ECE 637 Digital Image Processing Laboratory: Introduction to Colorimetry

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1 Introduction

Nothing due for report.

2 Plotting Color Matching Functions and Illuminants

In this section, color matching functions and illumants are used to plot according a discrete set of wavelengths.

2.1 Plot $x_0(\lambda)$, $y_0(\lambda)$, $z_0(\lambda)$ Color Matching Functions

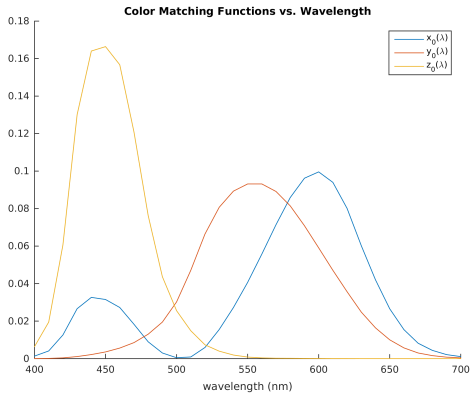

Figure 1: Color Matching Functions vs. Wavelength

2.2 Plot $l_0(\lambda)$, $m_0(\lambda)$, $s_0(\lambda)$ Color Matching Functions

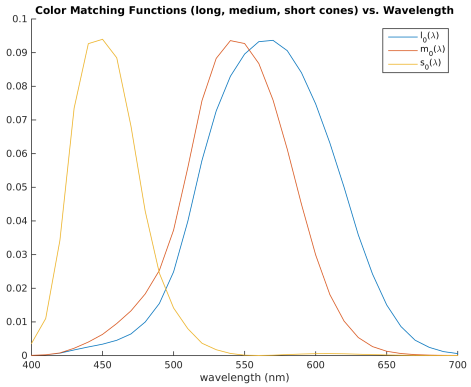

Figure 2: Color Matching Functions vs. Wavelength

2.3 Plot D_{65} and Fluorescent Illuminants

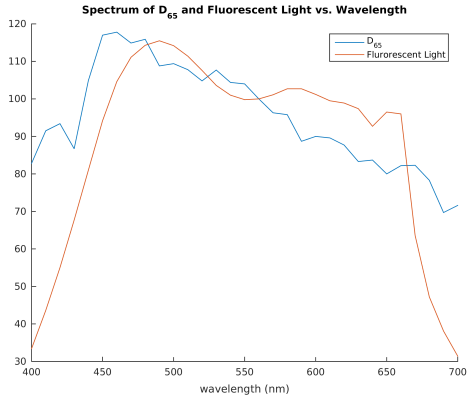

Figure 3: Spectrum of D_{65} and Fluorescent vs. Wavelength

3 Chromaticity Diagrams

In this section, chromaticity diagrams are plotted using provided data.

3.1 Plot Chromaticity Diagram

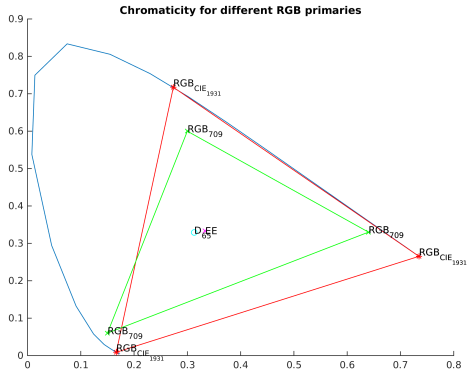

Figure 4: Chromaticity Diagram

4 Rendering an Image from Illuminant, Reflectance, and Color Matching Functions

In this section, image data are loaded. The transformation matrix using Rec. 709 RGB primaries and D_{65} white point is calculated. RGB coordinates are then computed using the XYZ and transformation matrix M. The image is then gamma-corrected and plotted.

4.1 Calculation of M_{709D65}

From equation (15) of the lab manual, we have:

$$M = \begin{bmatrix} x_r & x_g & x_b \\ y_r & y_g & y_b \\ z_r & z_g & z_b \end{bmatrix} \begin{bmatrix} \kappa_r & 0 & 0 \\ 0 & \kappa_g & 0 \\ 0 & 0 & \kappa_b \end{bmatrix} \tag{1}$$

and from equation (17), we have:

$$\begin{bmatrix} \kappa_r \\ \kappa_g \\ \kappa_b \end{bmatrix} = \begin{bmatrix} x_r & x_g & x_b \\ y_r & y_g & y_b \\ z_r & z_g & z_b \end{bmatrix}^{-1} \begin{bmatrix} x_{wp}/y_{wp} \\ 1 \\ z_{wp}/y_{wp} \end{bmatrix}. \tag{2}$$

We also have:

$$\begin{bmatrix} x_r & x_g & x_b \\ y_r & y_g & y_b \\ z_r & z_g & z_b \end{bmatrix} = \begin{bmatrix} 0.640 & 0.300 & 0.150 \\ 0.330 & 0.600 & 0.060 \\ 0.030 & 0.100 & 0.790 \end{bmatrix} \tag{3}$$

and,

$$\begin{bmatrix} x_{wp} \\ y_{wp} \\ z_{wp} \end{bmatrix} = \begin{bmatrix} 0.3127 \\ 0.3290 \\ 0.3583 \end{bmatrix}. \tag{4}$$

Using (3) and (4), we have:

$$\begin{bmatrix} \kappa_r \\ \kappa_g \\ \kappa_b \end{bmatrix} = \begin{bmatrix} 0.640 & 0.300 & 0.150 \\ 0.330 & 0.600 & 0.060 \\ 0.030 & 0.100 & 0.790 \end{bmatrix}^{-1} \begin{bmatrix} 0.3127/0.3290 \\ 1 \\ 0.3583/0.3290 \end{bmatrix}$$

Hence,

$$\begin{bmatrix} \kappa_r \\ \kappa_g \\ \kappa_b \end{bmatrix} = \begin{bmatrix} 0.6444 \\ 1.1919 \\ 1.2032 \end{bmatrix}$$

Finally,

$$M = \begin{bmatrix} 0.4124 & 0.3576 & 0.1805 \\ 0.2126 & 0.7152 & 0.0722 \\ 0.0193 & 0.1192 & 0.9505 \end{bmatrix}$$

4.2 Plot Images Obtained from D_{65} and Fluorescent Light Sources

Figure 5: Images Obtained from D_{65} and Fluorescent Light Sources

4.3 Qualitative Description of Two Images

The image obtained from the fluorescent light source is slightly brighter than than the image obtained from the D_{65} light source.

5 Color Chromaticity Diagram

5.1 Plot Color Diagram

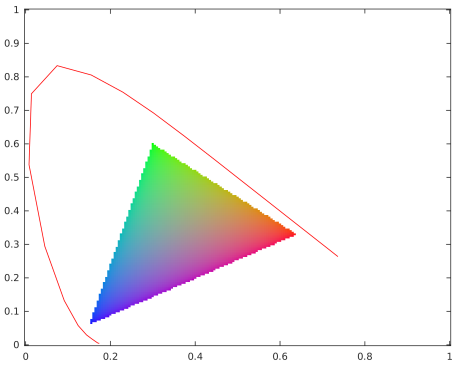

Figure 6: Color Diagram