**Engineering Tripos Part IIB, 4F12: Computer Vision, 2017-18**

**Module Leader**

Prof R Cipolla

**Lecturers**

Prof R Cipolla and Dr R Turner

**Timing and Structure**

Michaelmas term. 16 lectures (including 3 examples classes). Assessment: 100% exam

**Aims**

The aims of the course are to:

- introduce the principles, models and applications of computer vision.
- cover image structure, projection, stereo vision, structure from motion and object detection and recognition.
- give case studies of industrial (robotic) applications of computer vision, including visual navigation for autonomous robots, robot hand-eye coordination and novel man-machine interfaces.

**Objectives**

As specific objectives, by the end of the course students should be able to:

- design feature detectors to detect, localise and track image features.
- model perspective image formation and calibrate single and multiple camera systems.
- recover 3D position and shape information from arbitrary viewpoints;
- appreciate the problems in finding corresponding features in different viewpoints.
- analyse visual motion to recover scene structure and viewer motion, and understand how this information can be used in navigation;
- understand how simple object recognition systems can be designed so that they are independent of lighting and camera viewpoint.
- appreciate the industrial potential of computer vision but understand the limitations of current methods.

**Content**

- **Introduction** (1L)
  
  Computer vision: what is it, why study it and how? The eye and the camera, vision as an information processing task. A geometrical framework for vision. 3D interpretation of 2D images. Applications.

- **Image structure** (3L)
  

- **Projection** (3L)
  
  Orthographic projection. Planar perspective projection. Vanishing points and lines. Projection matrix,
homogeneous coordinates. Camera calibration, recovery of world position. Weak perspective and the affine
camera. Projective invariants.

- **Stereo vision and Structure from Motion** (3L)
  Epipolar geometry and the essential matrix. Recovery of depth. Uncalibrated cameras and the fundamental
  matrix. The correspondence problem. Structure from motion. 3D shape from multiple view stereo.

- **Object detection and recognition** (3L)

- **Example classes** (3L)
  Discussion of examples papers and past examination papers.

**Booklists**

Please see the [Booklist for Group F Courses][2] for references for this module.

**Examination Guidelines**

Please refer to [Form & conduct of the examinations][3].

**UK-SPEC**

The [UK Standard for Professional Engineering Competence (UK-SPEC)][4] describes the requirements that have
to be met in order to become a Chartered Engineer, and gives examples of ways of doing this.

UK-SPEC is published by the Engineering Council on behalf of the UK engineering profession. The standard has
been developed, and is regularly updated, by panels representing professional engineering institutions, employers
and engineering educators. Of particular relevance here is the 'Accreditation of Higher Education Programmes' (AHEP)

The [Output Standards Matrices][6] indicate where each of the Output Criteria as specified in the AHEP 3rd edition
document is addressed within the Engineering and Manufacturing Engineering Triposes.

Last modified: 31/05/2017 10:06

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iib-4f12-computer-vision-2017-18

**Links**

[1] mailto:rc10001@cam.ac.uk