

Name: \_\_\_\_\_

## EE 193-03 Bonus Homework

Due via provide at 11:59pm, December 19 2019

### Submission

Zip up your code (i.e., the “code” subdirectory of the starter code package) and submit it via provide from one of the Linux machines:

```
provide ee193HIP makeup <ZIP FILE>
```

You can also use the web interface at <http://www.ece.tufts.edu/ee/193HIP/provide.cgi>.

### Problem 1: Display gamut redux

Pull out your code from homework 3 problem 1, which draws the spectral locus in xy-chromaticity space. We assumed some basic RGB primaries; in this problem we’ll examine what happens when we change the primaries.

1. A traditional lamp projector uses a lamp as a backlight and passes this light through a spinning color wheel to produce a sequence of red, green, and blue images. Assume the backlight can be represented with D65 (it’s more likely to be a xenon arc lamp). The spectral transmissions of the filters is in the MATLAB variable `filters`.

Use MATLAB to sketch the gamut of this projector. How do you think the gamut would change if we used a halogen or tungsten lamp instead?

2. A laser projector uses lasers (which produce essentially monochromatic light) rather than a lamp and color filter. Suppose you had a laser projector with primaries at 620, 550 and 460 nanometers.<sup>1</sup>

Use MATLAB to sketch the gamut of this projector.

### Problem 2: Printer gamut

The MATLAB starter code variable `inks` contains the reflectances for hypothetical cyan, magenta, and yellow inks (each as one row, in that order).

We’ll define the amount of ink of each color as a number from 0 to 1. At zero ink, the paper remains white (i.e., the reflectance is simply the reflectance of the paper). At full-ink, the reflectance is the product of the reflectance of the ink and paper.<sup>2</sup>

Given these inks, what colors can you make? Draw the gamut on the xy-chromaticity diagram. Assume that the illumination is D65 and that the paper is perfectly white (i.e., it reflects all wavelengths equally).

### Problem 3: Pancake stacking

Suppose you’re designing a camera system (and any associated lighting) for an industrial pick-and-place machine, such as the ABB FlexPicker (see <https://www.youtube.be/wg8YYuLLOM0> and <https://youtu.be/aPTd8XDZOEK>).

List at least three ways you would optimize the camera system for this task, and three things you would be willing to compromise in order to reduce cost or to prioritize other aspects of the system.

<sup>1</sup>See <https://panasonic.net/cns/projector/products/rq50k/> for an example of such a projector.

<sup>2</sup>Real ink and paper is actually not linear, but this approximation isn’t totally off.