 (the standard fixed at a radiance value of 10) until the flicker goes away. Notice the V-lambda function take shape.

Write the formula for computing the luminous efficiency for each wavelength based on the radiance settings.

Luminous efficiency = (555 nm radiant power) / (Other λ radiant power)

D. <u>Plot V lambda ta</u>b: Using a web browser, go to http://www.cvrl.org/, select the CIE functions page, and open the 1924 photopic V(λ) data set (5-nm interval E/W data). Download the CIE data and make a graph of the V-lambda function. You can do this in Excel or another program that makes graphs.