EECS203A: HOMEWORK #2

Due: April 18, 2019

Submit your homework to the class dropbox as a single pdf that includes the images.

1. Consider a gray-level image with 50 brightness levels from 0 to 49. Suppose that the brightness histogram for the image f is given by

$$h(r_k) = 10 + r_k \qquad\qquad r_k = 0, 1, 2, \ldots, 49$$

a) Find the cumulative distribution $T(r_k)$. b) Use the method described in class to determine the gray level transformation $M(r_k)$ for $r_k = 0, 1, 2, \ldots, 49$ that corresponds to histogram equalization. c) Find the histogram for the transformed image.

2. Suppose that we capture the two images

$$\begin{aligned} g_1(x, y) &= f(x, y) + n_1(x, y) \\ g_2(x, y) &= 2f(x, y) + n_2(x, y) \end{aligned}$$

where $f(x, y)$ is a noise-free image, and $n_1(x, y)$ and $n_2(x, y)$ are samples of a zero-mean noise source with variance σ^2. Assume that $n_1(x, y)$ and $n_2(x, y)$ are independent. Let

$$g'(x, y) = 0.5g_1(x, y) + 0.25g_2(x, y)$$

a) What is the expected value of $g'(x, y)$? b) What is the variance of $g'(x, y)$?

Computer Problems:

a) Assume $L = 256$ and generate a lookup table that maps input gray-levels to output gray-levels for a power law transform with $\gamma = 0.4$ and $\gamma = 2.5$. For the two cases, plot output gray-level s versus input gray-level r. These should look like Figure 3.6 in the textbook. Submit a plot of your two curves. Apply these two GLTs to the cat image and submit the images. Describe the appearance of the two transformed images compared to the original image.

b) Apply histogram equalization to the cat image. Submit a plot of the output gray-level versus input gray-level for the transform. Submit the histogram equalized image. Describe the appearance of the transformed image compared to the original image.