ME-421

System identification

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Cursus	Sem.	Type
Energy Management and Sustainability	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

Identification of discrete-time linear models using experimental data is studied. The correlation method and spectral analysis are used to identify nonparametric models and the subspace and prediction error methods to estimate the plant and noise model parameters. Hands-on labs are included.

Content

Models (classifications, representations). Excitation signals (impulse, step, random, pseudo random). Least Squares algorithm (linear regression, analysis in stochastic case, bias-variance tradeoff). Time-domain nonparametric identification methods (impulse response by the correlation approach). Frequency-domain nonparametric identification methods based on the Fourier and spectral analysis. Parametric identification by linear regression (least squares method, instrumental variables method, recursive algorithms). Subspace identification methods. Prediction error methods (ARX, ARMAX, OE and BJ structures). Practical aspects of identification (input design, order estimation, model validation). Plant model identification in closed-loop operation. Introduction to nonlinear model identification.

Keywords

System identification, spectral analysis, correlation approach, prediction error method

Learning Prerequisites

Recommended courses

Dynamic systems, Control systems

Important concepts to start the course

- Represent a physical process as a system with its input, outputs and disturbances
- Analyze a linear dynamical system (both time and frequency response)
- Represent a linear system by a transfer function (discrete- and continuous-time)

Learning Outcomes

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

- Identify a dynamic system using experimental data, A6
- Construct and analyze a discrete-time model for a dynamic system, A5

Transversal skills

- Write a scientific or technical report.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Set objectives and design an action plan to reach those objectives.

Teaching methods

Ex-cathedra course with hands-on labs and project

Expected student activities

Hands-on laboratory for groups of two students, preparing technical reports.

Assessment methods

Written test (70%) and lab reports (30%).

Resources

Notes/Handbook

Course-notes (in English): System Identification
Slides available (pdf) in English

Moodle Link

- https://moodle.epfl.ch/course/view.php?id=14290