

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

Spring 2016

## Project Assignment #1

Assigned on Jan-25-2016

*Due on Feb-08-2016 in class or by 5PM at TA's office*

### A. Overview

This assignment reviews some basic operations in image analysis and computer vision, such as reading/writing of an image, displaying an image, calculating the intensity histogram of an image, and defining a region-of-interest, and image feature detection.

NOTE: Each student is required to complete this assignment individually.

Please install a copy of ImageJ for viewing images for this project. You may also find it useful to install a copy of IrfanView or comparable image viewer software that can handle 16-bit images.

For this assignment, we will use MATLAB 2015a or 2015b. Earlier versions may work as well. The total score for this assignment is 100 points.

### B. Questions

#### **Question 1 (40 points): Basic concepts of image analysis and computer vision**

**Part I:** Read Chapters 1-3 of the MATLAB Image Processing Toolbox 7 (or a newer version) User Guide. A PDF copy can be downloaded from Blackboard.

Go through the two examples in Chapter 1. Collect and run all the MATLAB code for each example into a single program. Submit the two programs as part of your assignment. Feel free to copy and paste. But make sure that your files can fully reproduce the results. See Section D for instructions on submitting your code.

**Part II:** Reading the following six examples in Chapter 1 of the MATLAB Computer Vision Systems Toolbox User Guide. A PDF copy can be downloaded from Blackboard. Run the code for these examples, and collect and submit the code as in Part I:

- *Detect SURF Interest Points in a Grayscale Image*
- *Using LBP Features to Differentiate Images by Texture*
- *Extract and Plot HOG Features*
- *Find Edges In An Image*
- *Enhance Image Quality Using Contrast Adjuster*
- *Find Vertical and Horizontal Edges in Image*

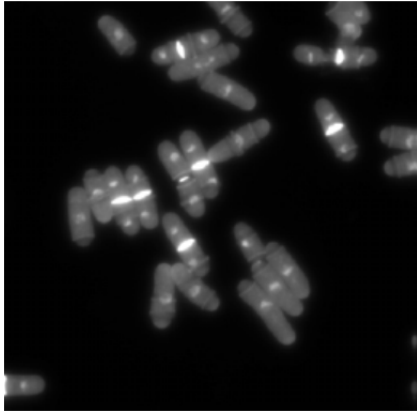
#### **Question 2 (20 points): Input/output of a static greyscale image**

**2.0** Download all the images from the following paper 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.

HINT: to find the mages, go to JCB DataViewer at <http://jcb-dataviewer.rupress.org/>. Then, type in “matsumoto” in the dialog box under “Search Images”. You can find the paper and its images from the search results.

Choose the one named “33705-WT yeast.ome.tiff” (as shown below), and rename it to something such as “image01.tiff” so that MATLAB can read it without problems.

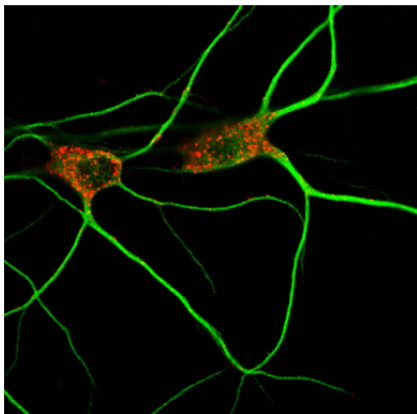


**2.1** Read the image into MATLAB by using command *imread*. Write a MATLAB program to plot its intensity histogram. **Please do NOT use the *imhist* function. Instead, please write your own image intensity histogram code. You will need to call MATLAB function *hist*.**

**2.2** Write a MATLAB program to interactively (manually) draw a rectangular region of interest (ROI) by calling MATLAB commend *imrect* or *getrect*. Crop the image within the ROI and save the cropped image in a non-compressed TIF format (please feel free to assign a name for the saved image).

### **Question 3 (20 points): Input/output of a static color image**

**3.0** Download the first image of Figure 2 (as shown below) from JCB ImageViewer for the following paper and rename to a name accessible to MATLAB.



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.

HINT: Similar to Question 2, you can find this image by searching using “baez” as the key word.

The download image will be in multi-frame TIFF format. To read it correctly, 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 separately using the intensity histogram function you created.**

**3.2** Interactively draw 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). **Save each channel separately.**

Now that you know how to read multi-frame TIFF images, check how many channels are there in the image downloaded for Question 2. **No need to redo Question 2.**

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

**4.0** Download the image sequence from BLACKBOARD. 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 using command *imrect* or *getrect*. Crop the image sequence in that region and write out the sequence in **individually numbered non-compressed TIF files (such as image001.tif, image002.tif, and so on).** Generate an AVI as in 4.1.

#### **C. Instructions on report writing**

1) Write a project report following the format listed below. Submit the report in hard copy.

The report should include the following sections:

- *Project number and title, student name, date of submission*
- *Introduction: write a general and brief summary of the project.*
- *Code execution instruction: provide clear instructions on how to run your code.*
- *Result section: present all the key results. Present these results by showing the images. This part should be organized largely following the sequence of questions. Concisely explain/comment on your results.*
- *Summary/discussion section: summarize and discuss what you have learned from this project.*
- *References: list all the references you want to cite.*

2) As a requirement for best practice in programming, your MATLAB code should be properly formatted and commented.

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

#### **D. Instructions on report submission**

- For this assignment, a shared folder will be created in BOX (cloud storage). Each student will be provided access this folder by invitation so that project report, code, and results can be uploaded.

- Package all MATLAB programs and results files (e.g. videos) into one file using any of the commonly used compression software (WinZip, WinRAR, etc). **Be sure to include your name in the file name.**

## **E. Report format**

There is no page limit for the project report.

Page size: letter

Line space: single

Page margins: 0.5 inch on each side (top, bottom, left, right)

Font size: 11 or 12 points font for the main text; 10 points for listed references