Advanced and Multivariable Control

lecturer: Riccardo Scattolini

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Office: room 224, II floor, building 20 (DEIB)

Office hours for students: Monday 15:00 – 17:00
(but send me an email to arrange for a meeting in different hours/days)
Please use the chat in Teams

Class schedule

Tuesday 13:15 – 16:15 *(mainly exercise hours and SW labs*)

Thrusday 8.15 – 10.15 (mainly lectures)

Friday 8.15 – 11. 15 (mainly lectures)

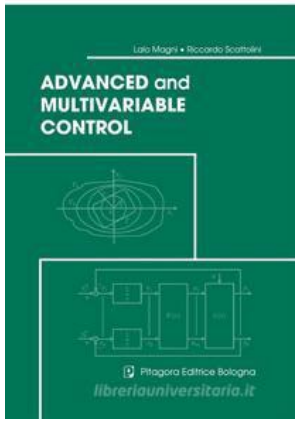
Exercises hours: teacher *Lorenzo Nigro*

SW laboratories: teachers *Lorenzo Nigro, Mattia De Pascali*

We will often exchange lectures and exercise hours, with a little notice

Course notes:

L. Magni, R. Scattolini
Advanced and Multivariable Control
Pitagora editrice
+
Slides



I will strictly follow slides and notes

Additional course material (**SW**, **past exams with solutions** …) available at the Webeep page of the course

This year I will not register the lessons

However, at the Webex page of the course you can find the lessons of the last year

Additional information

Course announcements with Webeep and/or polimi mail

Exams: tentatively 4-5 questions in closed-form and 2/3 numerical exercises or open questions

During the course I will prove some theoretical results, but during the exam proofs will not be required, save for one or two, specified during the course

Two tutoring courses (18 hours each) will be activated

Tutoring 1 (Dr. I. Lanzani)

4h per week: Monday 18:00-20:00. Thursday 18:00-20:00

Topics: recap of system theory, automatic control, industrial control schemes, digital control

strongly recommended to students coming from other universities, with limited background in control

Tutoring 2 (Dr F. Bonassi)

4h per week (in cascade with Tutoring 1), starting from the middle of March

Topics: Modeling and control of a **real** 4 tank system

Specifically:
4h modeling and design of the controller in Simulink
12h testing of your solution for control of the real plant

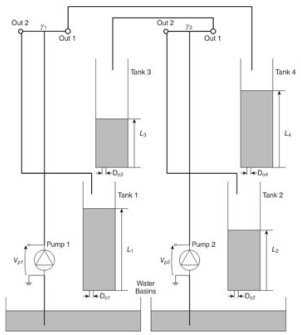
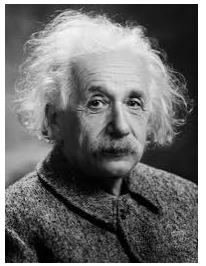


Fig. 1 *Schematic of the quadruple tank rig (adapted from the Quanser manual).*

Course characteristics

the course is on *control theory*, however during the course we will organize 6 SW labs., 3h each, devoted to the analysis and synthesis of control systems for simulated processes, such as a *magnetic levitation system*, a *chemical reactor*, an *aircraft*, an *inverted pendulum*

Are you bored with the theory? Remenber that:



“There is Nothing More Practical Than A Good Theory” *(Albert Einstein? Kurt Lewin?)*

Most of this theory will be very useful in the course *Automation and Control Laboratory*, and in many advanced courses on energy, vehicles, optimization,…

Main contents

Stability analysis of linear and nonlinear systems with the *Lyapunov theory*. Synthesis of nonlinear controllers (the *Backstepping* approach)

Analysis of Multi-Input Multi-Output (MIMO) systems in the frequency and time domains

Control synthesis methods for MIMO systems:

pole placement with state and output feedback, observers

optimal control with state and output feedback, LQ, LQG

Model Predictive Control

hints on H_2, H_{inf} control

Every time it will be necessary, a brief summary will be made on the main analysis and control synthesis methods for Single Input Single Output (SISO)systems