IPA 2017 Lab Exercise 1 (15 Points)

Exercise due: 20th of October 2017, 23:59

1 How to submit your report

Read carefully this document. Ask if you are unsure what to do, otherwise use common sense to solve the problems.

You should make the report of the exercise available as a PDF document. The hand-in for this laboratory exercises is done by using Moodle before the deadline (see http://vda.univie.ac.at/Teaching/IPA/17w/grading.html for more information.) containing:

- As attachments (.7z or .zip): the PDF document and ALL the MATLAB/JAVA/C++ code necessary to RUN your solution (including your chosen images, and an instruction file how to run your code, like a readme.txt and/or makefile). Please write (a lot of) comments in your source code, it is necessary.

You can discuss the results and solutions, **but you have to submit your own work**. **Warning! Plagiarism will not be tolerated.**

The PDF should include in the document your results and most importantly, a discussion of the results. Be careful: If the attached code does NOT run, we will reject your exercise completely. It is NOT necessary to include a copy of all the code in the PDF document, although key parts if you think are necessary to explain a point can be included.

Please follow the instructions. For this assignment you should not use any predefined image processing routines, except for the I/O functions, if not otherwise stated.

2 Image Transformations (3 points)

Write functions to do each of the following to an input grayscale image of 'Lena':

1. map a grayscale image to its 'negative image', in which the lightest values appear dark and vice versa.
2. map the image to its 'mirror image', i.e., flipping it left to right.
3. add or subtract a random value between `[0,255]` to every pixel in a grayscale image, then clip the resulting image to have a minimum value of 0 and a maximum value of 255.

4. (2 points) take the Lena image and break it into 16×16 non overlapping blocks. For each of the block compute the histogram (you are allowed to use a predefined function, hint for MATLAB user: command to be found by `help hist`) and visualize them in a 16 by 16 grid (it should fit in a page). How would you compute the histograms if the image would have been in color? Are histograms invariant to translation, rotation and scale? For each of the blocks compute the mean value and show the image of size 16×16 pixels produced (low resolution image). What can you say about the resulted image? Try to define a threshold `t` that will segment the face of the woman. Were you successful, if not why? Show some results.

Figure 1: Gray value image.

3 Canny Edge Detector (12 points)

For this assignment you should implement Canny's edge detection algorithm as described in the class. Your implementation should take as input a grayscale image and the edge detection parameters. These are the σ for the gaussian convolution and the gradient magnitude thresholds. The output should be a binary image.

You should implement gaussian convolution as a sequence of horizontal and vertical convolutions (separability of the filter).

The output of should NOT have fat edges! You should implement the hysteresis mechanism that uses two thresholds. Your implementation of hysteresis should be efficient. You should submit what each part of your code does, and a comparison of the results with the already existing implementation. Show some results and discuss the effects of parameters. Please write a lot of comments in the source code, explaining what is going on.