Description
The course lessons are taught in English.
The purpose of this course is to provide basic methodologies and software tools for building mathematical models of linear and nonlinear (static or dynamic) systems from experimental data.

Credits: 6

Prerequisites
The following notions are essential: knowledge of the representations of linear dynamic systems (input-state-output equations, transfer functions) and of their fundamental properties (stability, controllability, observability); essentials of probability theory and statistics; basic concepts of linear algebra and Zeta transform. The knowledge of the MATLAB software environment is required.

Program
1) Introduction to estimation and prediction problems. Main statistical estimation methods (least squares, weighted least-squares, maximum likelihood estimators, Bayesian estimators) and their basic properties (correctness, consistency, efficiency), with evaluation of parametric estimation error.
2) Set-membership estimation theory for different norm assumptions on noise, with evaluation of Estimate Uncertainty Sets and Intervals. Optimal and Central estimates, with evaluation of Feasible Parameter Sets and Parameter Uncertainty Intervals.

Exercises
Exercise sessions are focused on the development of both academic and applicative examples. Some other sessions are carried out in computer laboratories and are focused on modelling real-world static or dynamic systems (position transducer, hair dryer, water heater) and on Kalman predictor and filter design and simulation for a given linear dynamic system, using MATLAB toolboxes (Control System, System Identification, Neural Network based System Identification).

References

The overall tutorial material used during the course (lecture slides, laboratory exercises with proposed solutions, official formulary) can be downloaded from the web page [www.ladispe.polito.it/corsi/MIC/](http://www.ladispe.polito.it/corsi/MIC/)

**Examination rules**

- The final assessment consists of a written test, about three hours long, to be performed in the computer laboratory using the MATLAB software tools running under MATLAB R2014a. The examination is typically made of a model building practice of an unknown system starting from given data and a second exercise on Kalman predictor and/or filter design and simulation for a given linear dynamic system.
- If the student withdraws from the written test, the examination rating is recorded as “withdrawn”. If the student does not withdraw, the examination rating will be automatically recorded and cannot be refused.
- The exit from the laboratory before the end of the test is allowed only in case of student withdrawing.
- During the exam, the student may keep with him/her only what he/she needs to write, possible drawing tools (straightedge, square ruler, etc.) and an adequate number of blank sheets. Any other item (notes, books, mobile phones, backpacks, tablets, notebooks, etc.) must be left at the entrance or by the teacher desk.
- During the exam, the student is not allowed to use textbooks or notes, except the official formulary of this course, directly provided by the teacher during the exam as .pdf file (and downloadable before the exam from the course web page). No other material is allowed, i.e., no personal notes, exercises, MATLAB code or solutions of specific exercises, in complete or partial form, coded in any way.
- The exam of a student found with forbidden items (e.g., notes, books, solved exercises, phones, tablets, etc.) is automatically considered as failed.
- The exam of students who are found talking or trying to talk with each other is automatically considered as failed.

**IMPORTANT:** Any student has to attend at least four of all the six laboratory exercises, otherwise a penalty of 2/30 is applied to the examination rating. Exceptions are possible only for documented and justified motivations. This rule does not apply for the a.a. 2019/20, due to the Covid-19 emergency.

**Communications and announcements**

Communications and announcements are available in the official web page of the course in the “Portale della Didattica” of Politecnico di Torino and at [www.ladispe.polito.it/corsi/MIC/](http://www.ladispe.polito.it/corsi/MIC/)

**Office hours and how to contact the teacher**

The teacher is available for consulting in his office in the “Dipartimento di Automatica e Informatica” (at the fourth floor in the northern overpass on Corso Castelfidardo, over the LabInf laboratory) on Tuesday, 17:00-18:00, during the entire second semester (i.e., until June 12, 2020).

Personal appointments can be arranged for students who cannot use the above office hours or would like to consult the teacher later.

The teacher can be contacted:
- by phone (011-090.7063) in the “Dipartimento di Automatica e Informatica” (at the fourth floor in the northern overpass on Corso Castelfidardo, over the LabInf laboratory);
- by email (email address: michele.taragna@polito.it)

or alternatively at the beginning or at the end of lessons and classroom exercises.