

INTRODUCTION*

Model predictive control (MPC) is one of the most applicable control techniques available today; it has been widely adopted by the industry in general, and has witnessed explosive growth and proliferation in the process industries in particular. It is an optimization-based method designed for implicit feedback control of systems. It takes into account all constraints at the design stage, and simultaneously adjusts all control actions applied to multi-input multi-output systems while accounting for all interactions within the systems. This leads to minimal conservatism and aggressive control of the underlying processes close to the admissible boundaries of operation while adhering to strict safety standards.

MPC has witnessed intense activity over the past several decades, and both the theoretical and practical aspects of this technique are reasonably well-developed, especially in the linear regime. However, nonlinear models and uncertain environments pose significant challenges on the numerical tractability front for MPC, and indeed, tractable algorithms for MPC in the nonlinear regime are rare. Moreover, explicit MPC of nonlinear systems and systems with uncertainty is a challenging topic fraught with stiff numerical challenges. This course is designed to expose entirely novel (and some yet unpublished) ideas, with emphasis on heuristic-free computationally tractable methods, for explicit MPC for both nonlinear systems and systems with uncertain models.

BROAD OBJECTIVES*

To train students and professionals in the fast-evolving field of MPC in general, and to expose them to novel techniques for nonlinear and robust *explicit* MPC.

COURSE CONTENTS*

- The program will have **lectures and tutorials** which will give **hands on experience** to the participants with regard to solving problems and performing calculations.
- **Basics of MPC (2 hr)**: elementary theory of nominal MPC, effects of uncertainty, robust MPC, the ingredients of convexity; numerical exercises + solutions.
- **Techniques for uncertain and constrained optimal control (4 hr)**: a new technique for solving minmax problems in the convex regime, relationship with uncertain and constrained optimal control, global optimization, examples; numerical exercises + solutions.
- **Quasi-interpolation (2 hr)**: introduction to quasi-interpolation; exercises + solutions.
- **Explicit MPC, novel techniques (7 hr)**: quasi-interpolation driven explicit MPC; exercises + solutions.

WHO MAY BENEFIT*

- Students and professionals in Engineering working in the broad areas of Control, Process Control, and Robotics, who employ model predictive control in their work.
- Students and professionals interested in new results on various aspects of robust, stochastic, and explicit MPC.
- The course will specifically emphasize novel numerical techniques for the solution of MPC problems; MATLAB/python/Mathematica programs will be extensively as illustrative examples employed during the course.

VENUE FOR CLASSES

Course will be held at the Room no. 31, 3rd Floor Victor Menezes Convention Centre, IIT Bombay.

LECTURE NOTES

To comply with standard norms associated with intellectual property rights, lecture notes will not be distributed. However, the techniques will be vividly illustrated by means of several numerical experiments and hands-on in-class training.

FACULTY*

The lectures will be delivered by Prof. Debasish Chatterjee, Systems & Control Engineering, IIT Bombay.

ACCOMMODATION

Accommodation on twin sharing basis is available in the Institute Guest house for a limited number of participants on payment basis and with an advance request. Information on off campus accommodation is available [please click here](#).

REGISTRATION*

Participants are required to register for the course, online at the following portal. <https://portal.iitb.ac.in/ceqipapp/>

Course and fees details can be viewed at https://portal.iitb.ac.in/ceqipapp/courseDetails.jsp?c_id=61

Last date for online registration: 07 June, 2023.

Course fees are not refundable. A number of delegates from a single organization attending partially will have to pay separately and individually as per the rates

given above. That is, *one person attending only on one day and another only on the second day will be treated as two separate delegates and will have to pay accordingly.*

No income tax is to be deducted at source from the course fee, as IIT Bombay is exempt from the same. The course fee includes course material, lunch and coffee/tea.

A Certificate of participation will be awarded to all the participants of the course.



CEP Short Term Course on

Tractable techniques for robust and explicit model predictive control

June 19-21, 2023

Coordinator

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Systems & Control Engineering

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