

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:
$$H(u, v) = \frac{1}{1 + \left(\frac{D(u, v)}{D_0}\right)^{2n}}$$

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

where D_0 is the so-called cut-off frequency distance.

$D(u, v) = \sqrt{(u - M/2)^2 + (v - N/2)^2}$ 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.