ECE565 Computer Vision and Image Processing (Spring 2019)
Project #1

(Due date: Feb 28th, 2019)

1. (50 points) Histogram processing

   (a) (40 points) The global histogram equalization technique is easily adaptable to local histogram equalization. The procedure is to define a square or rectangular window (neighborhood) and move the center of the window from pixel to pixel. At each location, the histogram of the points inside the window is computed and a histogram equalization transformation function is obtained. This function is finally used to map the intensity level of the pixel centered in the neighborhood to create a corresponding (processed) pixel in the output image. The center of the neighborhood region is then moved to an adjacent pixel location and the procedure is repeated. Write an M-function for performing local histogram equalization. Your function should have the following specifications:

   - "**g = localhisteq(f, m, n)**" performs local histogram equalization on input image **f** using a window size $m \times n$ to produce the processed image **g**.
   - To handle border effects, image **f** is extended by using the 'symmetric' option. The amount of extension is determined by the dimensions of the local window.
   - If **m** and **n** are omitted, they default to 3. If **n** is omitted, it defaults to **m**. Both must be odd.

   (b) (5 points) Process "test1.tiff" with your function **localhisteq** using neighborhoods of sizes 3×3 and 7×7. Explain the differences in your results.

   (c) (5 points) Histogram-equalize the test image using the Image Processing Toolbox (IPT) function **histeq**. Compare the result with those obtained from (b).

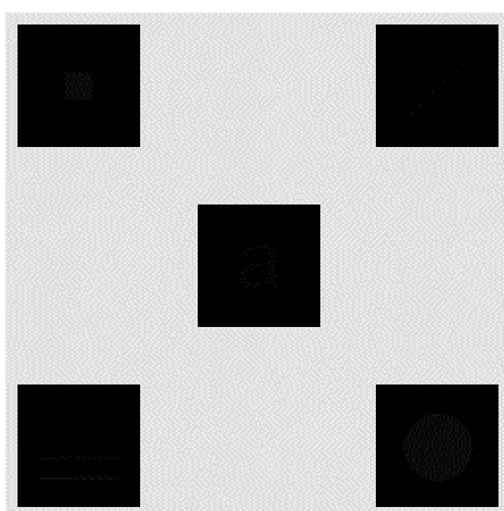

Figure 1. test1.tiff.

2. (50 points) The 2-D Fourier transform is represented in polar form as

$$F(u,v) = |F(u,v)|e^{j\phi(u,v)}$$

Here,

$$|F(u,v)| = [R^2(u,v) + I^2(u,v)]^{1/2}$$

is the magnitude spectrum and

$$\phi(u,v) = tan^{-1}\left[\frac{I(u,v)}{R(u,v)}\right]$$

is the phase angle. The phase angle carries information about the location of image elements and the spectrum carries information regarding contrast and intensity transitions. It is recommended that you look up functions **complex** and **angle**.

(a) (20 points) Compute the magnitude spectrum and the phase angle of image "test2.tiff" and show the phase image. Then, compute the inverse transform using only the phase term (i.e. **ifft2** of $e^{j\emptyset(u,v)}$). Apply appropriate functions in MATLAB to obtain the magnitude spectrum and the phase angle of the image and show the image. Discuss your results.

(b) (15 pts) Compute the inverse using only the magnitude term ((i.e. **ifft2** of $|F(u,v)|$). Show the image and discuss your results.

(c) (15 pts) Recover the image using the magnitude spectrum of "test2.tiff" and the complex conjugate of the phase component (i.e., you can compute **ifft2** of $|F(u,v)|e^{-j\emptyset(u,v)}$). Discuss your results.

test2.tiff