

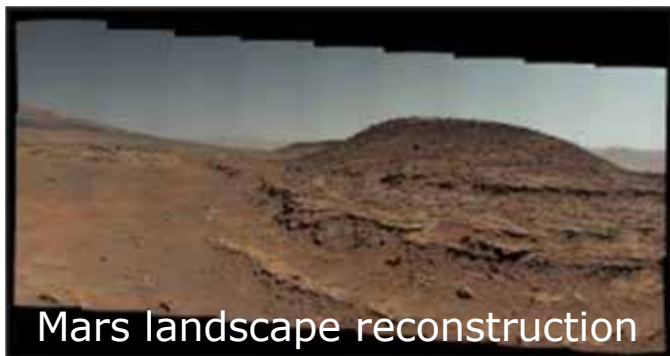
Digital image processing and analysis

Introduction

Professor Ela Claridge
School of Computer Science

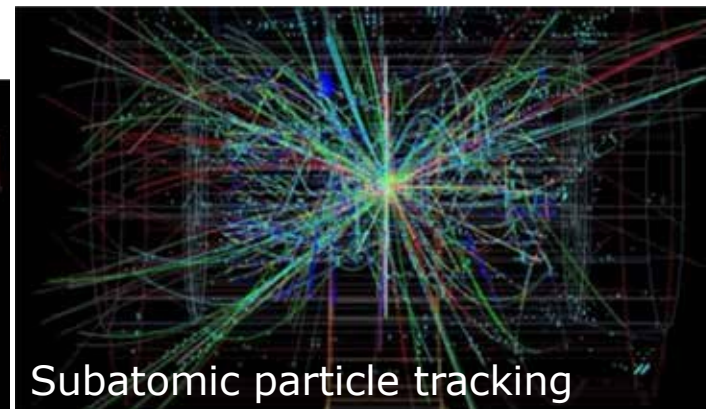
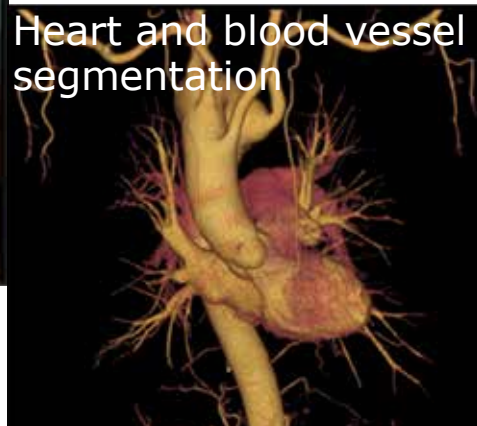


A widening horizons module

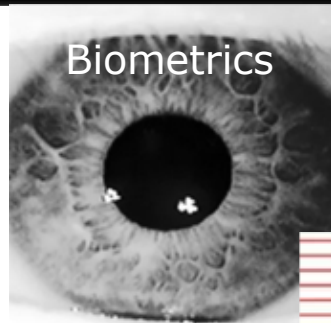


Mars landscape reconstruction

Heart and blood vessel segmentation



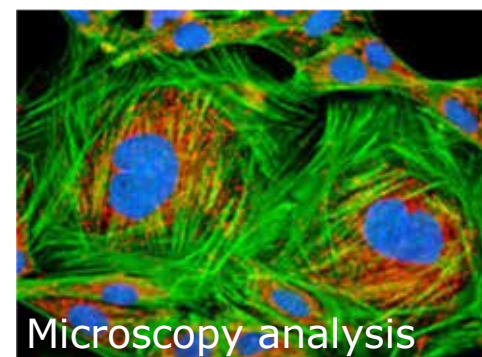
Subatomic particle tracking



Biometrics



Galaxy classification



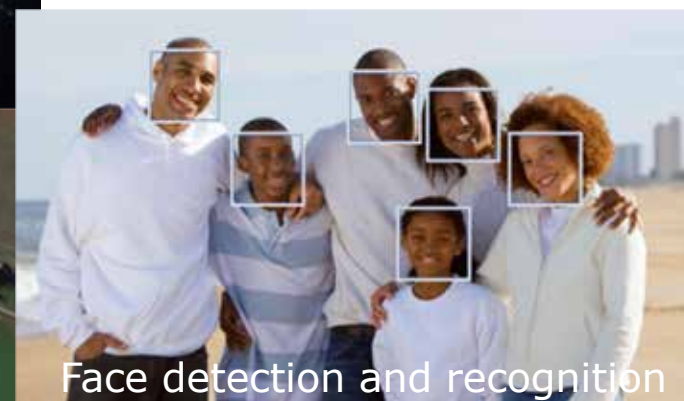
Microscopy analysis



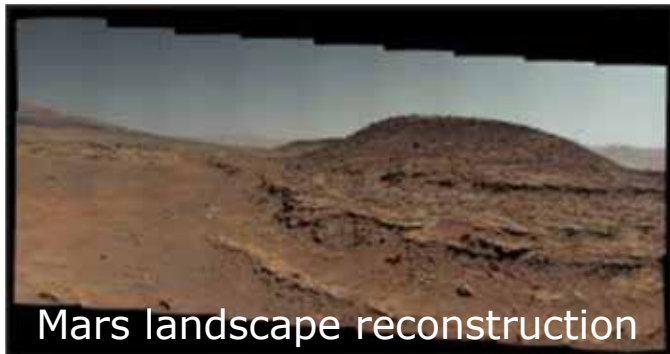
Car plate recognition



Crop health

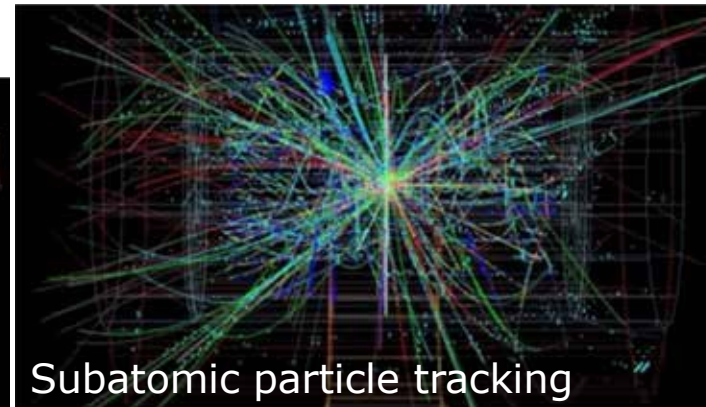
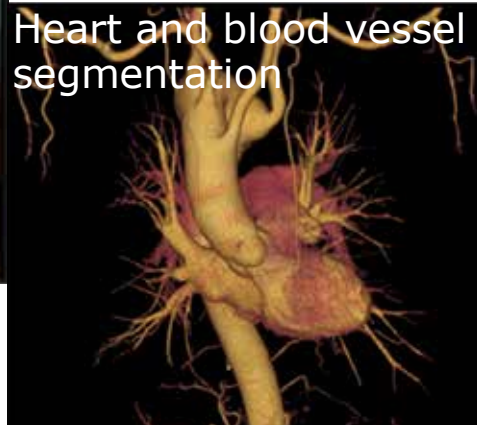


Face detection and recognition

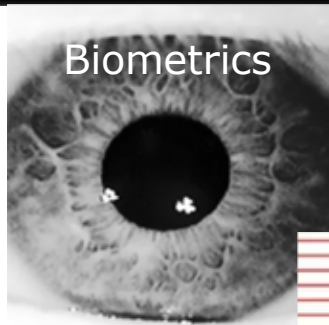


Mars landscape reconstruction

Heart and blood vessel segmentation



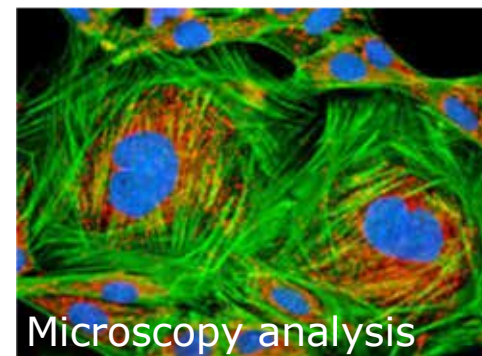
Subatomic particle tracking



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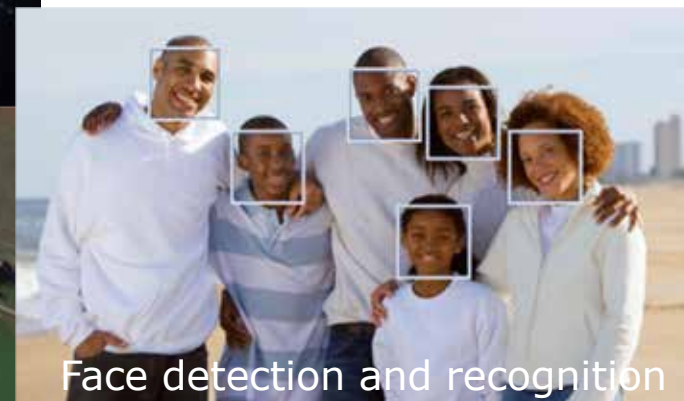
Microscopy analysis



Car plate recognition



Crop health



Face detection and recognition

In this lecture we shall find out about:

- Topics covered in the module
- Learning outcomes
- Material delivery and learning methods
- Assessment

What this module is about

- The fundamentals and practical applications of digital image processing
 - Digital images, acquisition and computer representation
 - Improving image quality
 - Object detection and description
 - Image alignment and stitching
 - Applications
 - Overview of selected advanced topics

What this module is about

- By the end of this module you should be able to
 - Describe the basic concepts of image processing and image analysis.
 - Discuss the advantages and drawbacks of different methods.
 - Make informed choices about what methods to apply to solve specific image processing problems.
 - Use image processing tools to carry out simple practical image processing tasks.

What this module is about

| What | How |
|--|---|
| Describe the basic concepts of image processing and image analysis. | Lectures, recommended reading |
| Discuss the advantages and drawbacks of different methods. | Lectures, recommended reading, unassessed exercises |
| Make informed choices about what methods to apply to solve specific image processing problems. | Lectures, demonstrations, unassessed exercises |
| Use image processing tools to carry out simple practical image processing tasks. | Demonstrations and unassessed exercises |

What this module is about

Delivery

- Lectures (no panopto recordings, sorry)
 - Weeks 1-5 & 7-11
 - Wednesday 10-11
 - Thursday 9-10
- Lab classes (demonstrations and practicals)
 - Weeks 2-5 & 7-9
 - Friday 9-10
- Exercises (theory and problem solving)
 - Weeks 2-5 & 7-9
 - Unassessed, in own time
 - Outline solutions provided one week after the submission date



Fiji (ImageJ)

What this module is about

Assessment

- MCQ (Multiple Choice Question) tests
 - 15% each
 - Via Canvas, open book, time limited (1 hr)
 - Sat in the lab
 - 6 February by 11:00 am
 - 6 March by 11:00 am
 - 20 March by 11:00 am
- Exam
 - 55%
 - Unseen
 - Normal examination period
- Reassessment
 - By examination only (i.e. quiz marks do not count)

What this module is about

Assessment

- Criteria
 - Materials from the lectures: up to 45%
 - Plus recommended further reading: up to 65%
 - Plus knowledge gained from exercises: up to 75%
 - Plus creativity: over 75%
- Recommended effort / study time
 - 200 hrs in total
 - 20 lectures
 - 8 lab classes
 - 172 work-based learning and independent study (including exam preparation)

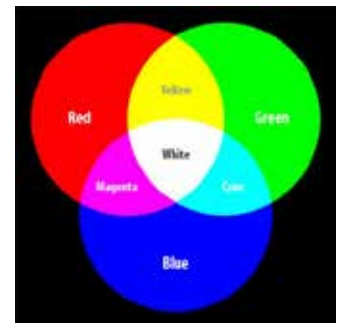
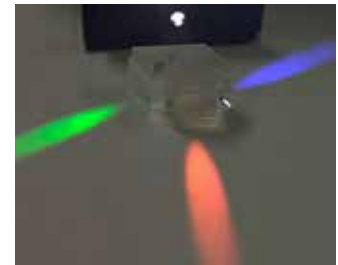
Lectures

- Visual perception and digital image acquisition
 - Basics of visual perception
 - Digital image acquisition
 - Cameras and other imaging devices
- Digital image properties
 - Digital image properties
 - Computer representation – pixels
 - Sampling – related to image coordinates
 - Quantisation – related to image values
 - ... and how they relate to image acquisition



Lectures

- Colours and their origins
 - Physical underpinnings
 - Human visual perception
- Colour images
 - Image acquisition
 - Colour spaces
- Digital representation of colour images
 - Colour mixing (vector arithmetics)
 - Pixel arrays
 - Colour models



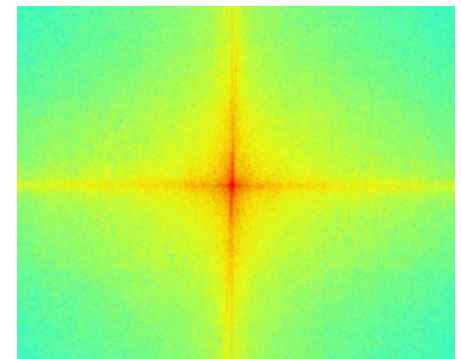
Lectures

- Image enhancement and restoration
 - Image statistics
 - Image histogram
 - Manipulating image brightness
 - Contrast enhancement
 - Colour Lookup Table operations



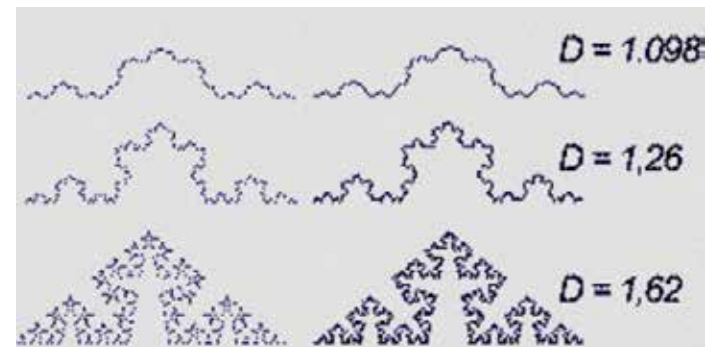
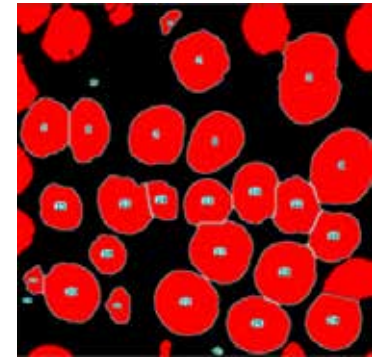
Lectures

- Image enhancement: digital filtering
 - Convolution and convolution kernel
 - Smoothing filters
 - Gradient detection filters
 - Sharpening filters
- Image enhancement: non-linear filters
 - N-th Order filtering
 - Median filter



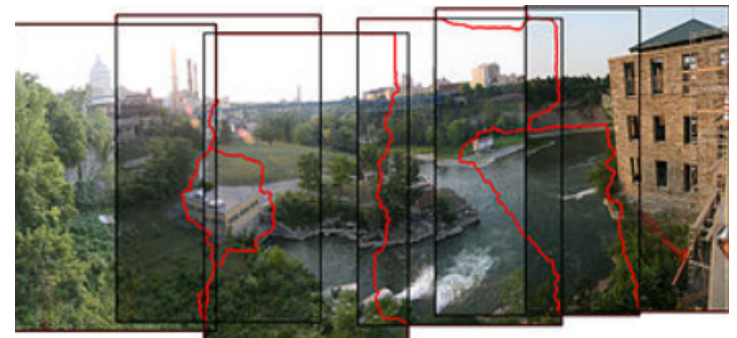
Lectures

- Object characterisation
 - Detection (segmentation)
 - Counting
 - Localisation
- Object characterisation
 - Shape
 - Texture



Lectures

- Image registration (alignment)
 - Features to match
 - Classes of transforms
 - Similarity criteria
- Image stitching
 - Features to match
 - Registration
 - Image interpolation



Lectures

- Applications
 - Medicine
 - Biology
 - Remote sensing
 - Astronomy
 - Food
 - Forensics
 - ...
- Selected advanced topics

Further reading and exploration

- On-line materials
 - Recommended (provided on lecture slides)
 - Own searches
- Books
 - Sonka, M. Hlavac, V. Boyle, R. Image Processing, Analysis and Machine Vision, Chapman & Hall Computing (various editions).
 - Gonzalez, R.C. & Woods, R.E. Digital Image Processing, Addison-Wesley (various editions).
 - Umbaugh, S.E. Computer vision and image processing : a practical approach using CVIPtools , Prentice Hall International (various editions).

Next lecture

- Image formation
 - Digital image acquisition
 - Visual perception
 - Cameras and other imaging devices
- ... and how these two compare

Contact

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Any questions?