BME42-731/ ECE18-795/CB02-740 Bioimage Informatics

Spring 2012
Project Assignment #1

Assigned on Jan-30-2012
Due on Feb-10-2012 by 5PM at TA's office

A. Overview

The main objective of this project assignment is to introduce several basic operations in image analysis. Students with previous experience with these operations are encouraged to complete the extra credit question.

NOTE: Each student should complete this assignment individually.

It is recommended that you download and install a copy of IrfanView or ImageJ for viewing images used for this project.

B. Questions

Question 1 (20 points): Demonstration
Read Chapters 1-3 of the MATLAB Image Processing Toolbox 7 User Guide. Go through the two examples in Chapter 1. Collect all the MATLAB code for each example into a single file. Turn in the two files as part of your assignment. Feel free to copy and paste. But mae sure that your files can reproduce the results.

Instructions regarding how to turn in your code will be given in class.

Question 2 (20 points): Input/output of a static greyscale image
2.0 Download the first (out of four) image from JCB ImageViewer

S. Matsumoto, M. Hayano, Y. Kanoh, H. Masai, *Multiple pathways can bypass the essential role of fission yeast Hsk1 kinase in DNA replication initiation*, Journal of Cell Biology, 195:387-401, 2011.

2.1 Read the image into MATLAB. Write your own function to plot its intensity histogram.

2.2 Interactively define a rectangular region of interest (ROI). Crop the image within the ROI and save the cropped image in a non-compressed TIF format (feel free to choose a name for the saved image).

Question 3 (20 points): Input/output of a static color image
3.0 Download the last image of Figure 2 from JCB ImageViewer for the following paper

M. Baez, L. Luchelli, D. Maschi, M. Habif, M. Pascual, M. Thomas, G. Boccaccio, *Smaug1 mRNA-silencing foci respond to NMDA and modulate synapse formation,* Journal of Cell Biology 195:1141-1157, 2011.

The download image will be in multi-frame TIFF format. To read it effectively, you may find the following article useful.
http://blogs.mathworks.com/steve/2009/04/02/matlab-r2009a-imread-and-multipage-tiffs/

3.1 Read the color image into MATLAB. Display all of its channels separately. Plot the intensity histogram for each channel.

3.2 Interactively define a rectangular region of interest (ROI). Crop the image within the ROI and save the cropped image in a non-compressed TIF format (feel free to choose a name for the saved image).

Question 4 (20 points): Manipulation of an image sequence

4.0. Download the image sequence from the class website. First, go to http://www.andrew.cmu.edu/course/42-731/index.html. Then, click on "Assignments" on the left panel. You will see the download link.

If you have not done so, download and install a copy of imageJ.

4.1 Import the image sequence into ImageJ. Generate an AVI file. Make sure that the AVI file plays in at least one of the video players (Apple Quicktime or Microsoft Media Player).

4.2 Interactive define a rectangular region of interest. Crop the image sequence in that region and write out the sequence in individual non-compressed TIF files. Generate an AVI as in 4.1.

Question 5 (20 points): Implementation of a Gaussian filter

Implement a Gaussian filter with its variance σ as a user defined variable. Be sure to normalize it. Apply Gaussian filter with σ=1, 2, 5, 7 to the image in Question 2. Briefly compare the result images at these variance levels.

Question 6 (20 points): Calculate image intensity derivatives

Use the image from Question2. Following what is introduced in the lecture, calculate the derivative in the horizontal and vertical direction. Display the derivative images.

Question 7 (extra credit 20 points): Implementation of a directional anisotropic filter

Implement the anisotropic Gaussian filter as described in the following paper (only the non-iterative form).

J.-M. Geusebroek, A. W. M. Smeulders, and J. van de Weijer, Fast anisotropic Gaussian filtering, *IEEE Trans. Image Processing*, vol. 12, no. 8, pp. 938-943, 2003.

C. Instructions on preparing your report

1) Organize your report based on the sequence of questions. Whenever possible, present your results for each question into the report, and briefly explain and/or comment on your results.

2) Your MATLAB code should be reasonably formatted and commented for ease of reading and grading.

3) Submit all relevant images and videos generated for this assignment.

D. Report format

There is no page limit for the project assignment report.

Page size: letter
Line space: single
Page margins: 1 inch on each side (top, bottom, left, right)
Font size: 12 points font for the main text; 10 points for listed references