Digital Image Processing (H.-M. Hang; 2014/10/12)

# Homework #2

## Due Date: November 10, 2014

- You are asked to write your own programs (in C, C++, or Matlab) to perform image (histogram) enhancement operation.
- You should be able to demonstrate your program on the PC if needed.
- Please attach your program to your report.
- Your report can be in the format of Microsoft Words or PDF.
- *Reminder*: The organization, clarity, etc. of your report contribute to 30% of the report score.

*Problem:* (Do not use library function or toolbox for the histogram operations. But you can use "imread" and "imwrite" in this Homework set.)

1. Original images: Four gray scale images and four color images in bmp format. (Images sizes are specified in the bmp header.) Download the images from http://cwww.ee.nctu.edu.tw/course

2. Do the following jobs on these 4 test gray scale images.
   A. Plot the histogram of each image. Also print the original images.
   B. Perform the (entire image) histogram equalization. Print the enhanced image and plot the new histogram. Also, plot your gray-level transformation curve.
   C. Perform the local histogram processing specified in the textbook (eq.3.3-24, and given below) on these 4 gray images. The neighborhood window size is 3x3. You need to select the parameters $E$, $k_0$, $k_1$, and $k_2$ values properly to get better visual quality. Include your parameter values in your report. You can test on different values particularly the $E$ parameter to see their effects. Print the enhanced image and plot the new histogram. The parameter values for each test picture can be different.

$$m_{S_{xy}} = \sum_{i=0}^{L-1} r_i p_{S_{xy}}(r_i)$$

$$\sigma^2_{S_{xy}} = \sum_{i=0}^{L-1} (r_i - m_{S_{xy}})^2 p_{S_{xy}}(r_i)$$

$$g(x,y) = \begin{cases} E \cdot f(x,y) & \text{if } m_{S_{xy}} \le k_0 M_G \quad \text{AND} \quad k_1 D_G \le \sigma_{S_{xy}} \le k_2 D_G \\ f(x,y) & \text{otherwise} \end{cases}$$

   D. Repeat Item C with a window size of 9x9. The parameter values may need readjusted for this window size.

3. Perform the histogram equalization on the 4 test color images.
   A. Treat each R, G, and B component as an independent gray scale image.

Perform the (entire image) histogram equalization on each of them separately. Print the enhanced color image and plot the new histogram. Print the enhanced color image and plot the new histogram. [*Hint*: *Check* the "hue" of the processed images.]

B. Convert the RGB image to the Y Cb Cr representation. Perform the histogram equalization only on the Y component. Convert them back to RGB images and print the enhanced color images and plot the new histograms.
[*Optional*: You can try to apply the histogram equalization on the Cb and Cr components separately and see their effects on the color images. Note that using the digital YCbCr formula, the digital value "128" is the original "0" value.]

- In doing research, it is important to interpret the data you obtained. At the end of your report, explain as much as you can the meaning (implication) of your results.

*Remarks*:

1. Upload your HW to the following FTP site:

   IP: 140.113.211.110
   Account/password: DIP2014/dip2014

2. Please pack all your files in a zip file with the following naming convention: hw2_StudentID.zip. Your files should include all the input images, the output images, your code, readme.txt file, and report (pdf or word).

3. If your program (code) is in C or C++, it should be executable under **visual studio 2010**.

4. Please hand in a hardcopy of your HW in the class.

5. Your report must contain:
   a. Your name and student ID
   b. Description of your algorithms
   c. Description of your program (flowchart)
   d. Results and discussions
   e. References

6. You should upload your HW report on time to avoid the late submission penalty.