System Identification

lecturers

Prof.dr.ir. P.M.J. Van den Hof, Eindhoven University of Technology
Prof.dr.ir. J. Schoukens, VUB, Brussels, Belgium
Prof.dr.ir. X. Bombois, CNRS, École Centrale de Lyon, France
Dr. G. Bottegal, Eindhoven University of Technology

objective

System Identification is involved with data-driven modeling of dynamical systems. The objective of this course is to present the important system identification techniques with a special attention to prediction error methods. Time- and frequency-domain methods will be covered, as well as parametric and non-parametric approaches, with particular attention for recently developed techniques in the domain of machine learning. While the focus will be on linear time-invariant systems, extensions will be made to nonlinear systems also. We will consider both the cases of open-loop and closed-loop data as well as problems of optimal experiment design.

contents

1. Introduction; concepts; discrete-time signal and system analysis; estimation
2. Parametric (prediction error): identification methods, model sets, identification criterion, statistical properties
3. Parametric (prediction error): identification methods, model validation, approximate modelling, Maximum likelihood and CRLB.
4. Regularization and non-parametric kernel-based identification; machine learning
5. Frequency-domain identification, parametric and non-parametric.
6. Nonlinear models
7. Optimal experiment design
8. Identification in closed-loop and dynamic networks.

course materials

Lecture notes will be distributed during the course.

prerequisites

Calculus and linear algebra. Some knowledge of statistics and linear systems theory and/or time series analysis is helpful, but not required. The lecture notes contain useful summaries of the important notions used during the course.

homework assignments

The assessment of this course will be in the form of three homework assignments.