INTRODUCTION TO DIGITAL IMAGE PROCESSING

ASSIGNMENT 3

Due date: Thursday, November 2, 2017 by 5 pm
Total marks: 5
Late penalty: 0.5 marks per day overdue. Late assignments will not be accepted after 5 pm of Monday, November 6, 2017, and a mark of zero will be given.

All assignments will be done in **groups** of 3-4, and the same final mark for the assignment will be assigned to all group members. For convenience, we prefer if you keep the same group as for previous assignments. However, if you wish to change groups, please send Prof. Ladak an e-mail (hladak@uwo.ca) indicating which group you are currently part of and which group you wish to change to. Instructions for checking your current group membership are given in Appendix A.

Instructions for submitting answers are given in the section titled "Submission". Note that I am asking you to write an informal report this time instead of filling in textboxes; see section titled "Report". Once one member submits an assignment, it is closed for resubmission by the group, so all group members should agree to submit before actually submitting online.

CONVENTIONS

Fixed-point font (`Courier`) is used to denote MATLAB commands, variables and filenames.

OBJECTIVES

1. To use an implementation of the background removal function discussed in class.
2. To automate the background removal function discussed in class.

PROBLEMS

1. **(a) [0.5 marks]** A MATLAB function implementing the background removal code that is based on our discussion in class is on the course OWL site in the folder **Lectures**. It is called `level.m`. Apply this function to the image `'rice.png'` that is available as part of the MATLAB image processing toolbox. In your report, include a printout of the levelled image (i.e., image with background removed). What did you estimate the coefficients a_i, i = 0, 1,…,5, to be? Would you expect these to be identical to what other groups found? Explain your answer.

   (b) [**0.5 marks]** Using the '`plot`' command, plot a vertical profile through column 50 of the original unlevelled image as a dashed curve. On the **same** axis, plot a vertical profile through column 50 of the levelled image as a solid curve. You may need to use the help facility in MATLAB to learn more about the `plot` command, including how to specify line types (dashed or solid) and how to plot on the same axis. Include this plot in your report, and explain whether or not the function `level` is working correctly.

2. In the `level` function, the user is asked to interactively select points in the background of the image to be levelled. In order to find background pixels *automatically*, one can break the image up into M x N non-overlapping blocks as discussed in class and find the minimum value and its coordinates in each block. The minimum value in each block and its coordinates can be used as background pixels. Modify the `level` function so that background pixels are found automatically, and no user interaction is required. You will have to select appropriate values of M and N, and these can be

hardwired into your code. The modified function should display the original (unlevelled) image with selected points superimposed. The `autolevel` function should have the header:

```
function [im2, a] = autolevel_#(fname)
```

where # is your group number. For instance, if you are part of group 1, your function name would be `autolevel_1`. If you are part of group 50, your function name would be `autolevel_50`.

HINTS:

(i) To find the minimum value in a sub-matrix extracted from an image, you can apply the MATLAB function `min` twice. Part of the exercise is for you to figure this out.

(ii) To plot points on top of a displayed image, you should use the `hold` function as follows:

```
imshow(im)
hold on
plot(x, y, 'y+')
```

(a) [3.5 marks] Save the function in a file called `autolevel_#.m`. Again, # is your group number. For instance, if you are part of group 1, your filename would be `autolevel_1.m`. If you are part of group 50, your filename would be `autolevel_50.m`. **NOTE: Use the exact filename and function name as specified above. All letters are in lowercase. Your function should be commented.**

(b) [0.5 marks] In your report, include a plot of the original image and the points automatically selected by your function. Also include a plot of the levelled image. What values of *M* and *N* did you use? Explain your rationale for using the particular values of *M* and *N*.

REPORT

Type up a report in MS Word. On the front page of your report, list the names of group members as they appear with the registrar (i.e., no nicknames) and also list student numbers. Your report should include printouts of any figures and answers to Questions 1(a), 1(b) and 2(b). Please keep the report short, i.e., answer the questions, but don't provide extraneous information.

SUBMISSION

Each group should only make one submission.

Your report and function must be submitted using OWL using the following instructions:

1. One group member should log into OWL and select "ECE 4445A 001 FW17".
2. From the left-hand side, select "Assignments".
3. From the page that comes up, select "Assignment 3".
4. You will now reach the submission page for Assignment 3.
5. Scroll to the bottom of the submission page, and attach your report and your M-file for Question 2(a).

MATLAB RESOURCES

All MATLAB guides can be found at:

http://www.mathworks.com/access/helpdesk/help/helpdesk.shtml

For information on the image processing toolbox, select the link labelled "Image Processing Toolbox".

APPENDIX

1. Log onto OWL and click on Site Info on the left-hand side when you are on the course site.

2. Click Groups you are a member of**.** The Assignment Group you are a member will come up.