Due date to submit project work with report: ***03.10.2017.*** *The report will contain explanations of the problem, the way it has been solved and discussion about the results. Also you have to show sample input image and outputs. Add the Matlab code in the report. Each exercise contains equal weight.*

Exercise-1

To understand image filtering in the spatial and frequency domains

Problem statement: (Directional filtering) Write a Matlab function that will do the following:

i- Filter an image in four directions using a user-specified dimension. For example, a dimension of three would yield a convolution kernel of [0 0 0; 1 1 1; 0 0 0]/3 and [1 0 0; 0 1 0; 0 0 1]/3 plus two more kernels rotated 90 degrees from these.

ii- Read *cameraman.tif* (it comes with Matlab) into Matlab. Add noise generated by *randn* and scaled by 10. Filter the image with directional filters of dimension 3, 5, and 7. Which filter appears to do the best job? Describe the effect of the filters on the image. What happens as the filter size increases?

Exercise-2

Image enhancement using intensity transformations:

Problem statement: (Unsharp masking) Give a 3 × 3 mask for performing unsharp masking in a single pass through an image. Show it with an example.

Exercise-3

Threshold median filtering an image.

Problem Statements

A threshold+median filter sometimes works even better than a standard median filter. A threshold operation is applied to the median filter such that the filter is only activated if the data within the filter window contain a grayscale level above some threshold value. For example, if we determine that a random point data fall within the range of 0-15 then the median filter is only activated and so on. This strategy will leave regions far from the scratches untouched by the smoothing effects of a median filter.

i- Load the threshold median filter file medfilt_th.m into your working directory.

ii- The syntax is medfilt_ th(old,n,threshold), where “old” is the image to be filtered and “n” gives the n × n dimension of the neighboring window of the filter and “threshold” is the threshold to be used.

iii- Add a scratch and/or isolated strong noise bursts to the Miranda image. Miranda is a moon of Uranus with some of the weirdest geology in the Solar System.

iv- Now design a median filter to eliminate this strong noise, and yet preserve sharpness.

Exercise-4 (Bonus points)

Filtering in the frequency domain.

Problem Statements: Create the following (128 x 128) filters in the Fourier domain, by typing them into the usual matrix form: (a) Butterworth low-pass filter; (b) Butterworth high-pass filter. Choose *D*=15 and n=2. Filter the image *cameraman.tif* with (a) and (b), using the following steps:

1. Read the image
2. Transform it using *fft2*, and shift the transform to the center using *fftshift.*
3. Multiply the transform by the filters created.
4. Invert the result, using *ifft2* and display the filtered image.