Digital Image Processing (Handout 2) (09/26/2013)

HOMEWORK ASSIGNMENT #1

Image Enhancement and Noise Removal

Due Date: 9:00pm on 10/9/2013

Please read the submission guideline (posted on the class website) carefully before getting started.

All images in this homework can be downloaded from our class website: *https://ceiba.ntu.edu.tw/1021DIP*. Images are in the **raw** file format. The size of each image is listed in the appendix.

For MATLAB users, you are **NOT** allowed to use the MATLAB Image Processing toolbox except the imshow() and image() functions.

PROBLEM 1: IMAGE ENHANCEMENT

In this problem, you are given an image I, as shown in Fig. 1. Please follow the instructions below to create several new images.

(a) Decrease the brightness of image I by dividing intensity values by 2. The output image is denoted as D.

(b) Perform histogram equalization on D and output the result as H.

(c) Perform local histogram equalization on image D and output the result as L.

(d) Plot the histogram of image I, D, H and L. What's the main difference between local and global histogram equalization?

(e) Perform the log transform, inverse log transform and power-law transform to enhance image D. Please adjust the parameter as best as you can. Show the parameters, output images and corresponding histograms. Provide some discussions on the results as well.

(f) [BONUS] Perform automatically thresholding method such as Otsu's method on image I.

Fig. 1: sample1.raw

PROBLEM 2: NOISE REMOVAL

The requirements of problem 2 are adding and removing noise. The original image I is shown in Fig. 2. Please follow the instructions below to create other new images.

(a) Add Gaussian noise with $\sigma = 10$ (see appendix) to image I, and denote the result as N_G.
(b) Add salt and pepper noise to the input image I and the output is denoted as N_P.
(c) Add both Gaussian noise with $\sigma = 10$ and salt & pepper noise to image I and output the noisy image as N_B.
(d) Choose proper filters and parameters to remove the noise in N_G, N_P and N_B, and denote the resultant images as R_G, R_P and R_B, respectively. Please describe the details of your denoise methods including the choice of parameters.
(e) Compute the PSNR values of R_G, R_P and R_B and provide some discussions.

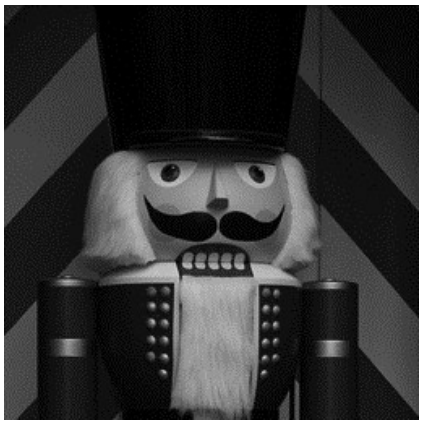

Fig. 2: sample2.raw

Appendix:

Equation

Gaussian noise generator:

$$\text{gaussian\_noise}(\sigma) = \sigma * \left[\left(\sum_{i=1}^{12} \text{rand}()/\text{RAND\_MAX}\right) - 6\right]$$

Image files

Problem1: GETTING STARTED & IMAGE ENHANCEMENT

sample1.raw	Fig. 1	256 x 256 image	gray-scale

Problem2: NOISE REMOVAL

sample2.raw	Fig. 2	256 x 256 image	gray-scale