ME-425 **Model predictive control**

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Cursus	Sem.	Type
Electrical and Electronical Engineering	MA1, MA3	Opt.
Energy Management and Sustainability	MA1, MA3	Opt.
Energy Science and Technology	MA1, MA3	Opt.
Mechanical engineering minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA1, MA3	Obl.
Systems Engineering minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Provide an introduction to the theory and practice of Model Predictive Control (MPC). Main benefits of MPC: flexible specification of time-domain objectives, performance optimization of highly complex multivariable systems and ability to explicitly enforce constraints on system behavior.

Content

- Review of convex optimization and required optimal control theory.
- Receding-horizon control for constrained linear systems.
- Practical issues: Tracking and offset-free control of constrained systems.
- Theoretical properties of constrained control: Constraint satisfaction and invariant set theory, Stability of MPC.
- Introduction to advanced topics in predictive control.
- Simulation-based project providing practical experience with MPC.

Keywords

Multi-variable control, Constrained systems, Model-based Control, Optimization

Learning Prerequisites

Required courses

- Automatique or Control Systems

Recommended courses

- Multivariable systems or Dynamic coordination

Important concepts to start the course

- State-space modeling
- Basic concepts of stability
- Linear quadratic regulation

Learning Outcomes

By the end of the course, the student must be able to:

- Design an advanced controller for a dynamic system, A11
- Assess / Evaluate the stability, performance and robustness of a closed-loop system, A12
- Work out / Determine the performance (by simulations or experiments) of a mechatronic system, A21
- Assess / Evaluate Define (specifications) the control performance for mechatronic systems, A18

Transversal skills

- Write a scientific or technical report.

Teaching methods

Lectures, exercises and course project

Expected student activities

- Participate in lectures, exercises and course project
- Homework of about 2 hours per week

Assessment methods

- Reports on weekly exercises
- Report on simulation-based project
- Written final exam

Resources

Bibliography

All material can be downloaded from the moodle site.

Ressources en bibliothèque

- Predictive Control with Constraints / Maciejowski
- Model Predictive Control: Theory and Design / Rawlings
- Convex Optimization / Boyd
- Predictive Control for linear and hybrid systems / Borrelli
- Numerical Optimization / Nocedal