EE-7150 Computer Project II & Home Work problem

Image Enhancement & Histogram Equalization

Due Date: Sept 17, 2021

Note-1: To learn about different image types in matlab, please go through:
http://www.mathworks.com/help/matlab/creating_plots/image-types.html

For this project the suggested images are uploaded on Pilot. The images are in tiff format.

1. **Intensity Transformation:** Download Figures 3.8(a) and 3.9(a). Then enhance these images using,

   (a) **The log transformation** of equation (3-4) [eqn. (3.2-2) of 3rd Edition] of the textbook. You will need to vary the free parameter c to obtain the "best" possible image.

   (b) **Power-law transformation** of the form shown in equation (3-5) [eqn. (3.2-3) of 3rd Edition] of the textbook. In this case, the values of two parameters, c and γ have to be selected.

Experimentation will be necessary to obtain the "best" visual enhancement possible with the methods in (a) and (b). Use your judgment to select the "best" visual result for each transformation and each image. Explain the reasons for the major differences between the resulting images. Use subplots to display images in same Figure so the differences are observable.

Note-2: You will need to use the Matlab in-built function im2double to convert the uint8 tiff image to double-precision before processing.

2. **Histogram Equalization**

   (a) Use Matlab function imhist() to calculate histogram of images in textbook Figure 3.16 to reproduce the results in Figure 3.20. Please comment on the relationship between the histogram and visual appearance of the corresponding images. Here are some useful Matlab commands.

```
% Make sure the image file is in the current directory. Then use,

img=imread('Fig0316(2)(2nd_from_top).tif');
figure (5);imshow(img);
[histgram,N]=imhist(im2double(img));
figure(10);
bar(N, histgram); %or use stem(N, histgram); or plot(N,histgram);
newmap=histeq(img,gray(256));
figure (20);imshow(img,newmap);   % this will display the histogram
                                  % equalized image in a new figure
figure(30);rgbplot(newmap);%Explain what function you see in the plot
```

Note-3: Applying histeq to an indexed image will not change the image content – it will only generate a new color map.

```
grayimgeq=ind2gray(img,newmap);      % get an intensity image
Figure;
imhist(grayimgeq,256);               % display the equalized histogram.
```

Please comment on the visual appearance of the equalized images and their corresponding histograms.

(b) Develop a Matlab function to perform local histogram equalization of a 256 gray scale (intensity) image.

```
output_img=localhisteq(input_img, mask_size, graylevel);
```

Perform the local histogram equalization on the image in Figure 3.32 (a) with a mask_size 3x3. Compare the performance of the histogram of the global and locally equalized images.

Note-4: You need to carefully consider the efficiency of the Matlab code in this case. Otherwise, it will take a long time to process an image.

Hint-1: Use the Matlab built-in function blockproc. You may set the overlap parameters to 0 in this case.

Hint-2: Alternately, you may use matlab built-in function, nlfilter.

If you have an older version of matlab, then use blkproc. i.e.,

```
gray_output_img=blkproc(gray_input_img,[3,3],[blk_overlap_I,
blk_overlap_J],'histeq',256);
```

3. **Histogram Equalization (Theory problem 3.14 from the Textbook)**

An image with intensities in the range [0,1] has the PDF, $p_r(r)$, shown in the following figure. It is desired to transform the intensity levels of this image so that they will have the specified $p_z(z)$ shown in the figure. Assume continuous quantities, and find the transformation (expressed in terms of r and z) that will accomplish this.