Edinburgh Imaging
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Course: Practical Image Analysis 2

Semester 2 / Spring **10 Credits**

Each Course is composed of Modules & Activities.

Modules:

Image segmentation	AMIA	IMSc
Image description	AMIA	IMSc
Image classification	AMIA	IMSc
Large images & time series	AMIA	IMSc
Other analyses	AMIA	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 MSc / Dip / Cert programmes
AMIA - Applied medical image analysis Cert programme

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Course: Practical Image Analysis 2

Modules include:

Image segmentation
- Histogram-based thresholding segmentation
- Colour segmentation
- Image segmentation using texture - theory
- Image segmentation using texture - Practical

Image description
- Texture, intensity and location descriptors
- Ultrasound image processing

Image classification
- Counting & classifying sperm cells

Large images and time series
- Manipulation of large images
- Manipulation of time series

Other analyses
- Computational modelling - 3D shape analyses

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Image segmentation:

Lecture 1
Title: Histogram-based thresholding segmentation – part 1
Description: An illustration of histogram-based segmentation using thresholding
Author(s): Maria del C. Valdés Hernández
Learning Objectives

- Apply contrast enhancement techniques to images
- Convert colour images to grayscale images
- Threshold images using the MATLAB tool "imtool"
- Apply connected component analyses in a logical & ordered manner to refine segmentation results

Lecture 2
Title: Histogram-based thresholding segmentation - part 2
Description: An illustration of histogram-based segmentation using thresholding
Author(s): Enrico Pellegrini & Maria del C Valdés Hernández
Learning Objectives

- Apply pre-processing techniques to medical images
- Threshold images using histogram-based thresholding techniques
- Apply morphological operations of erosion, dilation, thinning & skeletonisation to binary 2D images

Lecture 3
Title: Colour segmentation
Description: How to perform colour quantisation & segmentation
Author(s): Maria del C. Valdés Hernández
Learning Objectives

- Quantise colour images
- Transform colour image spaces
- Perform simple colour segmentation on medical images

Lecture 4
Title: Image segmentation using texture
Description: Principles of & vocabulary which define image segmentation using textural characteristics, including genetic algorithms.
Author(s): Dr. Lucia Ballerini & Dr. Maria del C. Valdés Hernández
Learning Objectives

Identify steps to identify clinically relevant features in medical images
Explain the concept of active contours
Explain the concept of genetic algorithms
Identify the elements for using genetic algorithms

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Image description:

Lecture 1
Title: Texture, intensity & location
Description: Introduction of image descriptors
Author(s): Victor González-Castro & Maria del C. Valdés Hernández
Learning Objectives

- Apply a histogram-based segmentation method as a pre-processing step to extract a ROI
- List other types of image descriptors
- Use the image descriptors in a practical task
- Describe Support Vector Machines: a conventional machine-learning classification method

Lecture 2
Title: Ultrasound image processing
Description: Lymph node characterization in ultrasound, drawing upon skills in image reading, segmentation & description, established in previous lectures
Author(s): Maria del C. Valdés Hernández & Qi Zhang
Learning Objectives

- Interactively delineate an ROI in a 2D medical image
- Extract 1o statistical features from an ROI in a 2D medical image
- Extract shape features from an ROI
- Extract 2o statistics from the GLCM

Image classification:

Lecture 1
Title: Counting & classifying sperm cells
Description: Application to a real world example, of histogram-based segmentation, binary morphological operations, GLCM & the K Nearest Neighbour classifier
Author(s): Victor González-Castro & Maria del C. Valdés Hernández
Learning Objectives

- Execute histogram-based segmentation as a part, pre-processing step to extract a ROI
- Apply binary morphological operation combinations as a part, pre-processing step to extract a ROI
- Use the GLCM
- Explain the “K Nearest Neighbour” classifier: a conventional machine-learning classification method

Large images and time series:

Lecture 1

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Title: Manipulation of large images
Description: Illustrated examples on how to manipulate large & stacked images
Author(s): Maria del C. Valdés Hernández
Learning Objectives

Explain the concept of block processing
Manipulate a block-struct
Create a class in MATLAB
Explain how to use the MATLAB function “blockproc”

Lecture 2
Title: Manipulation of time series
Description: Illustration of how to manipulate time series, using worked examples
Author(s): Maria del C. Valdés Hernández
Learning Objectives

- Read image time series recorded as movies
- Manipulate movie image frames
- Read image time series stored as 4D arrays
- Insert & use dialogs in a MATLAB script
- Identify situations for using try-catch statements
- Generate a movie from processed image frames

Other analyses:

Lecture 1
Title: Computational modelling - 3D shape analyses
Description: How to generate the 3D shape of a brain structure & analyse it with respect to other imaging & clinical parameters
Author(s): Maria del C. Valdés Hernández
Learning Objectives

- Enumerate & describe different computational modelling types in medical images
- Describe how to obtain the 3D shape of a brain structure
- Characterise regional morphological variations of the hippocampi in relation to a clinical or imaging parameter
- Investigate if there be a trend or an association between shape variations on a sample