Laboratorio di Elaborazione di Bioimmagini

Homework 1 – 30 Marzo 2012

Homework due by Wednesday, April 11th 2012. Please upload the archive (.zip or .rar) in the dedicated Repository Homework 1 folder located in Area Consegna, CorsiOnLine. Also, please read the How to file in the Homework section. Questions can be posted on the Forum section available on CorsiOnLine.

In case of troubles, please mail enrico.caiani@biomed.polimi.it and francesco.maffessanti@mail.poli

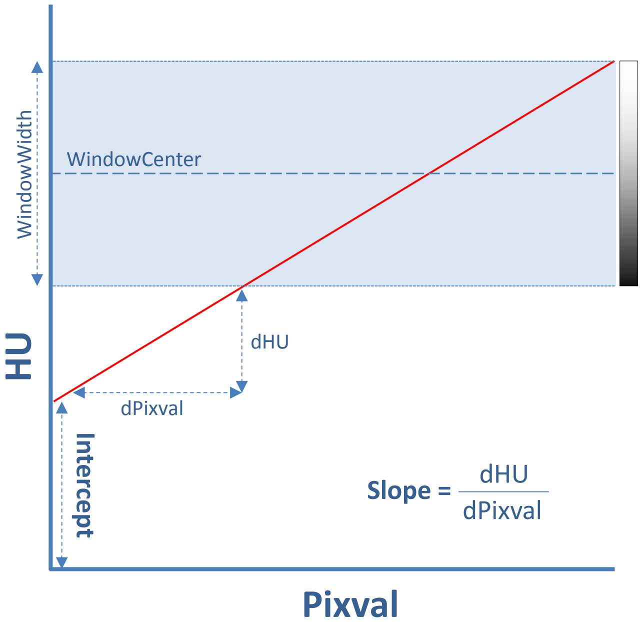
Exercise 1

The archive *CT.rar*, available with the homework, contains a series of cardiac CT images stored in the DICOM format. After unzipping the archive, the student should write a Matlab script able to:

a) let the user choose the directory containing the CT slices, using **uigetdir**(), and load the images in the workspace;
b) visualize the CT slices, in group of 16, in 3 separate figures using **montage**();
c) visualize the sequence of 48 images in the same figure, with a temporal lag of 0.5 sec between two subsequent slices, using **pause**();
d) save all the slices in a multilayer TIFF file, giving the user the opportunity to choose the name and the location of the output file.

NOTES

- CT values are commonly expressed using the Hounsfield (HU) scale, a quantitative scale for describing radiointensity, but stored in the DICOM file in a different format (pixval). The DICOM tags RescaleSlope and RescaleIntercept describe the linear transformation to decode HU from pixvals. Moreover, the tags WindowCenter and WindowWidth describe the center and the width of the grayscale that allows the best visualization.



- in order to save a multilayer TIFF file, the option ‘append’ should be used when saving the image (see the Matlab Help for more details).

Exercise 2

Load the images *coro.bmp* and *coro_mod.bmp*, available with the homework. The latter image has been created by transforming the histogram of *coro.bmp* using the command **imadjust**() with gamma=1. The student is expected to:

a) find an estimate (the best possible!) of the parameters utilized in **imadjust**();
b) verify the goodness of the estimated parameters, by applying them to the original image *coro.bmp* and then arithmetically comparing the resulting image to *coro_mod.bmp*;
c) visualize the transfer function between coro.bmp and coro_mod.bmp on the basis of the estimated parameters.

A brief report is expected (no code, please).

Exercise 3

Load the RGB image peppers.png, available in Matlab. The student should write the code able to:

a) visualize the loaded image;
b) convert the RGB colorspace into the HSV colorspace, visualizing the three components H, S and V in three separate figures using the adequate colormaps (ad hoc colormaps may be created);
c) normalize the RGB space and visualize the obtained image. In order to normalize a RGB image, each channel of each pixel has to be normalized by the intensity amplitude of the pixel itself. For instance, the normalized value p_n relevant to the R channel of the original pixel p, located in (i,j) is given by:

$$p_n(i,j,R) = \frac{p(i,j,R)}{\sqrt{p(i,j,R)^2 + p(i,j,G)^2 + p(i,j,B)^2}}$$

a) what is the effect of RGB normalization?

Exercise 4

Given the file *es4_300312.pdf*, please match each image (1-12) with its amplitude spectrum (A-L).

Exercise 5 (Optional)

The dataset hippocampal_neuron.tiff, available with the homework, is a 16 bit multilayer tiff file containing 5 microscope scanning of the same substrate. The student is expected to write the code able to:

a) visualize the first three layers, relevant to different fluorescence substances, as if they were RGB channels, by creating the adequate colormaps (layer 1 – R, layer 2- G, layer 3 – B). Being the original image a 16 bit image, each channel should be first suitably converted in the double format, and then the histogram of each channel should be adjusted using **imadjust**(), with a saturation equal to 1%.
a) overimpose the information relevant to the brightest spots in channel 4 to channel 5. To do that, channel 4 should be binarized (using an empirical threshold) to extract the hottest spots. The selected spots should be visualized using a hot colormap. The figure shows an example of an expected result