Edinburgh Imaging
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Image Analysis

Semester 2 / January   **20 Credits**

Each Course is composed of Modules & Activities.

Modules:

Digital Image Basics	NI4R	IMSc
Image Sampling and Quantisation	NI4R	IMSc
Image Perception and Morphological Operations	NI4R	IMSc
Image Transformations and Modelling Application	NI4R	IMSc
Computational modelling in medical image processing	NI4R	IMSc
Validation techniques	NI4R	IMSc
Artefacts and errors	NI4R	IMSc

Each Module is composed of Lectures, Reading Lists, MCQ self-assessments, & 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:

- NI4R - Neuroimaging for Research programme
- IMSc - Imaging programme

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Modules:

Digital Image Basics:
   Digital image basics

Image Sampling and Quantisation:
   Image processing basics – part 1

Image Perception and Morphological Operations:
   Image processing basics – part 2

Image Transformations and Modelling Application:
   Image transformations and modelling application

Computational modelling in medical image processing:
   Computational modelling in medical image processing: basics

Validation techniques:
   Validation techniques 1

Artefacts and errors:
   Artefacts and errors in image processing
   Methods to reduce the effect of artefacts in structural MRI

We can also provide a more detailed syllabus showing what lectures will be given for each module, and the learning outcomes for each module.

Digital Image Basics

Lecture 1
Title: Digital image basics
Description: Overview of how the image data is processed by computers and printers
Author(s): Dr Maria C. Valdés Hernández
Learning Objectives
- Identify the Central Processing Unit inside a computer
- Represent a decimal number in binary and hexadecimal formats
- Write the truth table of the main binary operations: using logical operators 'and', 'or' and 'not'
- Describe how the printer manages colours and how to convert a colour image from RGB to CMYK

Image Sampling and Quantisation

Lecture 1
Title: Image processing basics – part 1
Description: Introduction to sampling, quantisation and sources of noise in images
Author(s): Dr Maria C. Valdés Hernández
Learning Objectives
- Define sampling and quantisation
- For a given image type, identify the different sources of noise and describe the possible causes and their effects

Image Perception and Morphological Operations

Lecture 1
Title: Image processing basics – part 2
Description: Perception of images and morphological operations on images
Author(s): Dr Maria C. Valdés Hernández
Learning Objectives
- Discuss visual effects that can influence the perception of certain features on images
- Describe the morphological computational operations and how they are done

Image Transformations and Modelling Application

Lecture 1
Title: Image transformations and modelling application
Description: Introduction to Fourier and Laplace transforms, and the Markov chain model and their applications in imaging
Author(s): Dr Maria C. Valdés Hernández
Learning Objectives
- Explain what the Fourier Transform is and discuss some of its adaptations and applications in medical imaging
- Explain what the Laplace Transform is and discuss some of its applications in medical imaging
- Discuss the Markov chain model and mention some of its applications in medical imaging

Computational modelling in medical image processing

Lecture 1
Title: Computational modelling in medical image processing: Basics
Description: Modelling techniques used in medical image processing
Author(s): Dr Maria C. Valdés Hernández
Editor(s): Dr Andrew Farrall
Learning Objectives
- Discuss different modelling types used in medical image processing
- Explain principles of the techniques presented

Validation techniques

Lecture 1
Title: Validation techniques 1
Description: An outline of issues to be considered while evaluating papers on imaging processing techniques
Author(s): Dr Maria C. Valdés Hernández
Editor(s): Dr Andrew Farrall
Learning Objectives
- Critically evaluate the validity of the results obtained from a segmentation technique in the literature
- Analyze the results of a segmentation algorithm performed on medical images

Artefacts and errors

Lecture 1
Title: Artefacts and errors in image processing
Description: Description of the common artefacts in routine structural MRI scans
Author(s): Dr Maria C. Valdés Hernández
Editor(s): Dr Andrew Farrall
Learning Objectives
- Identify common artefacts in structural MRI scans
- Mention the nature and causes of each type of artefact
- Describe the effect of each type of artefact in common structural MRI sequences

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The author of this lecture thanks the contribution of Mrs. Gayle Barclay and Mrs. Cathy Scott, radiographers at the Brain Research Imaging Centre of Edinburgh, in proof-reading, revising and making valuable suggestions to the initial material.

Lecture 2
Title: Methods to reduce the effect of artefacts in structural MRI
Description:
Author(s): Dr Maria C. Valdés Hernández
Learning Objectives
- Identify the main post-processing methods used to reduce the effect of common artefacts in structural MRI scans
- Mention the principles upon which each technique is based
- Describe the image processing techniques applied to each type of artefact