Description

Aims:
This module focuses on digital image processing. It first introduces the digital image, with a description of how digital images are captured and represented. It then goes on to cover algorithms for image characterisation, manipulation, segmentation and feature extraction in direct space. The course then proceeds to cover image filtering techniques with some indication of the role and implications of Fourier space, and more advanced characterisation and feature detection techniques such as edge and corner detection, together with multi-resolution methods, treatment of colour images, template matching and optical flow techniques. The course has a strong practical component that allows students to explore a range of practical techniques by implementing their own image processing tools using Matlab or Python.

Learning outcomes:
On successful completion of the module, a student will be able to:
1. Understand (i.e., be able to describe, analyse and reason about) how digital images are represented (in the spatial and frequency domain), manipulated, encoded and processed, with emphasis on algorithm design, implementation and performance evaluation;
2. Implement a variety of image processing algorithms including image manipulation, segmentation, filtering, blending, feature extraction and description, edge detection, template matching and image editing;

Content:
Introduction to the digital image:
- Why digital images?
- Digital image capture;
- Data types and 2D representation of digital images;

Characteristics of grey-level digital images:
- Discrete sampling model;
- Noise processes;

Find out more
For more information about the department, programmes, relevant open days and to browse other modules, visit ucl.ac.uk

Disclaimer: All information correct as of June 2019. Please note that aspects of the module may be subject to change. UCL will make best efforts to inform applicants of major changes.
-Image attributes;

Segmentation:
-Thresholding and thresholding algorithms;
-Performance evaluation and ROC analysis;
-Connected components labelling;
-Region growing and region adjacency graph (RAG);
-Split and merge algorithms;
-Clustering algorithms;
-Graph based methods;

Image transformations:
-Grey level transformations;
-Histogram equalization;
-Geometric transformations;
-Affine transformations;
-Polynomial warps;

Morphological operation:
-Erode and dilate as max and min operators on binary images;
-Open, close, thinning and other transforms;
-Medial axis transform;

Image filtering:
-Fourier analysis;
-Linear and non-linear filtering operations;
-Image convolutions;
-Separable convolutions;
-Sub-sampling and interpolation as convolution operations;

Edge and corner detection:
-Edge enhancement by differentiation;
-Effect of noise, edge detection and Canny implementation;
-Edge detector performance evaluation;
-Image structure tensor;
-Relationship to image auto-correlation;
-Characterisation and Harris corner detector;

Template matching and advanced topics:
-Similarity and dissimilarity matching metrics;

-Template matching;
-Optical flow;
-Non-local means filtering;
-Poisson image editing;

Requisites:
In order to be eligible to select this module, a student must be registered on a programme for which it is a formally-approved option or elective choice AND must have EITHER (i) passed BSc Computer Science (Years 1 and 2) at UCL; OR (ii) passed BSc Mathematics and Computer Science (Years 1 and 2) at UCL; OR (iii) passed a suitable Physical Science or Engineering degree programme with sufficient mathematical and programming content.
Image Processing (COMP0026)

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- Why digital images?
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**Key information**

**Year** 2019/20
**Credit value** 15 (150 study hours)
**Delivery** PGT L7, Campus-based
**Reading List** [View on UCL website](ucl.ac.uk)
**Tutor** Prof Lourdes De Agapito Vicente
**Term** Term 1
**Timetable** [View on UCL website](ucl.ac.uk)

**Assessment**

- Written examination (main exam period): 80%
- Coursework: 10%
- Coursework: 10%

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**Find out more**

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- Image attributes;

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- Clustering algorithms;
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Image transformations:
- Grey level transformations;
- Histogram equalization;
- Geometric transformations;
- Affine transformations;
- Polynomial warps;

Morphological operation:
- Erode and dilate as max and min operators on binary images;
- Open, close, thinning and other transforms;
- Medial axis transform;

Image filtering:
- Fourier analysis;
- Linear and non-linear filtering operations;
- Image convolutions;
- Separable convolutions;
- Sub-sampling and interpolation as convolution operations;

Edge and corner detection:
- Edge enhancement by differentiation;
- Effect of noise, edge detection and Canny implementation;
- Edge detector performance evaluation;
- Image structure tensor;
- Relationship to image auto-correlation;
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Template matching and advanced topics:
- Similarity and dissimilarity matching metrics;
- Template matching;
- Optical flow;
- Non-local means filtering;
- Poisson image editing;

Requisites:
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