Image Processing-I
Image Enhancement (Lab Tutorial 2)

Objectives

The main objective of this lab is to explore the Image processing Tool box given in Matlab by writing different small script and further investigates different image enhancement techniques studied during the lecture.

Resources

In order to carry out this lab session, you will need to have the following images (you should have received them in your email):

1- Lena
2- Landsat
3- T10
4- Synthetic 1
5- Synthetic 2
6- Synthetic 3
7- Synthetic 4

Note: Save the images and your file in the same directory, otherwise give the full path of images in imread command

Theory

The aim of image enhancement is to improve the interpretability or perception of information in images and to provide better input for other automated image processing techniques. Image enhancement techniques can be divided into two broad categories:

1. Spatial domain methods, which operate directly on pixels.
2. Frequency domain methods, which operate on the Fourier transform of an image.

In this Lab we will work on Spatial Domain techniques.
Useful Matlab Commands: imread, rgb2gray, imshow, imhist, histeq, imadjust

Spatial domain methods include:-

i. Simple Intensity Transformation
ii. Histogram processing - equalization and modification

1. Simple Intensity Transformations

1.1 - Negative of an Image

The most basic and simple operation in digital image processing is to compute the negative of an image. The pixel gray values are inverted to compute the negative of an image

To Try:

1. Please load an image (for example t10).
2. Display the image in a figure.
3. Now use the (L-1)-r to find Image negative. L is the total number of grey levels and r is grey level of current pixel. For grey scale images the total grey levels are (0 - 255)
4. Comments?

1.2 - Image Subtraction

Image subtraction is the powerful technique to compare and highlight the difference between two images (e.g analysis of electrical boards, circulation of blood flow in veins).

To Try:

1. Load an image (for example synthetic 1) as an Image1
2. Load another image (for example synthetic 2) as an Image2.
3. Display both image in a figure.
4. Now subtract Image 2 from Image 1
5. Comments?

Homework: Try to explore 'imsubtract', imadd, imdivide, imresize

1.3- Contrast Stretching

Low contrast images can result from poor illumination, lack of dynamic range in the imaging sensor or even wrong settings on the image acquisition sensor. The idea of contrast stretching is to increase the dynamic range of the grey levels in the image being processed.

To Try:

1. Load an image (for example Landsat)
2. Display the image in a figure.
3. Select appropriate Threshold value(e.g. 100 for Landsat Image)
4. Display the resulting Image.
5. Comments?

2. The Image Histogram

The histogram of an image is a simple way to see how the gray level (i.e. the information) is spread over the available range of grey levels. This in turn can be used to highlight problems during the acquisition (clipping due to over exposure, low contrast). The histogram can also be modified to make better use of the available range for further processing and display.

One point to note is that the histogram of an image is unique, but the reverse of this statement is not true. Only one histogram can be created from an image but several different images could be re-created from the one histogram, since the histogram gives no indication about the location of the pixels just their grey scale values.

To Try:

1. Load an image (for example Landsat)
2. Display the image in a figure.
3. Use 'imhist' command to display the histogram of the image
4. Comments?
5. What is the influence of the number of boxes?

6. Load an image (for example synthetic 3) as Image1
7. Load an image (for example synthetic 4) as Image2
8. Use 'imhist' command to display the histogram of the Image1
9. Use 'imhist' command to display the histogram of the Image2
10. Comments?

2.1 Histogram Equalization

In histogram equalization, the goal is to obtain a uniform histogram for the output image by assigning the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. Histogram equalization improves contrast in the image.

To Try:

1. Load an image (for example Landsat)
2. Display the image in a figure.
3. Use 'imhist' command to display the histogram of the image.
4. Use 'histeq' command to equalize the histogram
5. Display the new image in a figure.
6. Use 'imhist' command to display the histogram of the new image.
7. Comments?
8. Use 'imadjust' command on original image.
9. Display the new image in a figure.
10. Use 'imhist' command to display the histogram of the new image.
11. Comments?

3. Matlab Demos

Matlab has a number of demos for Image Enhancement. Investigate the use of Histogram Equalization and Simple transformation functions using the demo "**Contrast Enhancement Techniques".**