Edinburgh Imaging
www.ed.ac.uk/edinburgh-imaging

Course: Practical Image Analysis 1

Semester 1 / Autumn   **10 Credits**

Each Course is composed of Modules & Activities.

Modules:

Introduction to Matlab	IMSc
Medical Image processing basics	IMSc
3D Medical Image processing basics	IMSc
Pre-processing medical images - registration	IMSc
Inhomogeneity correction	IMSc

Each Module is composed of Lectures, Reading Lists & Discussion Boards.

These Modules are taught on the following Programmes, or are incorporated into blended Courses which teach students enrolled outwith the Edinburgh Imaging Academy:

- IMSc - Imaging programme

Course: Biomechanics

Modules include:

Introduction to Matlab:
Practical medical image processing with MATLAB - basics
Basic processing with MATLAB - graph plots
MATLAB pipeline processing & interaction with Excel
Development of Graphic Unit Interfaces (GUIs)

Medical image processing basics
2D medical image analysis
3D medical image analysis

3D Medical image processing basics
ROI / VOI analysis

Pre-processing medical images - registration
Brain MR pre-processing & registration
Multimodality registration using MATLAB

Inhomogeneity correction
Bias field correction

Introduction to MATLAB:

Lecture 1
Title: Practical medical image processing with MATLAB - basics
Description: Scripts & functions, plots, interaction with Excel & text files, & GUIs
Author(s): Maria del C. Valdés Hernández
Learning Objectives
- State the background & history of MATLAB
- Outline the uses of MATLAB
- List key elements of MATLAB,including variables and operators
- Explain vectors and matrices
- Know basics of loading and saving in MATLAB
- Know MATLAB is a programming language
- Define scripts and functions

Lecture 2
Title: Basic processing with MATLAB - graph plots
Description: Overview of different types of plots commonly used in clinical research data analyses
Author(s): Maria del C. Valdés Hernández
Learning Objectives
- Describe various graphs generated using MATLAB
- Explain common plot arguments in MATLAB
- Describe how to generate graphs in MATLAB

Lecture 3
Title: MATLAB pipeline processing & interaction with Excel
Description: Functions for concatenating sequential tasks & interaction with Microsoft Excel
Author(s): Andreas Glatz
Learning Objectives
- Construct MATLAB functions & understand their benefits in daily routine tasks
- Read & write (simple) MS Excel sheets with MATLAB
- Concatenate functions to a pipeline

Lecture 4
Title: Development of Graphic Unit Interfaces (GUIs)
Description: How to build a MATLAB GUI
Author(s): Maria del C. Valdés Hernández
Learning Objectives
- Define Graphic Unit Interface (GUI)
- Explain how to generate a GUI in MATLAB
- Describe the elements of a GUI
- Add functionality to GUI elements in MATLAB
- Explain how a GUI script is constructed
- Explain how a GUI script works

Medical image processing basics:

Lecture 1
Title: 2D medical image analysis
Description: Reading, writing & manipulating intensity levels of 2D medical image data
Author(s): Maria del C. Valdés Hernández
Learning Objectives

- Read, display & save 2D images in MATLAB
- Manipulate large 2D image data
- Convert the different types of 2D images
- Describe MATLAB functions used to enhance image contrast & filter image intensities in 2D

Lecture 2
Title: 3D medical image analysis
Description: Reading, manipulating & saving 3D images; medical image formats
Author(s): Maria del C. Valdés Hernández
Learning Objectives

- Define 3D medical image formats
- List commonalities & differences between various 3D medical image formats
- Explain how to read & write 3D medical images
- Manipulate 3D medical images, including reading & writing

3D Medical image processing basics:

Lecture 1
Title: ROI / VOI analysis
Description: Using MATLAB functions to analyse ROIs & VOIs
Author(s): Andreas Glatz, Maria del C. Valdés Hernández
Learning Objectives

- Explain the concepts of ROIs & VOIs
- Use MATLAB functions which obtain voxel intensity statistics for ROIs & VOIs
- Determine VOI volumes

Pre-processing medical images - registration:

Lecture 1
Title: Brain MR pre-processing & registration
Description: Image registration; analysis of a brain MR processing pipeline example using Linux shell scripts & MATLAB
Author(s): Maria del C. Valdés Hernández
Learning Objectives
- Identify & explain processes of geometric image alignment
- List types of registration & their characteristics
- List factors to consider for optimizing registration
- Interpret & reproduce example pipelines to align two MR sequences

Lecture 2
Title: Multimodality registration using MATLAB
Description: Multimodal image registration types; analysis of examples using MATLAB
Author(s): Maria del C. Valdés Hernández
Learning Objectives
- List & explain different registration principles
- Interpret & reproduce examples which allow alignment of two 2D images from different modalities using MATLAB

Inhomogeneity correction:

Lecture 1
Title: Bias field correction
Description: Pre-processing brain MR; correction of low-frequency noise; analysis of an example from brain MR processing pipelines using Linux shell scripts & MATLAB
Author(s): Maria del C. Valdés Hernández
Learning Objectives
- List & explain concepts of noise & image enhancement
- State characteristics of low-frequency noise in medical images
- Interpret & reproduce examples to correct MR images for magnetic field inhomogeneities
- Be familiar with MATLAB File Exchange