

E6229: SPECIAL TOPICS

PART II: SYSTEM IDENTIFICATION

Lecturer: Professor Minyue FU

(Full set of lecture notes available only to enrolled students)

CONTENT

- Introduction to systems and signals
- Stochastic processes
- Linear prediction
- Nonparametric approaches to system identification
- Parameter estimation: Least-squares method
- On-line system identification:
Recursive least-squares method

Text: Lennart Ljung, *System Identification: Theory for the User*, 2nd ed., Prentice Hall, 1999.

Objectives:

- To understand the basics of stochastic processes;
- To gain more knowledge on system modelling;
- To be able to use linear models for prediction;
- To know how to estimate the frequency response of a linear system;
- To learn the most fundamental technique for system identification and parameter estimation:
Least squares
- To understand the recursive least squares technique for real-time implementation.

What you can do after completing this part of the course:

Able to apply system identification techniques to a range of applications, including:

- System modelling;
- Signal processing;
- Communications;
- Fault diagnosis and fault detection;
- System design and analysis;
- Automatic control

Lecture 1: Introduction

Topics:

- Introduction to system identification
- Linear time-invariant systems
- Stochastic processes

Lecture 2: Linear Prediction and System Models

Topics:

- One-step-ahead prediction
- k -step-ahead prediction
- Observers

Lecture 3: Nonparametric Methods for System Identification

Topics:

- Time response analysis
- Frequency response analysis
- Empirical transfer function estimate (EFTE)
- Spectral analysis
- Estimating disturbance spectrum

Lecture 4: Parameter Estimation Methods

Topics:

- Prediction-error Identification Methods
- Linear Regressions and the Least-Squares
- Maximum Likelihood Estimation
- Instrumental-variable Methods
- Parameter Estimation for Continuous-time Systems

Lecture 5: Recursive Estimation Methods

Topics:

- Recursive Least-squares Method
- Recursive Instrumental Variable Method
- Recursive Prediction-error Method
- Choice of Updating Step and Forgetting Factor