Constrained Optimization of Light Or Radiation (COLOR) V0.2.1

Needed Functionalities

2) Incorporate a library of real SPDs

3) Implement a UI for objective function and constraints.

4) Update tm30 code with https://arxiv.org/abs/1802.06067 suggestions

Thoughts/Concer ns:

1) The tristimuli of 2 deg and 10 deg stand. obs. are very very close with the illuminant E, but they give 106ish in 2deg and 116ish in 10 deg. Why wouldn't they be a nicer number?

2) The constraint inputs are not at all user-friendly.

3) I'm still unsure about constraint tolerances and such in the optimizer, yet the defaults seem to be quite good.

4) Implement code checking against other standard illuminants

5) I should either use tables or arrays for the CMFs, just for being clean.

Setup

Clean up.

```
matlabVersion =
'(R2021a)'
```

```
Your Matlab is (R2021a): I Used 2021a To Create This
```

User Inputs And Choices

Choose what spds you are trying to optimize. If you choose synthetic, you will need to input the peaks and fwhms of gaussian spds.

If you choose library, not yet implemented.

If you choose UserCSV, ensure it is all numbers and it starts at A1 and is 380:780. Do not have a wavelength column. It will know based on length, as long as the range is 380 to 780nm

Choose 2 degree or 10 degree standard observers from ISO/CIE 11664_2019.

This just changes the chromaticity diagram you can look at during the optimization.

```
You are scaling your SPDs and the graph will be in 2 degree standard observers
```

Once the SPDs are generated or loaded, you need to give the optimization an initial starting point. There are currently two options, and both work very well.

Equal Energy to YTarg means that the peaks of all spds have the same height, and then they are scaled (they start at 1w/nm at peak) such that they reach YTarg in the observer space you chose. Keep in mind that TM30 operates under 10 degree but uses 2 degree for cct calculations.

Currently, the code has a universal wavelength range from 380 to 830 nanometers. If you are loading SPDs, you don't need to enter anything here, as the program will find the interval and interpolate all alpha opics and cmfs to that interval.

If you are making synthetic spds, then you can generate spds with 1nm (380, 381, 382...) , 2nm, or 5 nm. Going from 1nm to 5nm only speeds up the code by maybe 10%.

```
You will optimize in 1nm increments of wavelengths
```

Next enter YTarg, which is the Y value, in whichever Observer you chose earlier, that the initial mix of spds will be scaled to.

YTarg is mandatory, but as of now it is not validated for values other than 100.

Enter xTarg and yTarg, which will be the initial chromaticities in whichever observer space you chose earlier. This is ONLY used if you chose "xyY" in the "initialGuessMode"

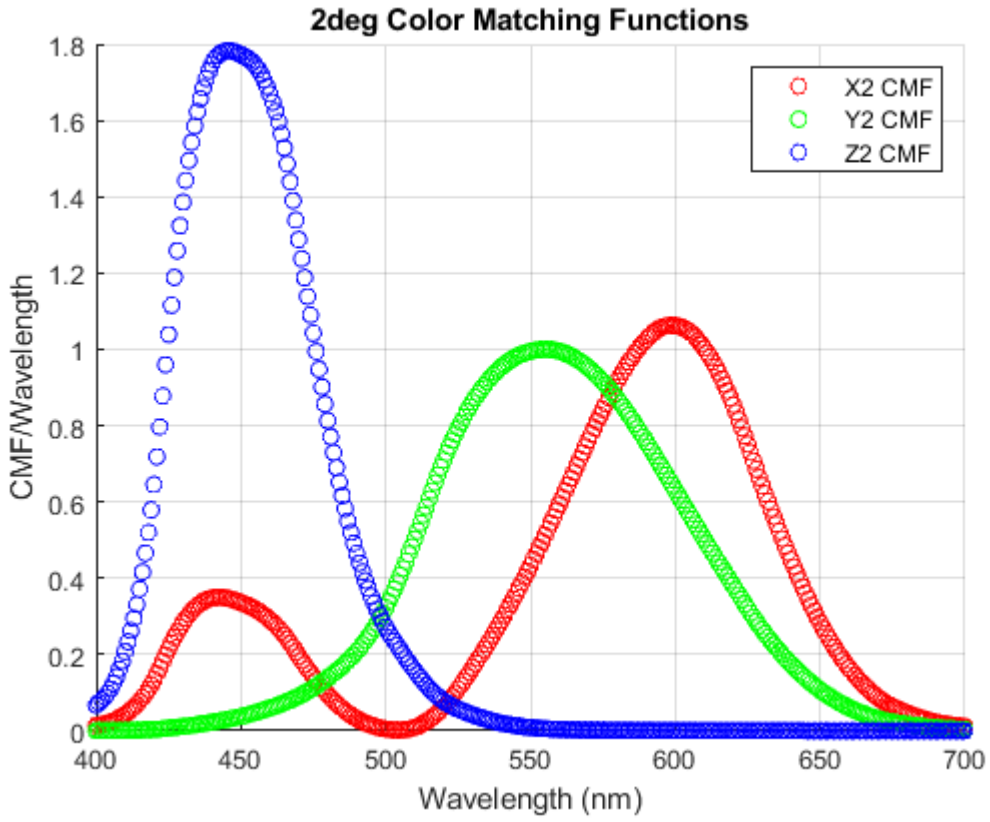
Load Color Matching Functions And Plot

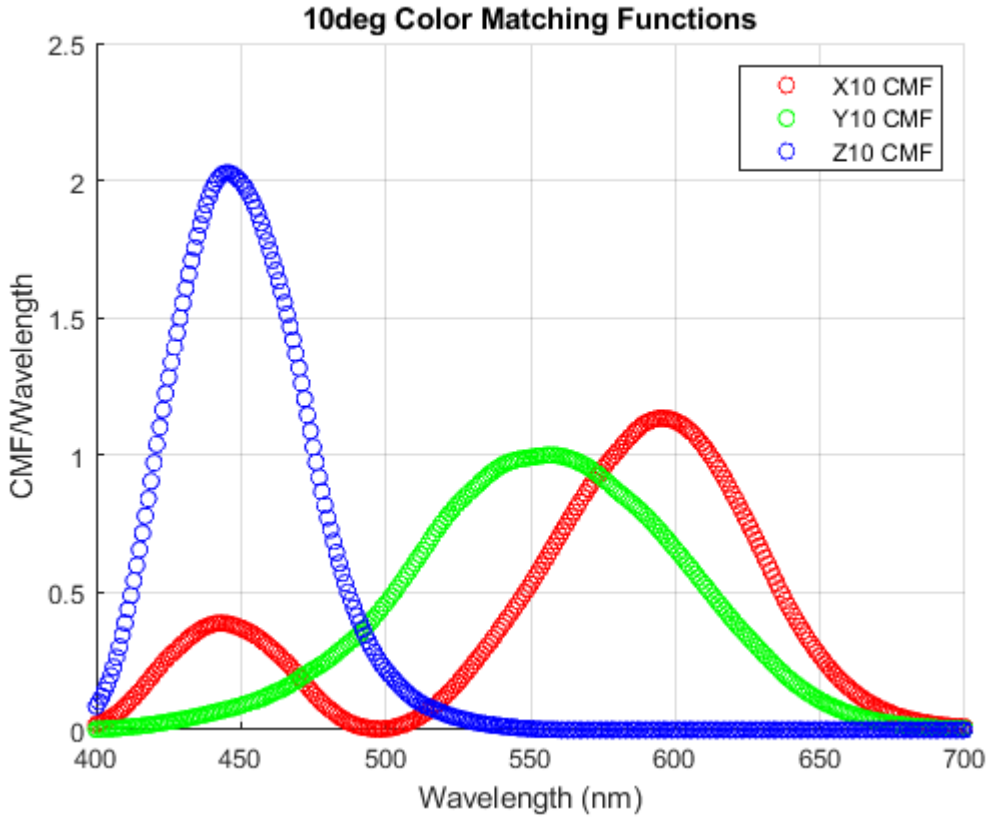
The program loads these tables inside the functions, but they will be plotted as an extra precaution for error checking and debugging.

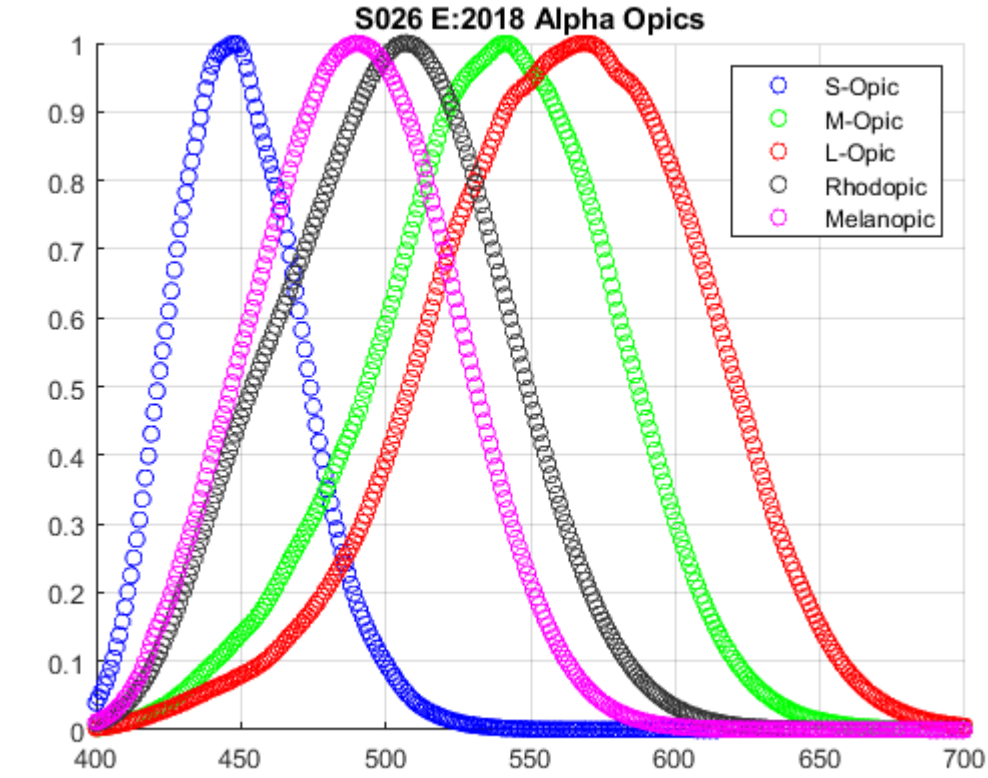
TM30 excel v2.04 is the same as luox or ISOCIE 11664.

Alpha Opics Are from CIE S026 E:2018 Toolbox V1.049a.

Both of these standards can be found under Standards/TM-30-18_tools_etc and Standards/CIES026_E2018







Synthetic SPD Generation

SPD Peak Wavelength Input (List or Equal Interval)

Wavlength is always from 380 to 780nm.

List Example: " 420 540 450 670 455 " (no commas)

Equal Interval: "450:50:600" --> 450, 500, 550, 600

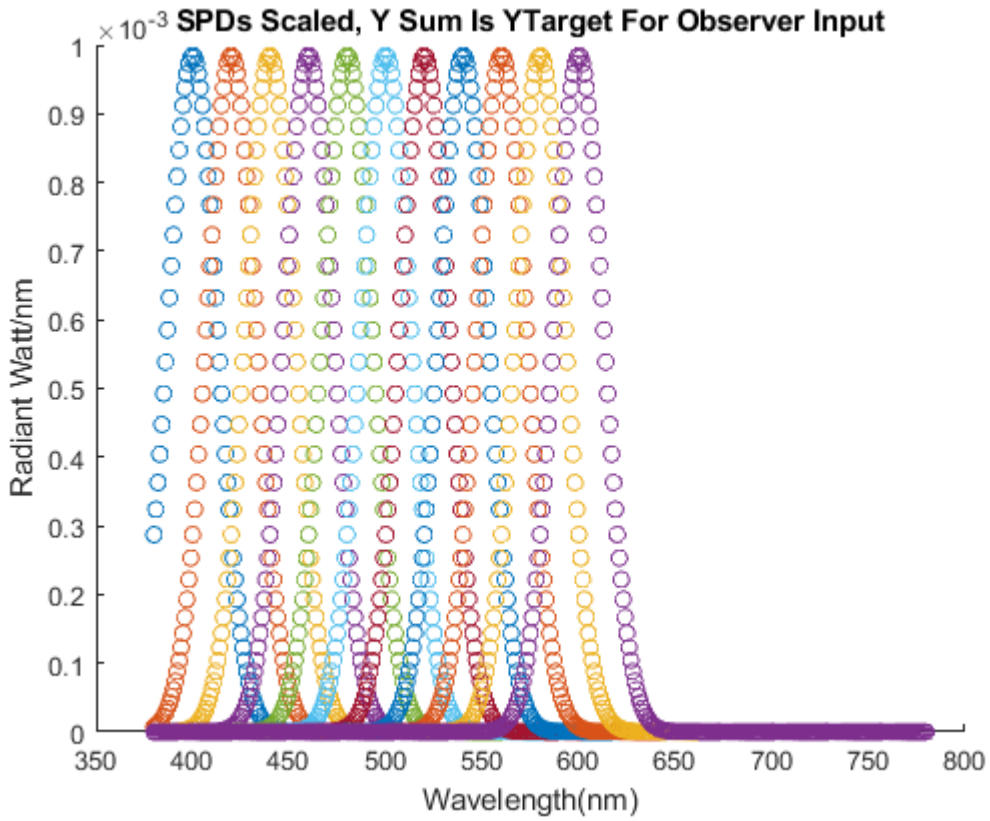
To use interval mode, remove text until you see "Enter Text" in the list input, otherwise it will assume you want the list input. You can still have values on the sliders for the interval mode, but it won't use them unless the list input says "Enter Text"

```
Your SPD peak wavelengths are

   400   420   440   460   480   500   520   540   560   580   600

You have 11 Independent SPDs
```

Choose Full Width Half Max for synthetic SPDs

Equal makes all the spds the same fwhm

List lets you input a list of fwhms that correspond to the entries above

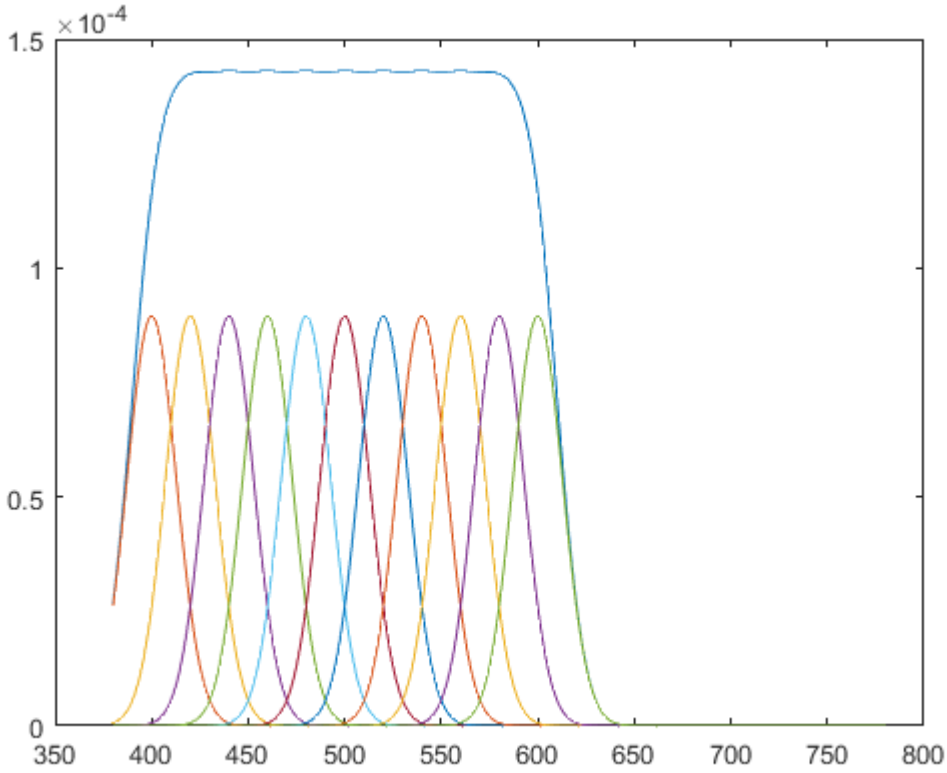


Setup Initial Guess Ratios

Get chromaticity and Tristim for each channel.

Create Initial Guess, spdPercents_0

```
Your spd channel percentages are
    0.090909    0.090909    0.090909    0.090909    0.090909    0.090909    0.090909    0.090909    0.09090
```



Graphically Verify LED Channels' Chromaticity

Verify LED Channels

Graphically Verify The Chromaticity Diagram and LEDs

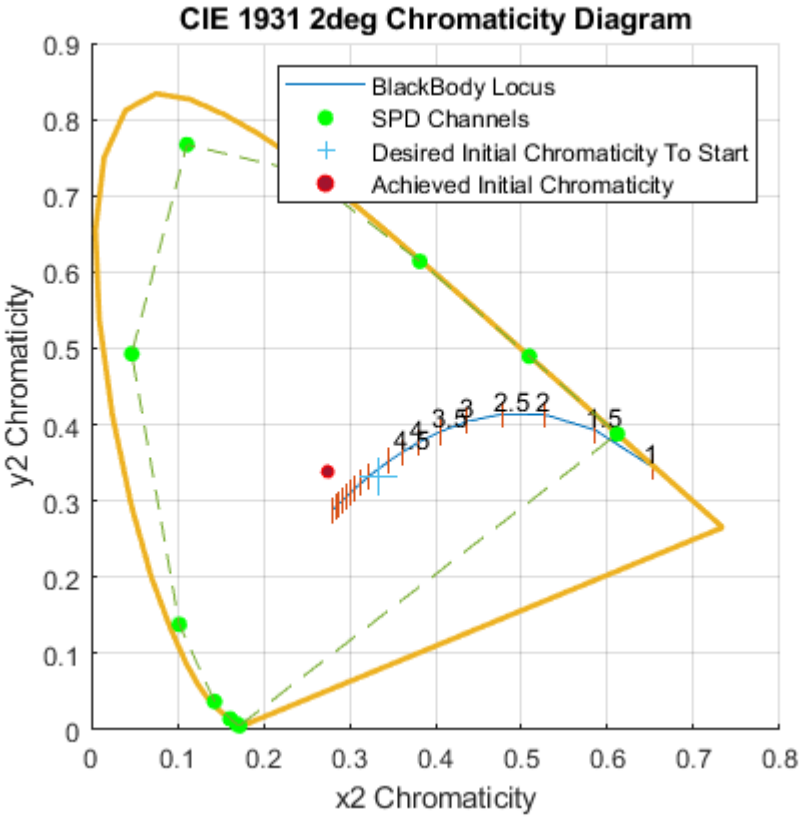
To match tm30 sheet, this is 2deg

Set Initial values

The optimizer uses an initial starting condition, set as equal energy or a target xyY.

```
Loading TM30 V2.04 Data
Loaded Table Planck
```

Put the SPD Channel chromaticities, their gamut, the desired guess, and the mix (which should be same as desired guess).



Data to Compare to

Setup Optimization Problem

Load Other Data

Error Checking

Optimizer Notes

Evaluate

Unsure what to do but I have to uncomment (drag select and press "Ctrl + T" to remove commment and "Ctrk + R" to comment