TEL 519E – Homework 1

Due 21.10.2010

The images used below may be downloaded from '`http://web.itu.edu.tr/ibayram/Courses/TEL519E/`'. Please do not use any toolbox of MATLAB.

1. Show that the frequency response of a separable system is a separable function, i.e., if

$$h(n_1, n_2) = g(n_1)\, f(n_2),$$

then

$$H(\omega_1, \omega_2) = G(\omega_1)\, F(\omega_2),$$

where

$$G(\omega) = \sum_{n \in \mathbb{Z}} g(n)\, e^{-j\omega n},$$
$$F(\omega) = \sum_{n \in \mathbb{Z}} f(n)\, e^{-j\omega n}.$$

2. Implement in Matlab the contrast strecthing operation. Experiment, using different values of $\{x_1, x_2, y_1, y_2\}$, on the image '`pollen.tif`'.

3. Write a Matlab function that does histogram equalization. You may assume that the input images have 8-bit intensity resolution. Apply the function on '`moon.tif`'. Plot the input and output histograms (using `hist`).

4. Implement your own function that does 2D convolution (without using `conv` or `conv2`). Convolve the image '`barbara.png`' with one of the filters shown in the slides and observe the output. Using the same filter, repeat the same convolution using the `conv2` command of Matlab. There should be no difference between the two outputs.

5. (a) Convolve '`man.tif`' with the filter `[1 0 -1]`. Then convolve the output with `[1; 1; 1]`. What do you observe?
   (b) Convolve '`man.tif`' with the filter `[1; 1; 1]`. Then convolve the output with `[1 0 -1]`. What do you observe?
   (c) Is there a difference between the output images from part (a) and (b) (look at the difference image)? Explain why there is (or there is no) difference.

6. (a) Convolve '`man.tif`' with the filter '`ones(1,7)`'. Comment on the output.
   (b) Convolve '`man.tif`' with the filter '`ones(7,1)`'. Comment on the output.