ME-524

Advanced control systems

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Cursus	Sem.	Type
Energy Management and Sustainability	MA2, MA4	Opt.
Energy Science and Technology	MA2, MA4	Opt.
Mechanical engineering minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA2, MA4	Opt.
Systems Engineering minor	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Project	1 weekly
Number of positions	

Summary

This course covers some theoretical and practical aspects of robust and adaptive control. This includes H-2 and H-infinity control in model-based and data-driven framework by convex optimization, direct, indirect and switching adaptive control. The methods are implemented in a hands-on lab.

Content

Stability, performance and robustness of closed-loop control systems. Robust controller design by convex optimization. Model-based H-2 and H-infinity control. Data-driven fixed structure controller design with loopshaping, H2 and H-infinity performance.
Two-degree of freedom RST digital polynomial controller. Robust pole placement with Q parameterization. Parameter adaptation algorithms. Direct and Indirect adaptive control. Switching adaptive control. Gain-scheduled controller design.

Keywords

Adaptive control, robust control, digital RST controller.

Learning Prerequisites

Required courses

Control systems + Lab
Commande numeriques des systèmes dynamiques

Recommended courses

1. System Identification
2. Multivariable systems

Important concepts to start the course

• Analyze a linear dynamical system (both time and frequency responses)
• Represent a linear system by a transfer function
• Identify a dynamic system using experimental data
• Design a PID controller
• Design a simple controller for a dynamic system

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
- Define (specifications) the adequate control performance for dynamic systems, A13
- Propose several control solutions, formulate the trade-offs, choose the options, A14
- Justify methodological choices and validate the results with respect to the specifications, A19

Transversal skills

- Write a scientific or technical report.

Teaching methods

Ex cathedra course, integrated demos and case studies, Hands-on laboratory.

Expected student activities

Hands-on laboratory in groups of two students.

Assessment methods

Hands-on lab reports (30%) and written test (70%).

Resources

Bibliography

1. Feedback Control Theory by Doyle, Francis and Tannenbaum; Maxwell Macmillan, 1992.
2. Adaptive Control by Landau, Lozano, M'Saad and Karimi, Springer, 2011.

Ressources en bibliothèque

- Feedback Control Theory / Doyle
- Adaptive Control / Landau

Notes/Handbook

Robust and Adaptive Control, Course-notes by Alireza Karimi