CS413-15 Image and Video Analysis

20/21

Academic year
20/21
Department
Computer Science
Level
Undergraduate Level 4
Module leader
Abhir Bhalerao
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The course will enable computer science undergraduates to apply their mathematical knowledge and understanding of algorithms to problems in image and video processing: from preprocessing, to quantitation, video compression and video interpretation. The methods have numerous applications e.g. in medicine, biology, robotics (computer vision), surveillance, security, biometrics, database searching, TV and entertainment.

Module aims

The module aims to teach the fundamentals of digital image processing, image and video analysis. In particular, it will present the mathematics and algorithms that underlie image analysis techniques such as filtering, denoising, edge detection, feature detection, tracking and 3D reconstruction. It will also present how these tools are used in algorithms image and video segmentation, motion estimation, stereo reconstruction, video denoising and video analysis, object detection and recognition, and standards for video compression and communication.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Introduction to Human visual perception;
- Image sampling and quantization;
- Filtering by convolution and correlation: blurring, sharpening, edge detection;
- Colour models and contrast processing;
- Histograms and basic statistical models of images;
- Information and entropy;
- Discrete Fourier transforms and Discrete Cosine Transforms for filtering, coding, correlation and motion estimation;
- Image Pyramids for analysis and image compression;
- Image and video segmentation and texture models;
- Algorithms for boundary and region segmentation from images and video;
- Optical flow techniques for motion estimation and tracking;
- Pinhole camera models and stereo and 3D reconstruction, including the principles image stitching and augmented reality;
- Feature detection and object recognition in images;
- Neural-networks for image analysis and end-to-end learning: from fully-connected networks to convolutional neural networks;
- Programming image and video analysis methods in Python + associated libraries, OpenCV and Keras.

Learning outcomes

By the end of the module, students should be able to:

- Understand and know how to apply state-of-the-art machine learning techniques (convolutional neural networks) to solving problems in image and video analysis
- Understand and describe the fundamental principles of image and video analysis and have an idea of their application.
- Perform written communication in lab report and examination. Use specialist toolboxes in Python programming.
- Assimilate mathematical and algorithmic material on image processing fundamentals and appropriately apply and program solutions to real problems in image and video analysis.
- Critically analyse multimedia applications.

Indicative reading list

Please see Talis Aspire link for most up to date list.

View reading list on Talis Aspire

Subject specific skills

- Fundamentals of digital image processing, image and video analysis, computer vision including camera calibration, feature matching and object detection and recognition.
- Practical programming of image and video analysis, processing, machine learning for image

analysis.

Transferable skills

- Written communications skills
- Formulate and test hypothesis, experimental design, evaluation and critical analysis
- Problem solving

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Supervised practical classes	9 sessions of 2 hours (12%)
Private study	102 hours (68%)
Total	150 hours

Private study description

30 hours lectures
9 x 2hr labs = 18 hours
35 hours coursework
67 hours private study

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group D2

	Weighting	Study time
Unsupervised practical assignments	30%	
Coursework assignment		

	Weighting	Study time
2 hour examination	70%	
2 hour examination		
~Platforms - AEP		

Assessment group R

	Weighting	Study time
CS413 Examination.	100%	
CS413 resit examination		
~Platforms - AEP		

Feedback on assessment

Individual written feedback on Assessed Coursework.
1-to-1 feedback on Assessed Coursework.

Past exam papers for CS413

Availability

Pre-requisites

Students must have studied the material in CS118, CS131 or have equivalent knowledge and experience.

Courses

This module is Optional for:

- Year 5 of UCSA-G504 MEng Computer Science (with intercalated year)
- Year 4 of UCSA-G402 MEng Computing Systems
- Year 5 of UCSA-G403 MEng Computing Systems (Intercalated Year)
- TCYA-G5P5 MSc in Scientific Computing
  - Year 1 of G5P5 Scientific Computing
  - Year 2 of G5P5 Scientific Computing
- Year 1 of TESA-H641 Postgraduate Taught Communications and Information Engineering
- Year 1 of TCSA-G5PD Postgraduate Taught Computer Science
- Year 1 of TCSA-G5P8 Postgraduate Taught Computer Science and Applications
- Year 4 of UCSA-G503 Undergraduate Computer Science MEng

This module is Option list A for:

- Year 4 of UESA-H163 MEng Biomedical Systems Engineering
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 4 of USTA-G304 Undergraduate Data Science (MSci)

This module is Option list B for:

- Year 4 of UESA-HH31 MEng Systems Engineering
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics