Digital Image Processing: Assignment 1

Instructions

- Please upload a soft copy of the code as well as the report highlighting your inferences on the moodle page before October 11 '2015.
- Please note that you will be graded for both the effort taken in the implementation of your code as well as the knowledge gained in the process.
- **Any form of plagiarism will not be entertained, and will result in a loss of grade in the course**.
- If the images are in RGB format, convert them to gray-scale by using 'rgb2gray' command in MATLAB.

1. Image Quantization

You are given an image **flower.jpg**.

(a) Utilize its histogram and display the image in eight levels.

(b) Repeat part (a) by assuming an uniform histogram for the image.

For each case, display the quantized image, its histogram and the optimum mean square error obtained.

2. Image Enhancement

Intensity transformations: Load the image **unenhanced.tif**. Perform the following enhancement operations

(i) **Contrast Stretching:** Improve the contrast of the image by a linear function, so that the minimum and maximum values map to 0 and 255 respectively. Display the resultant image and its histogram.

(ii) Apply a suitable power law transformation to enhance the contrast of the image. Justify the choice of function used. Display the resultant image and its histogram.

(iii) **Histogram Equalization:** Display the histogram equalized image.

3.Histogram Specification:

Modify the histogram of the image **givenhist.jpg** in such a way that the resulting histogram nearly approximates the histogram of the image **sphist.jpg**. Display the histogram of the image **givenhist.jpg** after this transformation.

4.Bilateral and Median Filtering

In this experiment, we will study the performance of the filters in de-noising images. You are given 3 images - **spnoisy.jpg**', **unifnoisy.jpg** and **spunifnoisy.jpg**. These are photographs corrupted with different types of noise. Try to reduce the effect of noise from each of them by applying:

- a bilateral filter with mask size 5×5 with appropriate values of σ_d^2 and σ_r^2, set through experimentation.
- a median filter of appropriate window size.

5.Edge Detection

Perform edge detection on the image **window.jpg** using the Sobel masks indicated below.

$$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}, \text{ and } \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix},$$

Display the following:

(i) Horizontal gradient component image G_x

(ii) Vertical gradient components image G_y

(iii) Edge map, obtained after thresholding the resultant gradient image $R = |G_x| + |G_y|$.

6. Edge preserving smoothing filters

You are provided with a noisy picture of Lenna. (**Lenna_noise.jpg**). In this task, you are expected to explore a set of edge preserving filters, to address the problem of image-denoising. For each filter, display both the input and de-noised image.

(a) **Anisotropic non-linear diffusion filter:** Implement the anisotropic diffusion filter for reducing the effect of noise. Consider adapting the value of the conduction coefficient, so as to stop the diffusion on the edges. Nevertheless, to get a visually pleasing result, it is suggested to iterate through the algorithm several times. You may consider either a 4 or 8 neighbor connectivity.

(b) **Isotropic linear diffusion filter:** How does your result in (a) compare with that of the Linear Diffusion filter (with fixed conduction coefficient applied across the entire image).

(c) **Non-local means filter:** Denoise the image using the non-local means filter. For faster implementation, restrict the search of similar patches in a window of size 5×5 pixels around the current patch. In addition, assume each patch to be of size 7×7. To get better results, it is expected that you compute the Gaussian weighted Sum of Squares distance between the patches. The bandwidth /scale of the Gaussian may set experimentally.

7. Corner Detection

Implement the Harris corner detector algorithm on the image **IITG.jpg**. Superimpose the corner points on to the relevant pixels in the image. It is suggested that you choose a suitable threshold to pick up the interest points, followed by a non-maximal suppression step.