Lab 1 – INT 302: Image Processing

Start Date: 2024-03-21 Deadline: 2024-04-12

15% of the final marks

Late Submission Policy: 5% of the total marks available for the assessment shall be deducted from the assessment mark for each working day after the submission date, up to a maximum of five working days.

Objectives:

1- Introducing the image processing capabilities of Matlab and its Image Processing Toolbox.
2- Learn to read and display different images.
3- Learn basic image processing steps.
4- Master different image enhancement techniques

Download:

Download the files of lab1-Material.zip from the Learning Mall, unzip the file into a folder lab1-Material, which contains “lenna512color.bmp”and “lenna512.bmp”.

Tasks:

1. Task1 (15 marks)

Download image "lenna512color.bmp". Use the functions imread to load the image into Matlab, and conduct the following questions:

(1) Display the image and decouple the image into RGB components. Please plot both original image and the decoupled components. **(5')**

(2) Change the color space into HIS and show the images of HSI components. Please plot both original image and the decoupled components. **(5')**

(3) Change the original image into gray level and show the gray image. Write the transformation code by yourself. **(5')**

2. Task 2 (35 marks)

In this task, we use the monochrome image *Lenna* (i.e., "lenna512.bmp") to do the following sub tasks, and let's call the original image Lenna as I_0.

(1) Write a function to measure the Peak Signal to Noise Ratio (*PSNR*) between two gray images in *dB*. For the peak value use 255. **(5')**

$$PSNR(dB) = 10log_{10}(\frac{255\text{^}2}{mse}),$$

where *mse* is the mean square error, and it is evaluated as:

$$mse = \frac{1}{N}\sum_{\forall ri}\sum_{\forall ci}(im(ri,ci) - im_2(ri,ci))^2$$

(2) I_0 -> down-sampling to I_1 with 1/4 size of I_0 (both horizontally and vertically) using mean value (**implement it by yourself**). Display it and compare to the original image. Explain your founding in the report; (**10**')

(3) I_1-> up-sampling to I_1' with the same size of I_0 using nearest neighbor interpolation (**implement it by yourself**). Display it and compare to the original image. Explain your founding in the report. (**10'**)

(4) Calculate the PSNR between the original image I_0 and the up-sampled images, i.e., nearest, bilinear, and bicubic, respectively. Compare the results of different interpolation methods. Explain your founding in the report. (**10'**)

(Note: for the bilinear and bicubic interpolation, you use the matlab function directly).

Image	nearest	bilinear	bicubic
PSNR (dB)			

3. Task 3 (**12 marks**)

In this task, we use the monochrome image *Lenna* (i.e., lenna512.bmp) to do the following sub tasks. You need to conduct Log transform on the input image, where log transform is $s = clog(1 + r)$, please plot the transformed images with c=1, 10, 20, 30, 40. Please write one function to generate this image instead of calling matlab

function directly and explain your founding in the report. **(12')**

4. Task 4 (38 marks)

1) Add salt & pepper noise with noise density xx% (xx=ID %50. e.g., ID:1234567, the noise density should be 17%.) to the image Lenna (i.e., lenna512.bmp) and display the noisy image. Name it as `im_SP`. Please write one function to generate this image instead of calling matlab function directly (you can use Matlab function to generate uniform random numbers, e.g., `rand()`). **(10')**

2) Apply the median filter with a 3X3 window and a 5X5 window on the image `im_SP` (you can use Matlab function `medfilt2`). Display and evaluate the PSNR of the obtained images. For each window size, comment on how effectively the noise is reduced while sharp edges and features in the image are preserved. **(8')**

3) Implement the mean filter 3X3 to filter the image `im_SP` by yourself (you are **not** allowed to use `Imfilter` and `fspecial` directly). Compute the PSNR and display the filtered image. You can use zero padding for the boundary pixels. **(8')**

4) As you experimented with the mean and median algorithms, what different "performance" did you notice? Which one is better for removing salt & pepper noise? and why? **(12')**

Lab Report

Write a **short** report which should contain a **concise description** of your results and observations. **Include** listings of the **Matlab scripts** that you have written. **Describe each of the images** that you were asked to display.

Answer each question completely:

- Do not attach the code at the end of the report, just put the useful code under each question
- The results maybe contain some figures, please add some index and title of each figure

Report format: Single column; Fond size: #12; Page number: no more than 15;

Submission **before 2024-04-12**.

- Electrical version to LM with a rar (ZIP) of all files
  - Rar file name: INT302-Lab1-Name-studentID.rar/zip
  - One file with same file name of Rar/zip File: Report (with studentID, name, Lab title on the homepage)
  - One folder: codes and other materials. (I can run it directly)

Marking scheme

80%-100% Essentially complete and correct work.

60%-79% Shows understanding, but contains a small number of errors or gaps.

40%-59% Clear evidence of a serious attempt at the work, showing some understanding, but with important gaps.

20%-39% Scrappy work, bare evidence of understanding or significant work omitted.

<20% No understanding or little real attempt made.