Engineering Tripos Part IIB, 4F3: An Optimisation Based Approach to Control, 2024-25

Module Leader and lecturer

[Prof I Lestas](#) [1]

Lecturer

[Prof I Lestas](#) [1]

Timing and Structure

Lent term. 14 lectures + 2 examples classes, Assessment: 100% exam

Prerequisites

3F1 and 3F2 useful

Aims

The aims of the course are to:

- introduce methods for feedback system design based on the optimization of an objective, including reinforcement learning and predictive control.
- demonstrate how such control laws can be computed and implemented in practice.

Objectives

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

- understand the derivation and application of optimal control methods.
- appreciate the main ideas, applications and techniques of predictive control and reinforcement learning.

Content

Optimal Control (7L + 1 examples class, Prof I Lestas)

- Formulation of convex optimisation problems
- Status of theoretical results and algorithms
- Formulation of optimal control problems. Typical applications
- Optimal control with full information (dynamic programming)
- Control of Linear Systems with a quadratic objective function
- Output feedback: 'LQG' control
- Control design with an "H-infinity" criterion

Predictive Control and an Introduction to Reinforcement Learning (7L + 1 examples class, Dr T Burghi)

- What is predictive control? Importance of constraints. Flexibility of specifications. Typical applications

- Basic formulation of predictive control problem without constraints and the receding horizon concept. Comparison with unconstrained Linear Quadratic Regulator
- Including constraints in the problem formulation. Constrained convex optimization
- Terminal conditions for stability
- Emerging applications: advantages and challenges
- Policy and generalized policy iteration; rollout algorithms and predictive control
- Approximate dynamic programming
- Deep neural nets as universal approximators for value and policy.
- Simulation based vs state space models - Q learning.

Booklists

Please refer to the Booklist for Part IIB Courses for references to this module, this can be found on the associated Moodle course.

Examination Guidelines

Please refer to [Form & conduct of the examinations](#) [2].

Last modified: 08/11/2024 15:33

Source URL (modified on 08-11-24): https://teaching24-25.eng.cam.ac.uk/content/engineering-tripos-part-iib-4f3-optimisation-based-approach-control-2024-25

Links
[1] mailto:icl20@cam.ac.uk
[2] https://teaching24-25.eng.cam.ac.uk/content/form-conduct-examinations