CUA-EECS Department
ENGR 652: Advanced Optical and Image Processing
Project -1 -
Due date: 10 /1 /2014

Local Contrast Enhancement

Definition

- The Local Contrast Enhancement scales the intensity of each pixel in the image based on the ***Local Mean*** and ***Local Contrast*** about the pixel.
- The term "local" means that the mean and contrast are calculated from the pixel elements that form a box around the pixel of interest.
- ***Local Mean*** is simply the mean of the pixels within the box.
- ***Local Contrast*** is calculated from the local mean subtracted from the intensity of the pixel of interest.

Objective: Compute this formula: $y(m,n) = 64\frac{x(m,n) - \mu(m,n)}{\sigma(m,n)} + 127$

Procedure

1. Create a function my_local_contrast as shown below.

```
function out = my_local_contrast(in, window_size, gauss_std );

% Performs a local contrast enhancement using a gaussian smoothing function
% of specified size and standard deviation and uses mirror padding to treat border effects.
%
% Required Input Parameters:  in - chest X-ray image (double precision format).
%                             window_size - averaging filter size (odd integer number).
%                             gauss_std - desired standard deviation
%
% Outputs: out - enhanced chest X-ray image (output is double precision format)
%
```

2. Create 2 one dimensional Gaussian filters (separable filters) of specified size and standard deviation (one in the x direction and the other in y direction) using MATLAB fspecial function.

3. Convert the image to double precision variable.

4. Compute the mirror padding window size (for border effect)

5. Compute local mean using 1 D convolution along each row first and another 1 D convolution along each column and incorporating mirror padding to treat border effects.

   $\mu(m,n) = x(m,n) * h(m,n)$

6. Compute $x(m,n)^2$.

7. Compute $\mu(m,n)^2$ (local mean squared)

8. Compute $x(m,n)^2 * h(m,n)$ (expectation of the signal squared) using separable filters and mirror padding.

9. Compute standard deviation squared using this formula:

$$\sigma^2(m,n) = x^2(m,n) * h(m,n) - \mu^2(m,n)$$

10. Assuring that the standard deviation squared is of positive value.

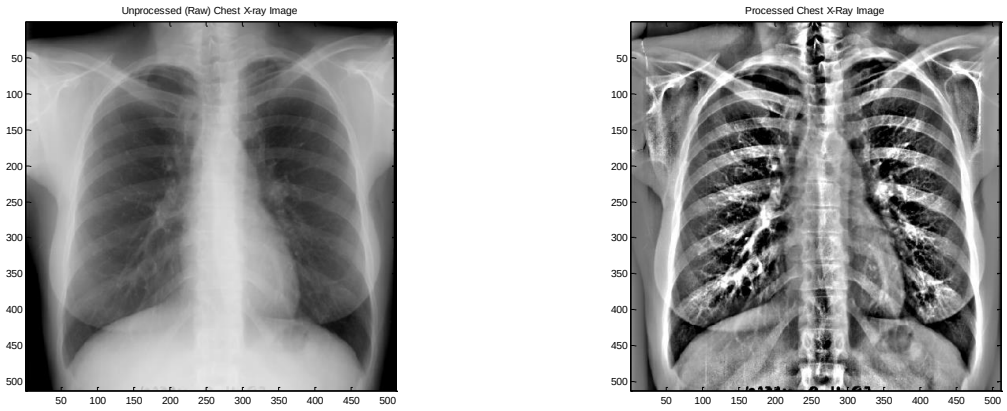
11. Handling zero std region using the find function and setting the zero values if they exist to 1% a value close to zero (concept of limit).

12. Perform a local contrast enhancement on chest x-ray image by using the following formula:

$$y(m,n) = 64\frac{x(m,n) - \mu(m,n)}{\sigma(m,n)} + 127$$

13. Write a script file that will load the image from JPCNN001_small.mat file and extract the image data from the jrst structure and display the initial image and the output image after calling the local contrast function you have created using the im() function given on blackboard.

Typical output



Input Image: in **Output Image: out=my_local_contrast(in, 51,16)**

What to submit:

A. Submit the code which should include comments for clarification.
B. Use the publish command to transfer your code to a word file with the input and output figures.
C. Zip everything in one file and email it to me.