LAURENTIAN UNIVERSITY
BHARTI SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

CPSC5416 - Digital Image Processing & Computer Vision

ASSIGNMENT 2

Due date: Sunday, November 6, 2022

IMPORTANT: In your report, you have to show the input images and all processed images. Add captions to your figures to make them self explanatory.

Question 1 (10 Marks)

The Fourier transform is complex, so it can be expressed as

$$F(u,v) = R(u,v) + j.\mathrm{Im}(u,v) = |F(u,v)|\, e^{j\phi(u,v)}$$

where,

$|F(u,v)|$ is the spectrum, and $\phi(u,v)$ is the phase angle. (angle( ))

Interesting and sometimes nonsensical results are obtained when the symmetry and signs in the Fourier transform are not preserved.

Download the image "pirate.tif" from the course webpage, and obtain its spectrum, S, and phase, P. Then,

a) Let $S1 = S$ and $S1(0.75M{:}M, 0.75N{:}N) = 0$ where $[M, N] = \mathrm{size}(S)$. Recover the image using $S1$ and P. Show your result.

b) Let $F^*(u,v)$ be the complex conjugate of $F(u,v)$. Recover the image using $F^*(u,v)$ and display it.

c) Multiply the real pat of $F(u,v)$ by 0.4. Leave the Imaginary part unchanged. Recover the image using the modified $F(u,v)$ and display it.

Question 2 (10 Marks)

Download the image "boat.png" from the course webpage. Filter the image using:

a) Ideal low and high pass filters.

b) Butterworth low and high pass filters.

c) Gaussian low and pass filters.

Try at least three different values for D_o and n. Include all trials in your report and comment on the outputs.

Question 3 (20 Marks)

Download the images "livingroom_noisy.tif" and "pirate_noisy3.tif" from the course webpage.

a) Clean up the images, and display the cleaned ones.

b) Extract and display the noise pattern in both images.

$g(x,y) = f(x,y) + \eta(x,y) \rightarrow \eta(x,y) = g(x,y) - f(x,y)$ (input, noise; noisy, input)

Question 4 (10 Marks)

Download the image "boat_noisy1.tif" from the course webpage. The image is corrupted by noise.

a) Extract its *noise* histogram. Display the histogram (using function `bar`) and indicate (by name) what you think the noise PDF is. Determine the relevant noise parameter(s) using the histogram you extracted. (*Hint*: Use function `roipoly` to extract the data you think will help you identify the noise.)

b) Use function `imnoise` or `imnoise2`, as appropriate, to generate X samples of the noise type and parameter(s) you determined in (a). Generate the histogram of the samples using function `hist`, and display the histogram. Here, X is the number of pixels in the ROI in (a). Compare with the corresponding histogram from (a).

Question 5 (10 Marks)

Download the images "`peppers_noisy.tif`" and "`us092_noise.pgm`" from the course webpage. Try different filters to reduce noise in both images. Include all trials in your report. Then, use visual evaluation to recommend the best filter in each case.

Question 6 (10 Marks)

Download the images "`cameraman_noisy.tif`", "`pirate_noisy1.tif`", "`peppers_noisy.tif`", and "`lena_gray_noisy.tif`" from the course webpage. Try to de-noise them using a Haar-based DWT. Comment on the outputs. Include all trials in your report.

Question 7 (10 Marks)

Download the images "`goldhill.bmp`", and "`us021.pgm`" from the course webpage. Enhance the edges in both images using:

a) spatial domain filters
b) Wavelet Transform

Comment on the outputs.