SGN-12006 Introduction to Image and Video Processing

EXERCISE 6

16.11.2015 – 17.11.2015

1) Signal Creation

Create the following 128 x 128 gray-scale images:

(a) Constant value 0.5 for whole image;

(b) 20x20 white square in the middle;

(c) Ramp from 0 to 1 in horizontal axis, constant in vertical axis.

(d) Delta function at the center of the image;

(e) Cosine signal having four periods in both directions; (help meshgrid)

All the images should be created using the full range 0 to 1, and without using any for or while loops.

2) DFT

a) Perform the 2D Fourier transform on all the images in task 1. (help fftshift, fft2, log). Have a look at Ex6_DFT.pdf for instruction of DFT in matlab.

b) Explain what information you get from Fourier transform of an image.

c) Consider DFT images from task 1, where is the energy concentrated and why?

2) Filtering in the Frequency Domain

Butterworth filters can be defined as:

(a) Butterworth low-pass filter: $H(u,v) = \dfrac{1}{1 + \left(\frac{(D(u,v)}{D_0}\right)^{2n}}$

(b) Butterworth high-pass filter: $H(u,v) = 1 - \dfrac{1}{1 + \left(\frac{(D(u,v)}{D_0}\right)^{2n}}$

where D_0 is the so-called cut-off frequency distance.
$D(u,v) = \sqrt{\left(u - M/2\right)^2 + \left(v - N/2\right)^2}$ with $M \times N$ is the size of the image.

Use the given Butterworth low-pass filter (BWLPfilter.m) Choose $D_0 = 2, n = 2$ order and filter the image cameraman.tif with both (a) and (b) filters. Show images of the filters and the final filtered images.