In-course assessment (ICA)

Course(s): Practical image analysis 1 [PIA1]

Overview

It is important to be able to apply the techniques & approaches taught in Practical image analysis 1 course & we feel the best way to do this is for you to try carrying out the functions & processes taught, yourselves.

This activity will help you re-enforce content taught in the lectures, by getting you to apply taught materials to real images & databases.

Aims

- To provide hands-on experience in using MATLAB for Medical image processing & analysis

Learning objectives

Upon completion of this activity you should be able to:

- Demonstrate competence carrying out basic image manipulation tasks using the MATLAB environment & the Image Processing Toolbox
- Manipulate both 2D & 3D images using MATLAB
- Register images from different modalities, using MATLAB
- Compare & contrast MATLAB scripts that perform similar or related tasks
- Demonstrate own independent learning & skills development in the programming environment

This in-course assessment has four (4) parts.

Tasks & structure

PART 1 – Intensity analysis of a MR image

You will focus on writing a simple MATLAB script to analyse image intensities. We provide the image file in the course area on Blackboard Learn.

- Write a MATLAB script to carry out the following:
    1. Read the image and display it.
    2. Calculate the intensity profile along a line that you can draw in the figure.
    3. Plot the intensity profile generated previously
    4. Display the histogram of the image
    5. Select a region in the image and crop it
    6. Display the cropped image
    7. Display the intensity distribution across the cropped region
    8. Pseudocolour the image and scale the image data to the full range of the current colourmap & show the results
- Submit your M file, your data & the plots you have generated via the Part 1 drop box
- Label the submitted files appropriately

Checklist

☐ **Submit your M file**
☐ **Submit your data**
☐ **Submit the plots you have generated**
☐ **Specify the MATLAB version & operating system used**
☐ **Cite (including license) and append any 3rd party source code you may have used**
☐ **Consolidate all sections of Part 1 into a single document**

PART 2 – 3D image manipulation & group discussion

PART 2.1 – **Image manipulation**

You will focus on running & analysing two scripts as well as adding comments to the code given in the lecture from Module 3: *Basics of 3D medical image processing*.

- Look for the two scripts In the subfolder: ..\example2\solution\ of Module 3 Lecture
    - example2_main_easy.m
    - example2_main_interesting.m
- Your tasks are to:
    - Run both M files
    - Insert comments to explain the purpose of each line of code
- Submit your M file with the line by line comments you have added
- Label the submitted files appropriately

Checklist

☐ **Submit your M file and line-by-line comments**
☐ **Specify the MATLAB version & operating system used**
☐ **Cite (including license) and append any 3rd party source code you may have used**
☐ **Consolidate Part 2.1 with Part 2.2 below into a single file**

PART 2.2 – **summary**

- Summarize in no more than 500 words the differences between the two M files
- Submit your summary via the drop box provided for this part.
- Label the submitted files appropriately

Checklist

☐ **Submit your summary**
☐ **Consolidate Part 2.2 with Part 2.1 above into a single file**

PART 2.3 – **group discussion**

- We will post your commented code in the M files & your summary, for group discussion
- Post at least two comments of no more than 300 words discussing the work submitted by others

Checklist

☐ **Post at least twice in the discussion board**
☐ **Posts should be limited to 300 words each**

PART 3 – Registration

In this part you will analyse a MATLAB example code & modify it to process given images. We will provide you with number of files for this part of the activity.

PART 3.1

- Register the three images given using the *MATLAB registration estimator app*
- MATLAB version 2015 or later is required if you prefer, or
- Modify the example *Registering multimodal MR images* from MATLAB help
- The images given are 3D brain MRs, of the same modality, at baseline & follow-up, as well as another image acquired by a different modality, at baseline
- Submit your work via the drop box provided under this part; label the submitted files appropriately

Checklist

☐ **Submit registered images**
☐ **Specify the MATLAB version & operating system used**
☐ **Consolidate Part 3.1 with Part 3.2 below into a single document**

PART 3.2

- Write no more than 300 words explaining your choice of tool: *MATLAB registration estimator app* vs modifying the relevant MATLAB help example

Checklist

☐ **Submit your explanatory summary**
☐ **Limit your summary to 300 words maximum**
☐ **Consolidate Part 3.1 with Part 3.2 above into a single document**

PART 4 – GUI creation

PART 4.1

In this part you create a Graphical User Interface (GUI) that integrates all the previous ICA parts.

- Create a Graphical User interface that allows to:
  1. Read different types of images
  2. Perform different types of intensity analyses on these images.
     For the analyses select elements from the previous ICA parts & from the lecture activities
  3. Correct background intensity inhomogeneities or prepare the image for registration by:
     - Selecting a region of interest (i.e. cropping)
     - Resizing
     - Rotating / flipping
- Submit your work via the drop box provided under this part.
- Please label the submitted files appropriately.

Checklist

☐ **Submit your GUI**
☐ **Specify the MATLAB version & operating system used**
☐ **Cite (including license) & append any 3rd party source code you may have used**
☐ **Consolidate all sections of Part 4.1 into a single document**

PART 4.2

We will share the GUI you have designed & submitted with your peers.

- Launch & run this GUI, focusing on the user's as opposed to the developer's point of view
  - How intuitive & user-friendly is it?
  - Please reflect on its usability & suggest any improvements that might come to mind
    - Share your thoughts in the discussion board with a post of no more than 500 words
- Have another look at the code from the developer's point of view.
  - Are there any improvements you could suggest in terms of usability or any potential code optimisation?
  - Share your thoughts in the discussion board with a post of no more than 500 words

Checklist

☐ **Submit one post from the user's point of view**
☐ **Submit one post from the developer's point of view**
☐ **Limit each submission to 500 words each**

Marking & assessment criteria

- This learning activity comprises 100% of your overall course mark
- Each of the four (4) parts is weighted differently
- Marking criteria & weightings are below:

PART	ASSESSED COMPONENT	% GRADE	DURATION & MARKING CRITERIA
PART 1			**Duration: 5 weeks**
	Intensity analysis	14%	10% for each of the following: • Read & display the image • Use the correct function (5%) • For each result (5%) • Display the intensity profile along a line • Plot the intensity profile • Display the image histogram • Select a region in a 2D image • Crop your selection • Display the intensity distribution of a 2D image • Pseudocolour a 2D greyscale image • Scale image data to full range of current colourmap • Display image processing steps results
PART 1 total		**14%**	
PART 2	3D image manipulation		**Duration: 4 weeks**
PART 2.1	Running & commenting scripts	9%	• Run both M files using breakpoints or the key functions F10 & F11 (20% - 10% for each) • Explain correctly the purpose of each line of code (40% - 20% for each) • Add your comments correctly to each script (40% - 20% for each)
PART 2.2	Summary	5%	*Handbook Supplement 01 Written submissions*
PART 2.3	Peer review	7%	*Handbook Supplement 01 Written submissions*
PART 2 total		**21%**	
PART 3	Registration		**Duration: 2 weeks**
PART 3.1	**EITHER** **• Use the *Registration Estimator App*.** **OR** **• Choose to modify an existing example.**	11%	**Registration Estimator App:** • Load images into the Registration Estimator App (33%) • Obtain the initial registration estimate (16.6%) • Refine the registration settings (16.6%) • Export the registration results (33%) **Modify an existing example:** • Load the images (33%) • Set-up initial registration (16.6%) • Get geometric transformation right (16.6%) • Apply transformation estimate; move image correctly [display (16.6%); save results (16.6%)]
PART 3.2	Summary	4%	*Handbook Supplement 01 Written submissions*
PART 3 total		**15%**	

PART 4	GUI		**Duration: 4 weeks**
PART 4.1	Creation	36%	• Read different types of images (10%) • Perform >2 types of intensity analyses (30%) • Correct background intensity inhomogeneities or prepare selected image for registration (20%) • Make the GUI correctly (40%)
PART 4.2	Discussion	14%	*Handbook Supplement 02 Peer review*
PART 4 total		**50%**	
Overall total		**100%**	