Engineering Tripos Part IIB, 4M20: Introduction to Robotics, 2025-26

Module Leader

F Forni [1]

Lecturers and Demonstrators

R. Antonova, J. Bonsor-Matthews, K. Chu, F. Forni, D. Hardman, M. Ishida, A. Prorok, C. Sirithunge, X. Wang [2]

Timing and Structure

Michaelmas term, 100% coursework

Prerequisites

3C5 useful; 3C8 useful; 3F2 useful; 3F3 useful, 3F8 useful.

Aims

The aims of the course are to:

- Explain the core principles of modern robotics.
- Gaining a comprehensive overview of the current robotics landscape.

Objectives

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

- Apply fundamental modeling and control methodologies to a range of robotic systems.
- Understand robotic systems across key sub-fields, including soft robotics, robotic learning, human-machine interaction, multi-agent robotics, and bio-inspired robotics.
- Demonstrate practical skills through hands-on project work and comprehensive assignments.

Content

The course is divided into six modules, each providing a specialized look into a core area of robotics. The syllabus may be subject to minor adaptations.

Part A – Fundamentals – (5h, F. Forni)

Introduction, architectures, kinematics, dynamics, and control.

Part B – Soft robotics – (3h, D. Hardman, X. Wang)

Materials, models, actuation, and sensing.

Part C – Robotic Learning – (3h, R. Antonova, K. Chu)

Real-time perception, control policy learning, generalization and sim-to-real, semantic understanding.

Part D – Human robot interaction (2h, C. Sirithunge)

Interaction modalities, information in HRI, and interaction modeling.

Part E – Multiagent systems and bio-inspired locomotion (2h, A. Prorok, M. Ishida)

Multirobot systems, collective movements, localization, and bio-inspired locomotion.

Part F – Microcontrollers and robotic programming (1h, J. Bonsor-Matthews)

Controller choice, I/O & comms, real-time systems, programming languages, debugging, and simulation platforms.

Coursework

The assignments will be 100% coursework. The coursework is divided in four assignments. Each assignment is worth 25% of the final grade, with an expected time commitment of approximately 10 hours/assignment.

Part A – Fundamentals

Format: Individual report, 4 pages, anonymously marked.

Due date & marks: 13 November 2025 [15/60]

Part B – Soft robotics:

Format: Individual report, 4 pages, anonymously marked.

Due date & marks: 27 November 2025 [15/60]

Part C – Robotic learning

Format: Individual report, 4 pages, anonymously marked.

Due date & marks: 6 December 2025 [15/60]

Part D – Human-machine interaction

Format: Individual report, 4 pages, anonymously marked.

Due date & marks: 17 December 2025 [15/60]

Booklists

Recommended further reading materials will be instructed in the lectures.

Examination Guidelines

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

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Links
[1] mailto:ff286@cam.ac.uk
[2] mailto:ra702@cam.ac.uk, jpm66@cam.ac.uk, kfc35@cam.ac.uk, ff286@mca.ac.uk, dsh46@cam.ac.uk, myi20@cam.ac.uk, asp45@cam.ac.uk, csh66@cam.ac.uk, xw438@cam.ac.uk
[3] https://teaching26-27.eng.cam.ac.uk/content/form-conduct-examinations