

Number of positions

EPFL

# ME-421 System identification

Karimi Alireza

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Cursus	Sem.	Туре	Language of	English
Mechanical engineering minor	Е	Opt.	teaching	English
Mechanical engineering	MA2, MA4	Opt.	Credits	3 Summer Spring
Microtechnics	MA2, MA4	Opt.	Semester	
Robotics, Control and Intelligent Systems		Opt.	Exam	Written
Robotics	MA2, MA4	Opt.	Workload 90h Weeks 14	90h 14
Systems Engineering minor	E	Opt.	Hours	3 weekly
			Lecture Project	2 weekly 1 weekly

# 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). 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%).

# Supervision

Office hours	Yes
Assistants	Yes
Forum	No

#### Resources

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

# **Moodle Link**

• https://go.epfl.ch/ME-421