

# **Digital image processing and analysis Overview**

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## **In this lecture we shall recall:**

- 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 representation
  - Improving image quality
  - Object detection and description
  - Applications
  - Overview of advanced topics

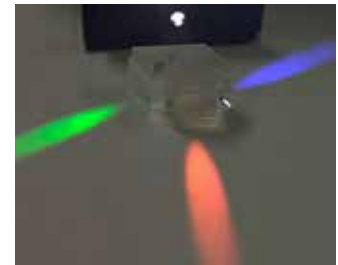
# Lectures

- 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



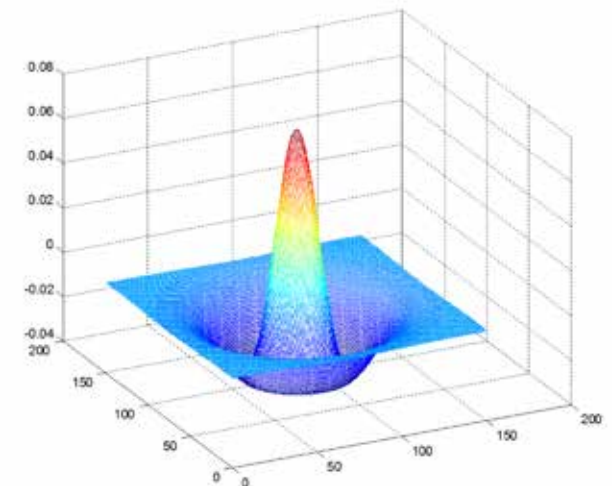
# Lectures

- Image enhancement and restoration
  - Image histogram
  - Manipulating image brightness
  - Contrast enhancement
  - LUT operations
- Image enhancement: frequency manipulation
  - Relationship between image properties and frequency properties
  - Convolution and convolution kernel
  - Smoothing (low-pass) filters



# Lectures

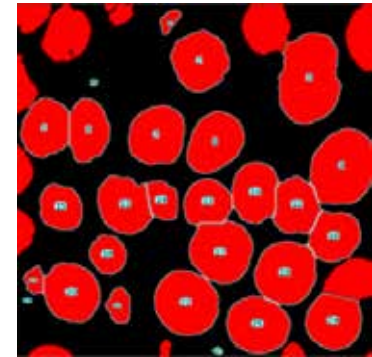
- Image enhancement: digital filtering
  - Gradient detection (high-pass) filters
  - Sharpening filters
  - Frequency filters
- Image enhancement: non-linear filters
  - Nth Order filtering
  - Median filter
  - Edge preserving smoothing



# Lectures

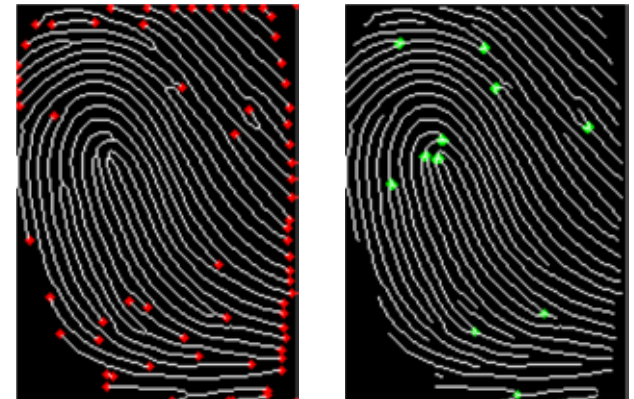
- Object characterisation

- Detection
- Counting
- Localisation



- Object characterisation

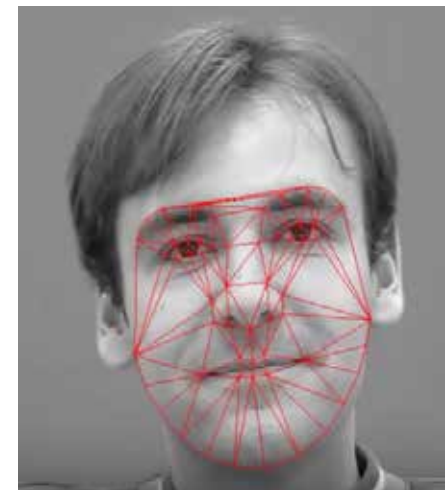
- Shape
- Texture





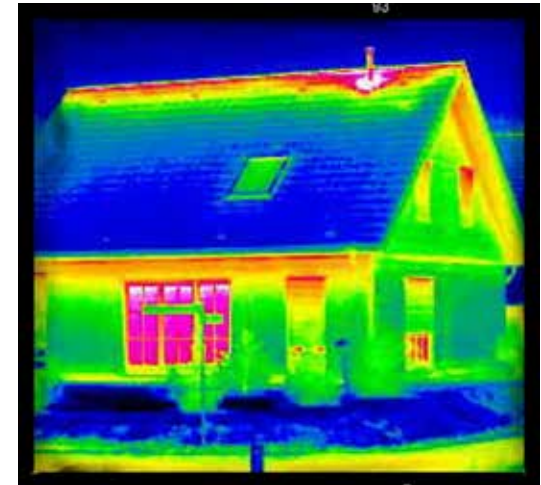
# Lectures

- Statistical shape models
  - What they are
  - What they are used for
- Principal Component Analysis (PCA)
  - What it is
  - How it is used for shape modelling
- Point distribution models
- Active shape models
- Active appearance models



# Lectures

- Multispectral imaging
  - Why colour that we see does not always tell the full story
  - General principles of multispectral imaging
  - How to acquire multispectral images
  - Analysis and applications



# Lectures and labs

- Applications
  - Medicine
  - Biology
  - Remote sensing
  - Astronomy
  - Food
  - Forensics
  - Photography
  - ...

# What you have learned

- 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 you have learned

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

# Assessment

- MCQ (Multiple Choice Question) tests
  - 15% each
  - Via Canvas, open book
  - 6 February
  - 6 March
  - 20 March
- Exam
  - 55%
  - Unseen
  - Normal examination period (29 May)
- Reassessment
  - By examination only

# Assessment

## Exam paper structure

- All questions compulsory
- Part 1
  - Short questions (ten, 4% each)
- Part 2
  - Problem solving questions (two, 30% each)

# 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, including
    - lectures
    - demonstrations
    - work-based learning and independent study (including exam preparation)



# Revision lecture

- Wednesday 1<sup>st</sup> May, 10-11
- Learning Centre room UG05.

# Any questions?