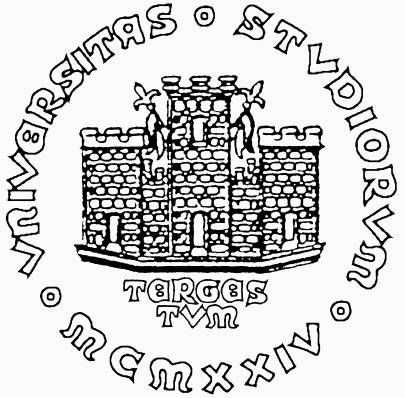
Systems Dynamics

Course ID: 267MI – Fall 2019

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267MI –Fall 2019

Course Overview

Course Administration

Lecturers & examiners

- Thomas Parisini (t.parisini@gmail.com)
- Gianfranco Fenu (fenu@units.it)

Course home page

- slides, exercises and computer code examples
- old exams

http://control.units.it



Course credits

- 9 CFU

Examination

- **Final exam**: a preliminary written examination followed by oral questions.
- The **final grade** depends on both the written part and the outcome of the oral discussion.
- Written examination and oral discussion usually usually take during the same exam session.

Examination (cont.)

Written examination

The exam paper consists of 3 – 4 essay questions:

- typical numerical application problems
- specific questions about theoretical aspects (theorems, properties, definitions) could be included

Oral questions

Oral questions deal with any possible topic, discussed and analysed in the lectures.

- A short discussion about the written examination results generally also takes place

Examination (cont.)

Homework (not compulsory)

- Advanced engineering specific projects are offered during the course, characterised by challenges more difficult to address than the usual ones.
- The aim is to stimulate learning advanced concepts during the course also to help the learning exercise
- These projects are then evaluated upon request by the students.
- It's allowed to solve the projects in groups, up to 3 persons.
- Working on homework problems is **not compulsory**

Examination (cont.)

Homework & final grade

- Homework contributes to the final grade, with an increment of the score up to 2 points.
- The grading of the homework is **independent** from the grading of the examination

Exam Sessions

Examination timetable

- 3 sessions in January–February
- 3 sessions in June–July
- 1 session in September

How to sign up for examinations

- In order to participate to the exam session you must sign up/register for the exam **(compulsory)**
- To sign up, use the students university career management system Esse3 to access to the on-line University Services.
- Please, **pay attention** to the dates of the registration periods and the examination periods!

Course Information

Prerequisites

- Linear algebra, calculus and complex analysis
- Course 034IN “Fundamentals of automatic control” (or equivalent for students enrolled from other universities/programs)
- Basic knowledge of probability and statistics is not mandatory, but highly helpful

Course organization

- Lectures
- Exercise sessions

Desiderata

Students who pass the course should be able to:

- carry out a complete and comprehensive analysis of the main properties of deterministic and stochastic discrete-time dynamic systems;
- design and implement parametric estimation and identification, and state estimation algorithms that use available data or data collected in real-time with reference to engineering application scenarios;
- . . .

Desiderata (cont.)

Students who pass the course should be able to

- evaluate, among several options, what's the best choice of parametric estimation and identification, and state estimation algorithms starting from requirements and considering technological constraints;
- describe in a clear and plain way the functionalities of a parametric estimation and identification, and state estimation algorithm in the context of discrete-time dynamic systems and with the correct use of technical terminology

Lectures Plan

Lect.	Content
1	Course overview. Generalities: systems and models (defs, props, problems). Sampling and discrete-time representation of linear continuous-time dynamic systems.
2	Time-evolution of state and output of linear dynamic systems.
3	Stability of discrete-time dynamic systems.
4	Model identification from data.
5	A glimpse on prob. theory, random vars and discrete-time stochastic processes.
6	Definitions and properties of the estimation and prediction problems.
	...

Lectures Plan (cont.)

Lect.	Content
7	Dynamic models of stationary discrete-time stochastic processes.
8	Least-squares estimation.
9	Bayes estimation.
10	Solution of the prediction problem.
11	Identification Based on Prediction Error Minimization (PEM).
12	Batch PEM Identification Algorithms.
13	State estimation from observed data.

References

References on dynamic systems analysis:

P. J. Antsaklis and A. N. Michel.
Linear Systems.
Birkhäuser, 2006.

G. Calafiore.
Elementi di Automatica.
CLUT, Torino, 2007.
(in Italian).

G. Marro.
Teoria dei Sistemi e del Controllo.
Zanichelli, 1989.
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S. Rinaldi.
Teoria dei Sistemi.
CLUP, Milano, 1977.
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References (cont.)

References on data-based estimation and identification:

T. Söderström. P. Stoica.
System Identification.
Prentice Hall, 1989.

L. Ljung.
System Identification – Theory for the User.
Prentice Hall, 1999.

S. Bittanti.
Teoria della predizione e del filtraggio.
Pitagora Editrice, Bologna, 2000.
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S. Bittanti.
Identificazione dei Modelli e Controllo Adattativo.
Pitagora Editrice, Bologna, 1997.
(in Italian).

S. Bittanti, M. Campi.
Raccolta di Problemi di Identificazione, Filtraggio, Controllo Predittivo.
Pitagora Editrice, Bologna, 1996.
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267MI –Fall 2019

Course Overview

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