EE4704 Image Processing and Analysis

CA1

Semester 1, AY2020/21

This assignment is to be done with Matlab. You may use built-in Matlab functions or write your own Matlab scripts.

A. Image noise

1. Examine image ***test1*** and its histogram. Where possible, relate the modes (peaks) of the histogram to the regions of the image.

2. (a) Add Gaussian noise $\sigma = 15$ to ***test1***, giving image ***test1a***. Observe the effects of the noise and calculate the SNR. Plot the histogram of the noisy image and explain its main features. (You should obtain an SNR value of about 21.05 dB.)

   (b) Add salt-and-pepper noise of probability (density) = 0.05 to ***test1***, giving image ***test1b***. Observe the effects of the noise and calculate the SNR. Plot the histogram of the noisy image and explain its main features.

3. Apply mean and median filtering to ***test1a*** as follows:

   (a) mean filter with 3×3 and 7×7 windows

   (b) median filter with 3×3 and 7×7 windows

   Compare the results in terms of SNR, visual quality, and other pertinent parameters.

4. Apply mean and median filtering to ***test1b*** as follows:

   (a) mean filter with 3×3 and 7×7 windows

   (b) median filter with 3×3 and 7×7 windows

   Compare the results in terms of SNR, visual quality, and other pertinent parameters.

B. Fourier transform

1. Write a simple script to display the Fourier spectrum (the DFT magnitude) of an image:
   - the centre of the display window corresponds to the point $(u,v) = (0,0)$
   - the DFT values are scaled by the log transformation and normalized such that the maximum value corresponds to gray level 255.

   Use this script for B.2 and B.3.

2. Load image ***test2*** and obtain the Fourier spectrum. Describe the main visual features of the Fourier spectrum and explain how they are related to the image.

3. Add Gaussian noise $\sigma = 10$ to ***test2*** giving ***test2a***. Obtain the Fourier spectrum of ***test2a***. Describe and explain the main features of the Fourier spectrum.

C. Report

1. Your report should focus on the results, observations, explanations and discussion. Relevant images should be included.

2. The GA for the assignment is Yan Hanshu (hanshu.yan@u.nus.edu). You may consult him if you need any clarification on the assignment.

3. Submit a softcopy (pdf file) of the report to the "CA1-report" folder on the EE4704 module LumiNUS website, by 2 pm, 25 September. The Matlab code/scripts are to be included in the appendix.

4. The file is to be named as follows:
matric number_full name.pdf (e.g., A010134J_Tan_Shu_King.pdf).

5. ***The results and report must entirely be your own work. Plagiarism is a serious offence.***

Note:

1. The Matlab functions imtool and improfile may be useful in examining an image.

2. The SNR (in dB) an image I_B with respect to the reference image I_A (***test1***) is defined as

$$\text{SNR (dB)} = 10 \log_{10} \left(\frac{\sum\sum I_A^2(x,y)}{\sum\sum \left[I_A(x,y) - I_B(x,y) \right]^2} \right)$$

3. In implementing the mean and median filtering (masking) operations, the image size must remain unchanged and there are no filtering artifacts at the margins of the image array (the outermost rows and columns).

4. The log transformation is described in Chapter 6A, pg 10.