

ECE-GY 6123 Image and Video Processing, Fall 2023
Computer Assignment: Color and Contrast Manipulations
Due 9/22/2023 at 11:59 PM

Please submit your solutions, including Python code and outputs (when relevant), as a single PDF file to GradeScope.

In this assignment, you will get familiar with Python, some basic image-processing libraries, and perform fundamental image-processing tasks. It is recommended that you use,

- **NumPy**: for manipulating images as arrays.
- **Matplotlib**: for displaying images and plotting graphs.
- **OpenCV**: for loading images and converting between colorspace.

You are not allowed to use specialized libraries for histogram equalization.

Problem 1 (Working with Images).

- (a) Load an RGB color image and display the RGB image as well as the R, G, and B channels separately. Describe what you observe in each component.
- (b) Convert the RGB image to the HSV colorspace and display the H, S, and V channels separately. Describe your observations.
- (c) Detect blue pixels, defined by having a hue in range $[110, 130]$. Your detected pixels should be in the form of a binary mask. Use this mask to display only the blue pixels of your original image, with the non-blue pixels displayed as black.

Problem 2 (Contrast Enhancement).

- (a) Load and display a low-contrast grayscale image.
- (b) Calculate and plot the image's histogram. Comment on the relation between the image's contrast and its histogram.
- (c) Recall, we derived in lecture that the cumulative distribution function (CDF) of the histogram is the theoretic optimal histogram-equalization transformation function. Plot the CDF of your histogram. Is this an appropriate equalization function? Why or why not?
- (d) Apply the CDF as a transformation function to your image¹. Display your transformed image and its histogram. Has your image's histogram been equalized? Comment on the your original image and histogram vs. the transformed image and histogram.

¹Hint: think about using python array indexing in a smart way.