Course of "Automatic Control Systems"
2022/23

Introduction

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Course Administration

- **E-mail: francesco.montefusco@uniparthenope.it**
- **Books**
  - Introduction to Dynamic Systems: Theory, Models, and Applications, D. G. Luenberger. John Wiley & Sons
  - Fondamenti di Controlli Automatici, 4° Ed , P. Bolzern, R. Scattolini, N. Schiavoni. McGraw-Hill (Italian)
  - Modern Control Engineering, 3rd Edition, K. Ogata, Prentice Hall, (2004)
- **Slides of the lectures**
- **Prerequisites**
  - Basic classes in mathematical analysis, physics, algebra and geometry
- **Exam**
  - Written exam
  - Oral exam including discussion of a project report about analysis of the dynamics of a linear system, and the device of a closed-loop control system with required characteristics by using Matlab/Simulink

Contents of the course

- This course is an introductory course on control systems providing the students with the basic engineering knowledge of dynamic systems and feedback.
- The course is conceptually divided in three parts:
  - Analysis of linear dynamic system in the time and frequency domains
  - Key concepts in control
  - Design method of feedback control systems for linear dynamic system
- After the course the student should be able
  - to describe and explain how feedback mechanisms affect system properties such as stability, speed of response, precision, sensitivity and robustness.
  - to design feedback systems guaranteeing a set of these properties

Introduction to automatic control

- Automation or automatic control is a discipline whose aim is the study of the methodologies able to reduce or completely eliminate the human intervention in applications of interest.

- Benefits:
  - Quality
  - Accuracy
  - Reliability
  - Repeatability
  - Cost reduction
  - Security
  - …

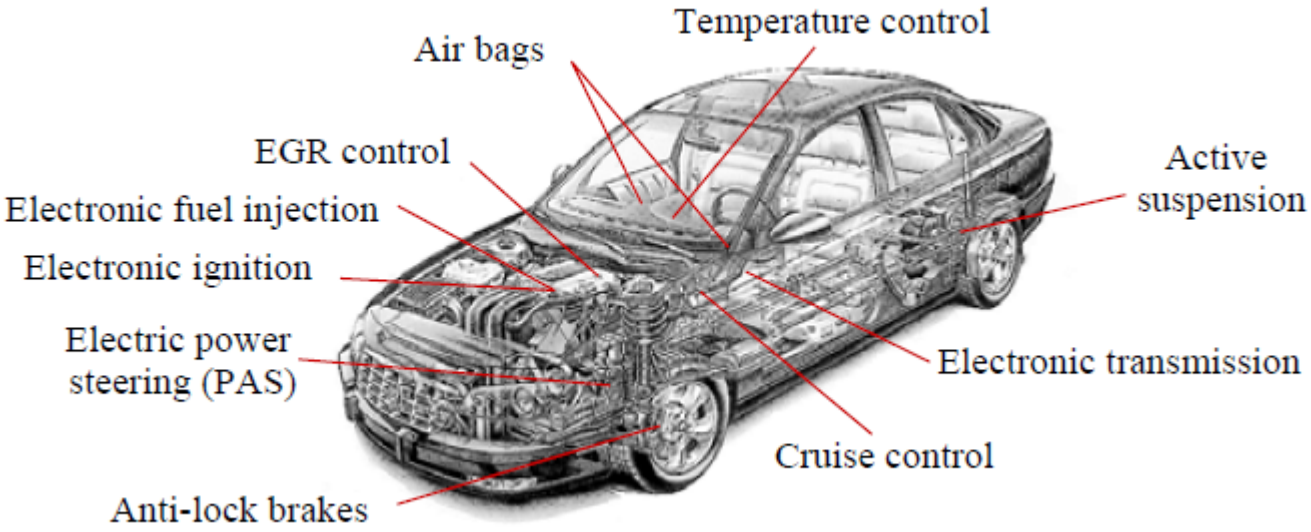
Applications

- Applications in most engineering domains:
  - Aerospace
  - Cars and Vehicles
  - Process industry
  - Energy storage and distribution
  - Home automation
  - Logistic
  - Biology
  - Autonomous systems and robots
  - …

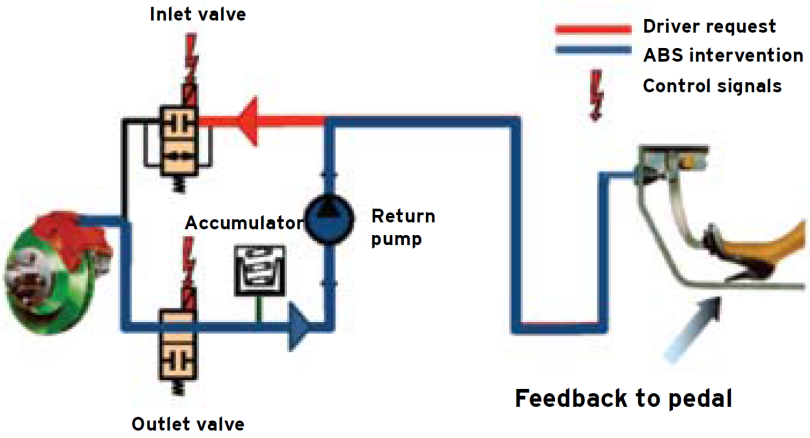
Aerospace

Vehicle control

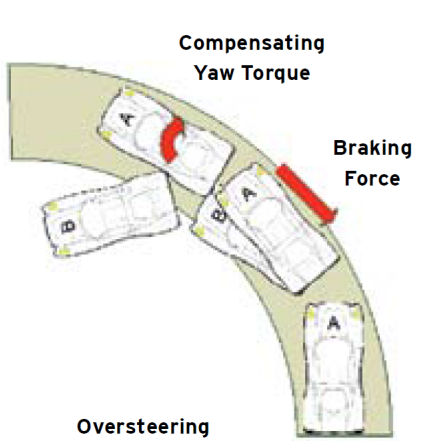
Automobile control

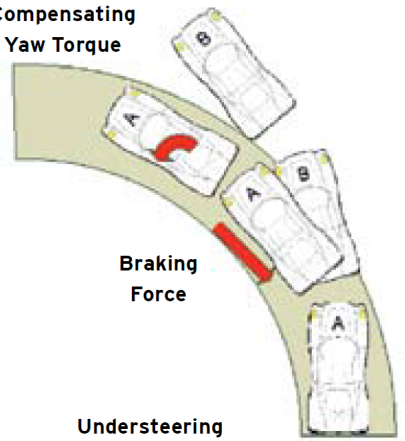


ABS: Antilock braking system (Bosch, 1978)

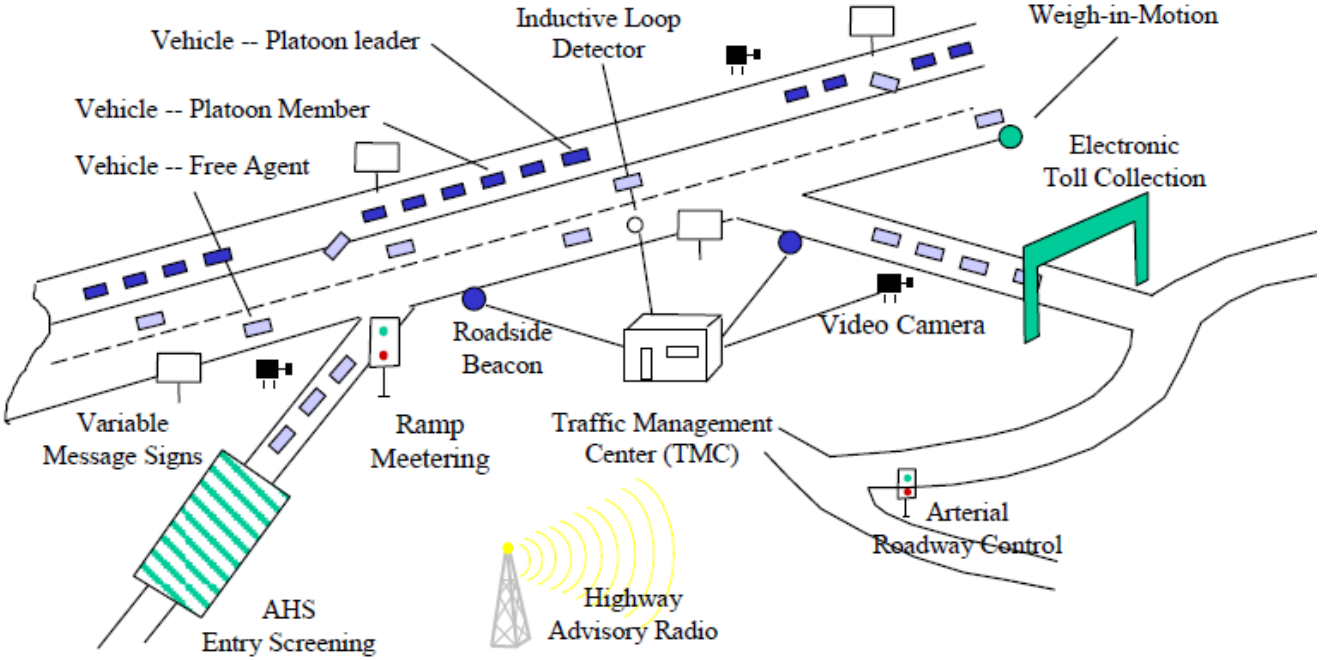


ESC: Electronic Stability Control (Mercedes-Benz, 1992)



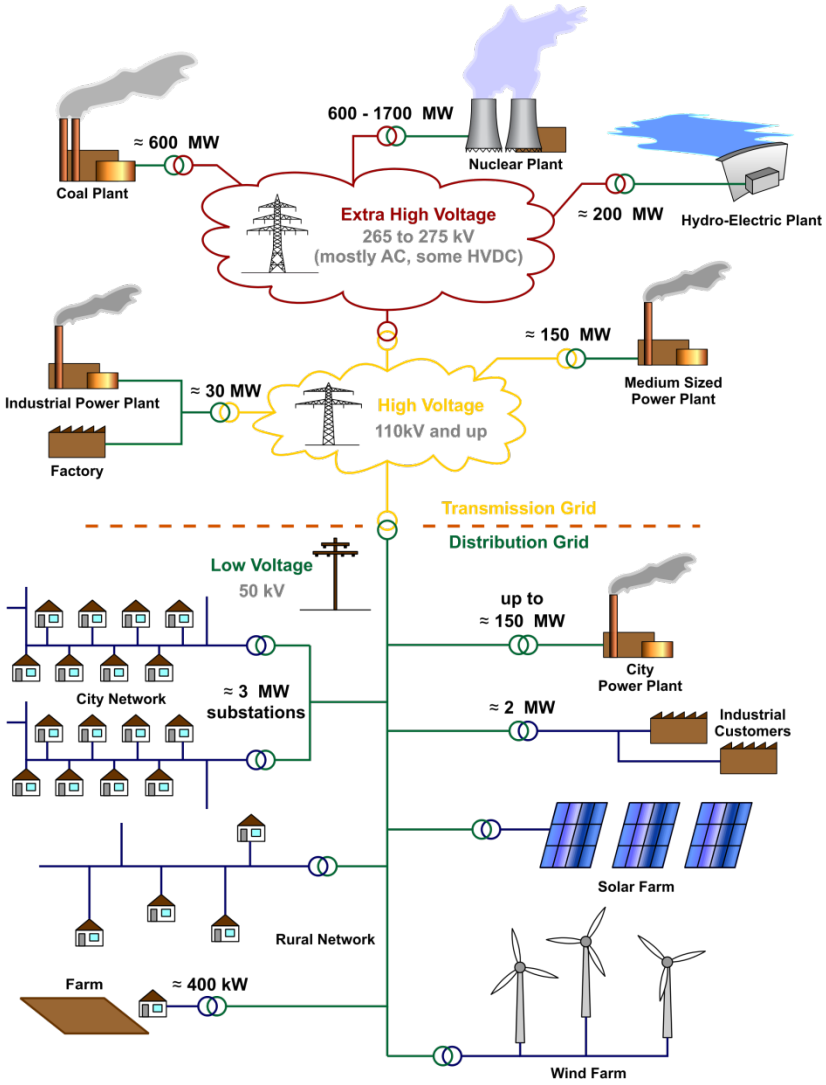


Intelligent vehicle highway systems



Process Industry

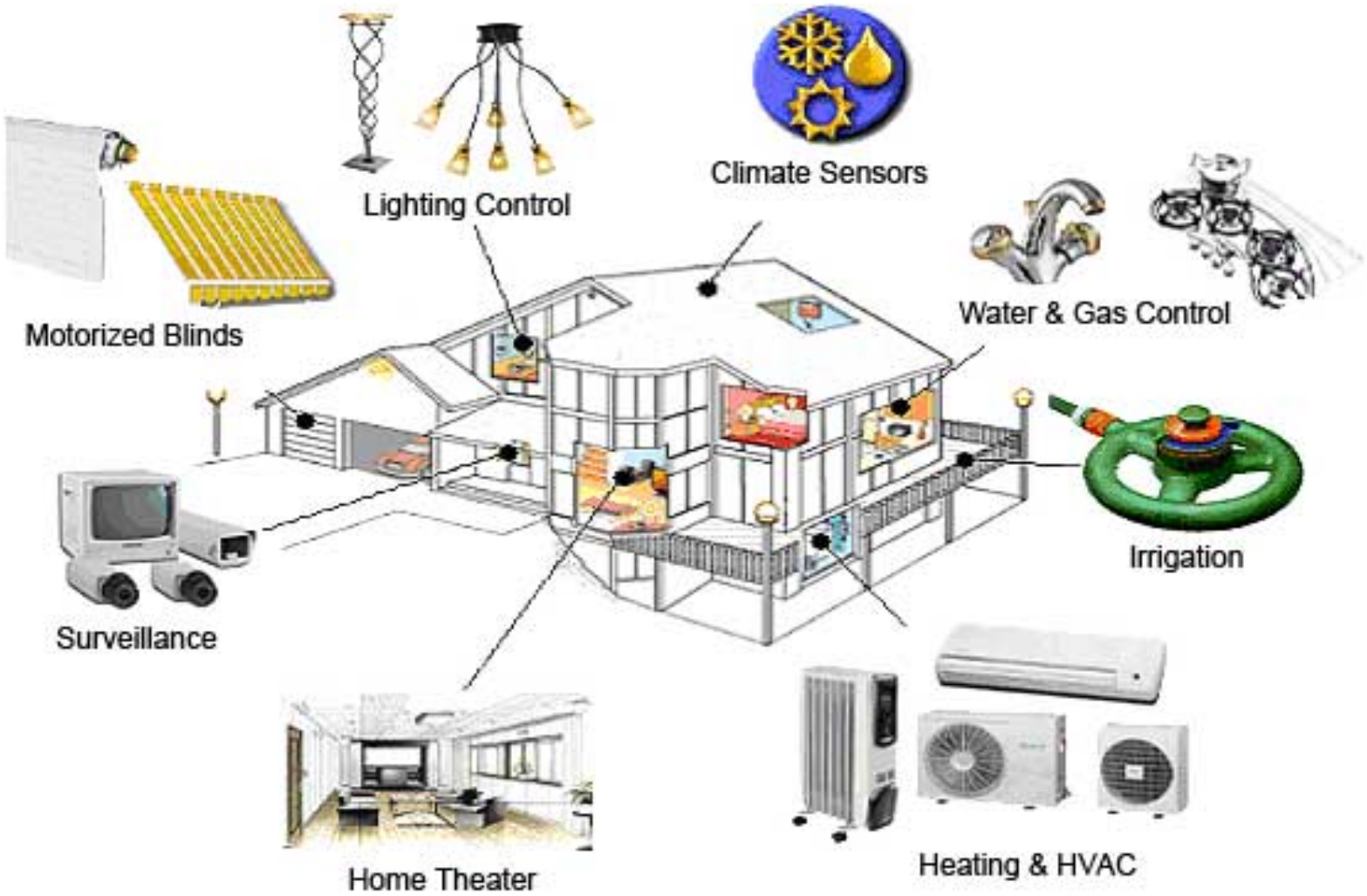
Energy control (power grids)



Automation in logistic

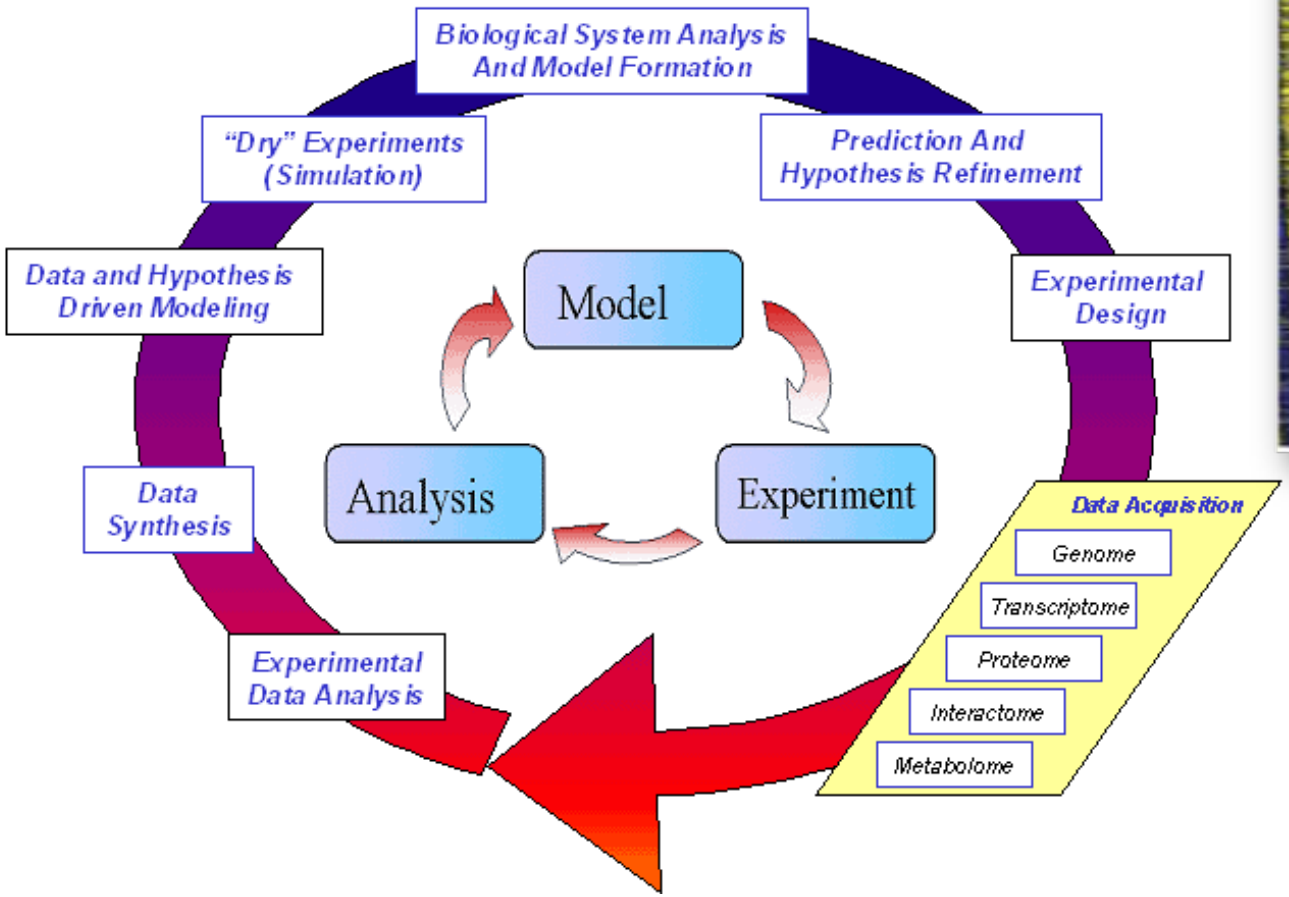
automated guided vehicle (bot)

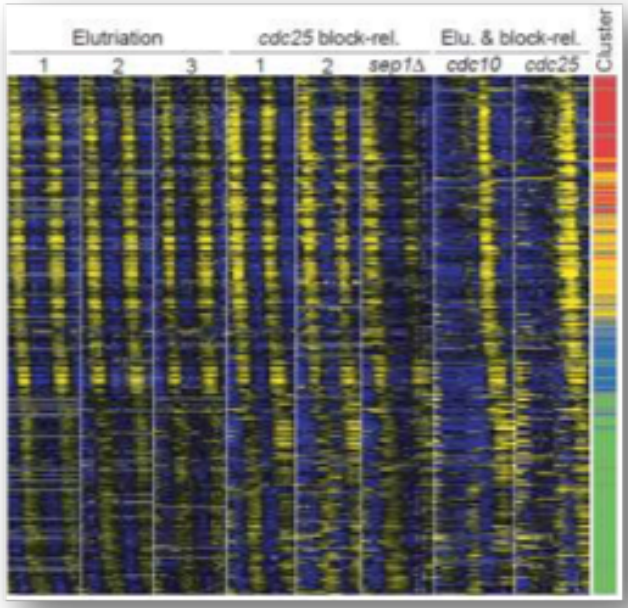
Home automation

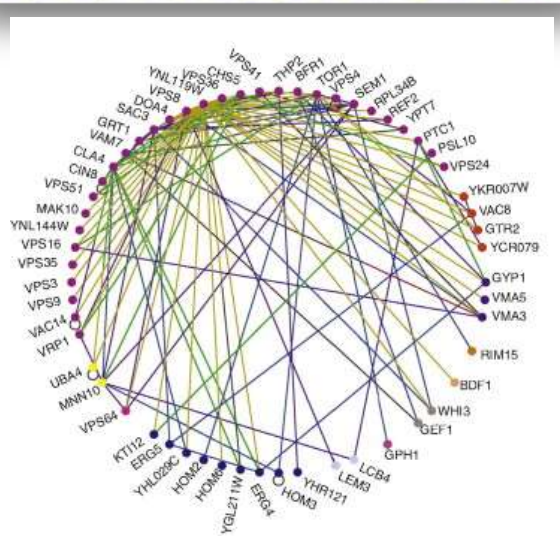


Automation in the Life Sciences

Systems Biology







Detailed program of the course 1/2

- Introduction
- Analysis of linear dynamic system
  - Definition and classification of dynamical systems
  - Free and forced evolution of linear system in the time domain
  - Stability analysis
  - Definition and properties of Laplace transform
  - Transfer function
  - Analysis of linear systems in the frequency domain
  - Bode diagrams

Detailed program of the course 2/2

- Understanding of key concepts in control
  - Feedback and feedforward controls
  - Block diagrams
  - Steady-state and transient requirements

- Design method of feedback control systems
  - Nyquist plots and Nyquist criteria
  - Nichols plots and Nichols charts
  - Frequency shaping technique for closed loop control design
  - PID
  - Example