MIT CSAIL

6.869 Advances in Computer Vision

Fall 2016

Problem Set 3: Color

Posted: Thursday, September 22, 2016	**Due:** Thursday, September 29, 2016

You should submit a hard copy of your work in class, and upload your code (and all files needed to run it, images, etc) to Stellar.

Your report should include images and plots showing your results, as well as pieces of your code that you find relevant.

Problem 1

For this problem you should use Matlab for computations and plotting. We say that a set of primaries, $p_i(\lambda)$ is associated with a set of color matching functions, $c_i(\lambda)$ if the spectrum $s(\lambda)$ is a perceptual match to $\sum_i (p_i(\lambda) \sum_{\lambda_1} c_i(\lambda_1) s(\lambda_1))$ (in words, we project an input spectrum onto the color matching function associated with each primary to determine the amount of that primary needed to give a perceptual match to the input spectrum). In all data provided in this example, the data points are sampled at wavelengths $[360 : 5 : 730]nm$.

(a) We can transform the color coordinate in CIE XYZ space to RGB space using a transformation matrix T:

$$\begin{pmatrix} R \\ G \\ B \end{pmatrix} = T \times \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}, \text{where } T = \begin{bmatrix} 3.24 & -1.54 & -0.50 \\ -0.97 & 1.88 & 0.04 \\ 0.06 & -0.207 & 1.06 \end{bmatrix}.$$

(i) Using the transformation matrix T (*CIE2RGB.mat*) and the color matching functions for CIE XYZ color space (*CIEMatch.mat*), compute the color matching functions associated with those specified by RGB primaries.

(ii) Find a valid set of primary light spectra associated with the RGB color space. Plot them as function of wavelengths. Comment on the positivity of the power spectra.

(iii) Find a valid set of primary light spectral associated with the CIE color space. Plot them as a function of wavelengths. Comment on the positivity of the power spectra.

(b) Figure 1 shows the spectral response curves for eye photoreceptors (we have also provided the response curves in *LMSResponse.mat*). Find a set of primary lights that correspond to the spectral sensitivity curves of the eye. Comment on the positivity of the power spectra.

(c) Show that if the spectral response curves of the eye (assumed to be non-negative) were orthogonal to each other (with a zero dot product), there would exist a corresponding set of primaries with power spectra that were non-negative.

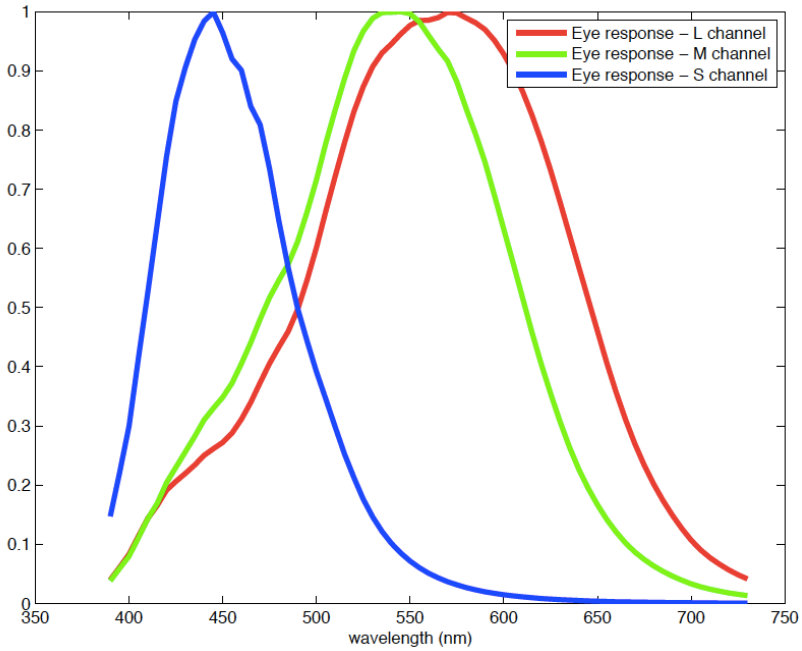

Figure 1: The spectral response curves for eye photoreceptors.