Lab 3

Likhitha Nagahanumaiah

1. Where are the black and white display values located (which rows of `rgb`)? What are the black and white XYZ tristimulus values?

Solution:

Black values are located at = [1, 53,105,157]

White value is located at = [208]

Black XYZ tristimulus values are= [0.1322 0.1283 0.2211]

White XYZ tristimulus values are= [113.2000 119.5000 127.7000]

2. What is the primary matrix of the display? What do these numbers indicate (where do the values in the rows and columns come from, and what do they mean)?

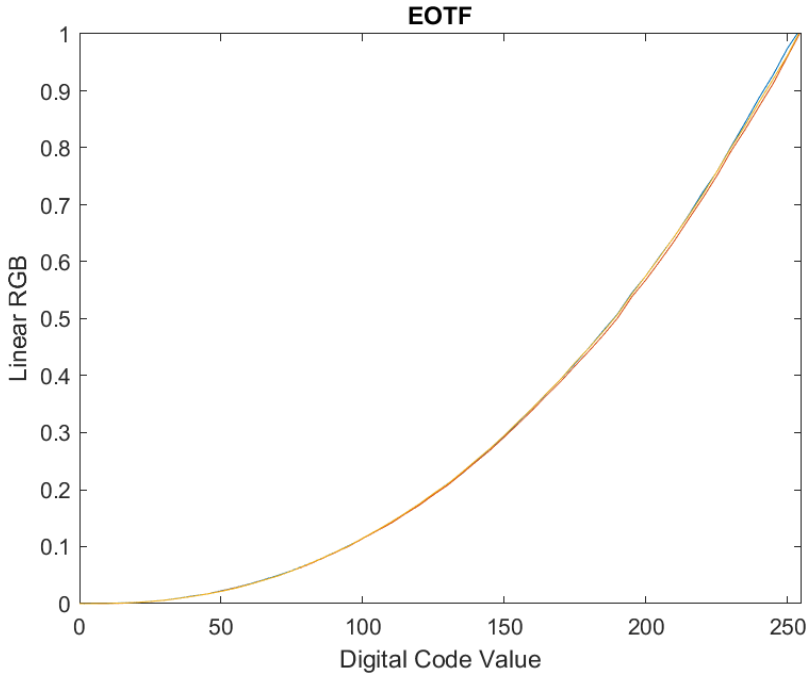
Primary Matrix= [47.3678 43.5877 21.0578

24.3617 86.3017 7.7647

1.4179 13.3789 111.4789] -Remove black content from the RGB primaries.

Primary index = [52, 104, 156]
Index of RGB primaries are obtained. Complete Red is present in 52nd row [255 0 0]. Complete Green is present in 104th row [0 255 0]. Complete blue is present in 52nd row [0 0 255].

3. Use the neutral(gray) ramp and primary matrix to create EOTF curves (transform input RGB [0-255] to linear RGB [0-1], then interpolate from measured values to full 0-255 range). Plot the EOTF curves. These are your 3x1D LUTs.



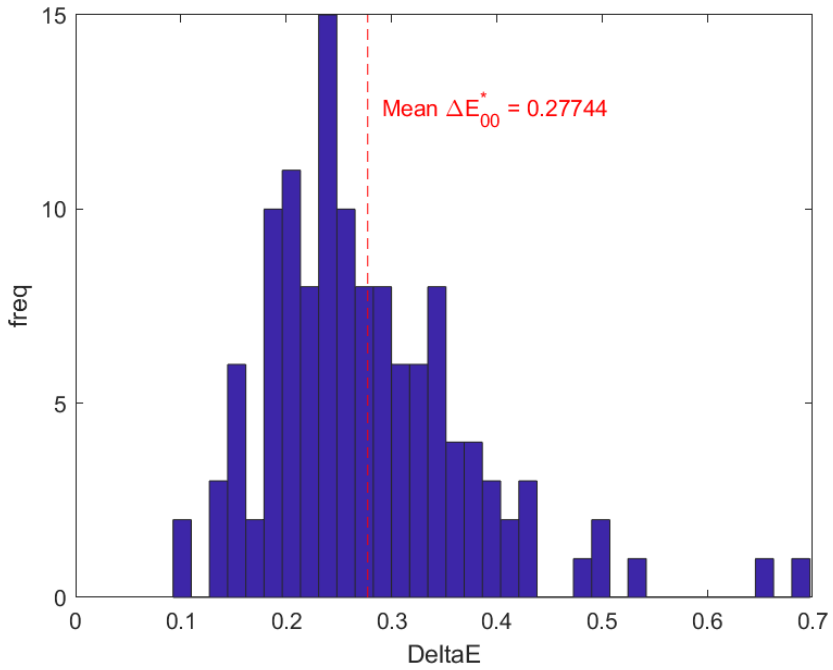
Using grey ramp 157:208 range to get EOTF curves and use this to transform input signal to linear output signal. It convert the red, green and blue (0 to 255) values to RGB (0-1)

4. Now use these to run a whole forward model for the 'verification' colors: RGB[0-255] -> linRGB[0-1] via LUT -> XYZpred via primaryMatrix (+blackXYZ). You will end up with predicted XYZ values for the verification colors. What do these mean (or why do we want these)?

To get Electro-optical transfer function (EOTF) curve we used verification colors ranging from 209 to 333. By using these values, forward model gave the predicted XYZ values based on input RGB values,
that is monitor display RGB- $RGB_{8bit} \rightarrow RGB_{linear}$.
It helps to transfer Digital input to light output by using following equation.
$RGB_{lin} = inv(M) * XYZ_{ramp} - XYZ_{k}$.

5. Quantify the colorimetric error between the measured and predicted XYZs of these colors using deltaE00. Create a histogram of the color differences and report the overall mean, min, and max color difference. How well does your model fit the display measurements (would this be a good model to use for color-critical tasks)?

Color difference is calculated using deltaE00. meanDE = 0.2774, minDE = 0.0926 and maxDE = 0.6975. The higher the DE, the more colorimetric error. DE < 1 is likely imperceptible by the human eye and thus it considered as very good.
By analyzing errors and plots, we can conclude that it is good model, can be used for color-critical task.



6. Create a new variable consisting of the following XYZ values:
These are 6 new colors (in XYZ) that you want to accurately display on the monitor. Run a 'reverse model' that will give the predicted RGB inputs [0-255] for these colors for the display. What are the RGB inputs you get?

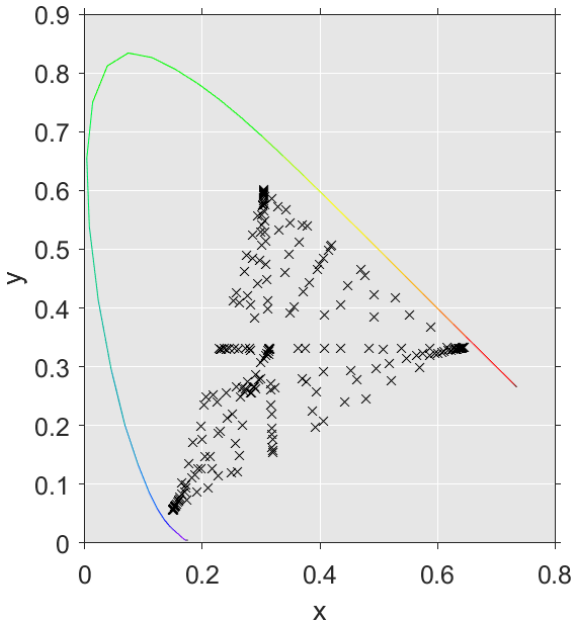
RGB inputs for given XYZ values are: -

Red	Green	Blue
235	238	83
184	236	183
77	238	182
249	250	249
72	82	76
0	141	0

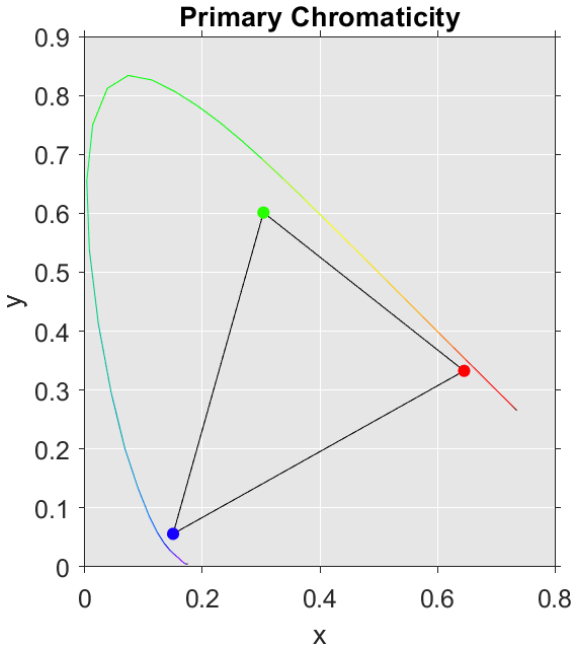
6. Using the code provided with the in-class demo as a starting point, make the following plots (4 separate plots) in xy chromaticity space (remember xyz[chromaticity coordinates] is different than XYZ[tristimulus values]):

a. Plot the spectral locus using the `StdObsFuncs.xls` data. What does this spectral locus represent?

The edges of the gamut are called the spectral locus. This spectral locus represents gamut of all visible colors. Each point representing a pure hue or unique hue of a single wavelength with wavelengths listed in nm. All the chromaticity values theoretically visible to the human vision system appear inside the horseshoe-shaped spectral locus

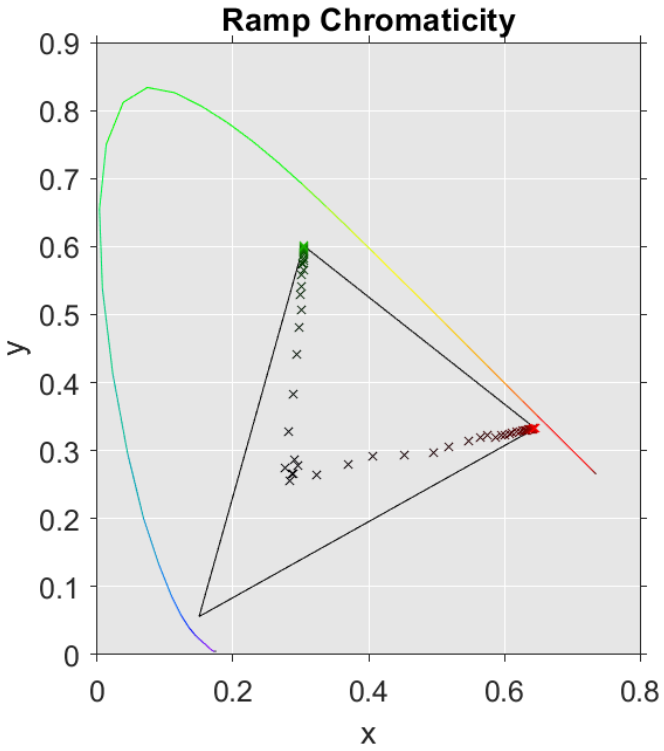


b. Plot the measured xy chromaticity coordinates of the display's primaries. What do these points represent? If you were to draw a triangle connecting them, what does the triangle represent?

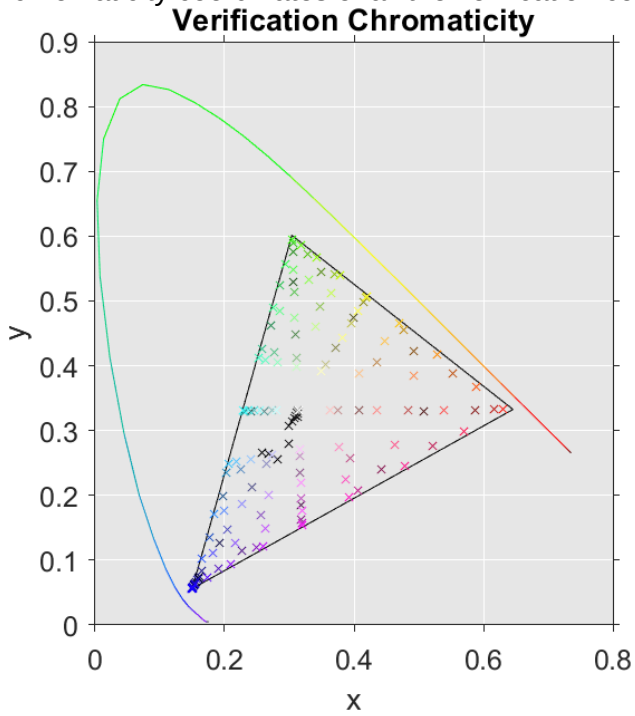


The three points represents primaries RGB- RED, GREEN, BLUE. These primary Chromaticity locations x-y of the three-color stimuli R, G and B are joined to each other, the area within the triangle formed by the three lines represents all the colors that can be matched of the three stimuli of visible light. These primaries are of vital importance for displays to render a pleasing and realistic appearance in terms of color image quality.

c. Plot the measured xy chromaticity coordinates of the primary ramps (the individual R, G, and B ramps).



d. Plot the measured xy chromaticity coordinates of all the verification colors.

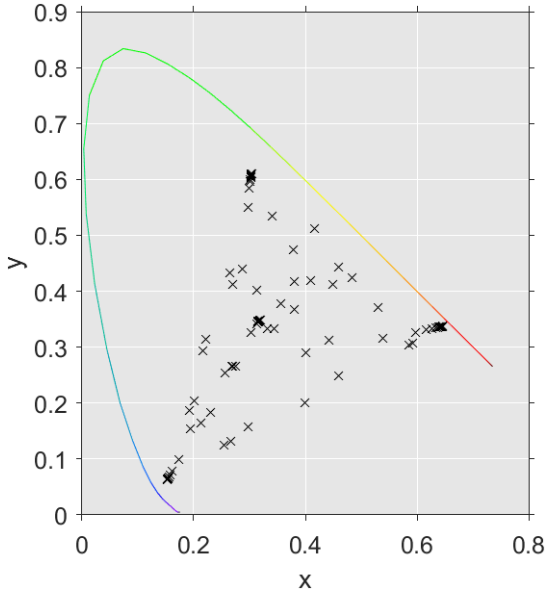


8. Finally you will take your own measurements of a display (your monitor or someone else's. This can also be done in a group – e.g., everyone taking measurements of one person's monitor). Please coordinate with the TA to arrange a time to come in, and have them help setup the CR-250, drivers, and code needed to take measurements. You can use '`monitorMeasureLoop.m`' and the 'shorter version' (106 colors) of the rgb array to make your measurements.

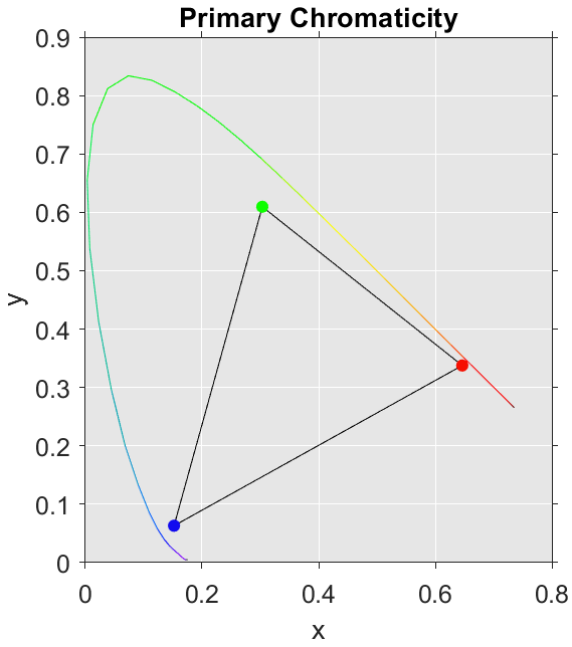
a. Once completed, include the RGB(input) and XYZ(measured) files in your submission on MyCourses.

b. Create a plot for this new display data: it should contain 1) the spectral locus, 2) the xy chromaticity coordinates of the display's primaries, 3) a triangle connecting them.

1)



2)



3)