Industrial Automation

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Dr. Jean-Charles Tournier

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The material of this course has been initially created by Prof. Dr. H. Kirrmann and adapted by Dr. Y-A. Pignolet, J-C. Tournier & Philipp Sommer.

Agenda for Today

- Course Overview
  - Lecturers
  - Course Organization
  - Schedule
- Introduction to Automation Systems: Automation & Plants, Sensors & Actuators

Lecturers

Dr. Jean-Charles Tournier
CERN
Geneva

Dr. Philipp Sommer
ABB Corporate Research
Baden, AG

Jean-Charles Tournier
Short Introduction

- Background in Software Engineering
  - PhD in Computer Science 2005
- R&D in Power Grid Automation
  - ABB, 2007-2011
- Development of large Control Systems
  - CERN, since 2011
- Industrial Automation Lecturer
  - EPFL, since 2013

Philipp Sommer
Short Introduction

- Background in Computer Engineering and Communication Networks
  - PhD in Electrical Engineering and Information Technology, ETH Zürich, 2011
- R&D in Wireless Sensor Networks and Industrial Internet of Things
  - CSIRO, Brisbane, Australia, 2011–2014
  - ABB Corporate Research, Baden-Dättwil, Switzerland, since 2014
- Industrial Automation Lecturer
  - EPFL, since 2021

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Control Theory

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Programmable Logic Controllers (PLCs)

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SCADA

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OSI Layers / Internet Protocols

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Fieldbus

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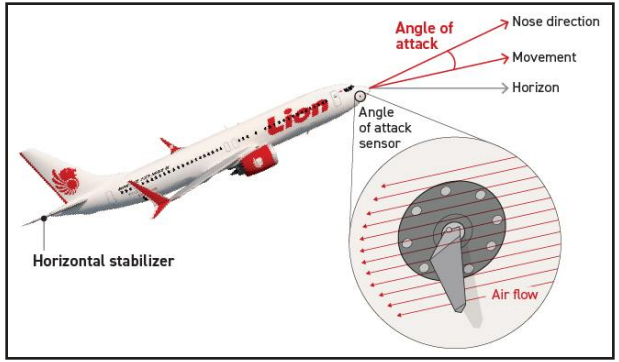
Industry Trends and Challenges

[src: wired.com]



[src: politico.com]

[src: forbes.com]

Course Goals

- Raise interest for industrial automation systems
- Understand industrial control systems (purpose, structure, HW/SW, communication networks/protocols)
- Methods and trade-offs in real time systems
- Understand terms in publications and standards
- Be able to analyze a plant and propose automation solutions
- Compare automation solutions with other domains
- Analyze reliability, availability and safety of systems
- Become productive in an industrial company or utility rapidly

Automation as a hierarchy of services

5 Planning, Statistics, Finances

4 Production planning, orders, purchase

3 Workflow, order tracking, resources

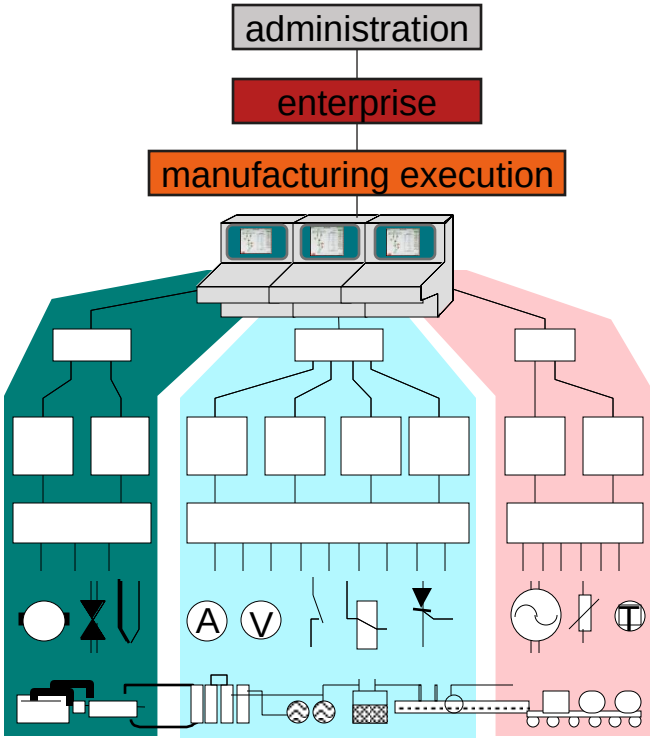
2 Supervision

SCADA =
Supervisory Control
And Data Acquisition

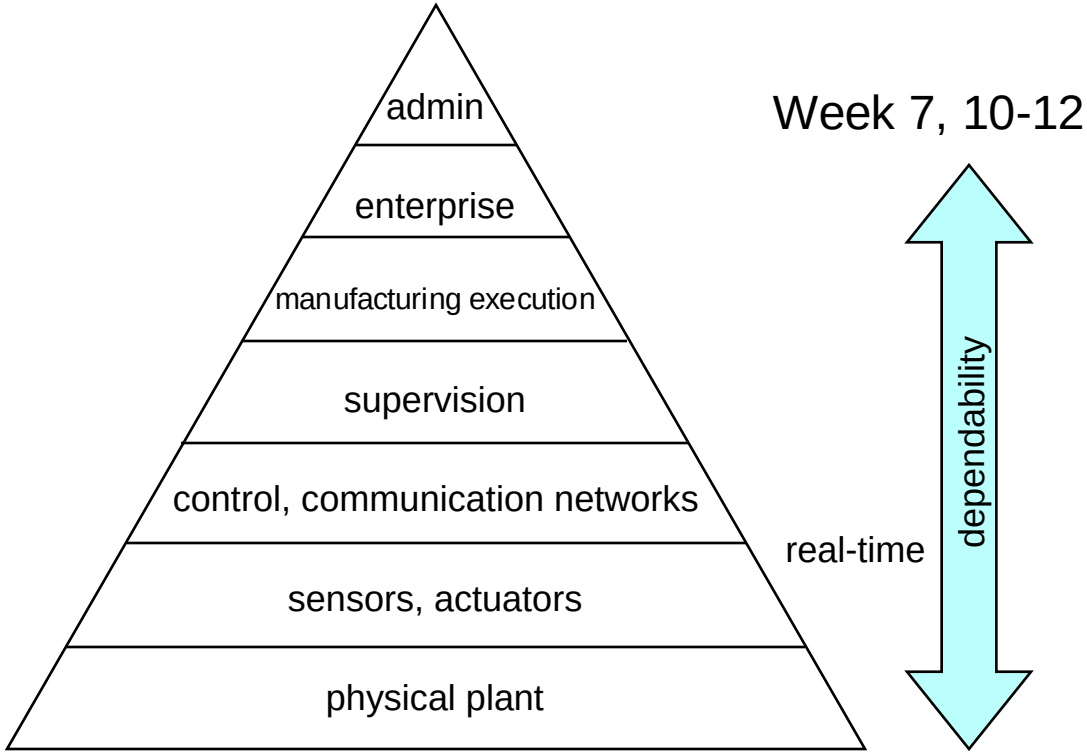
1 Control
- Group control
- Unit control

Field
- Sensors & actuators

0 Primary technology



Automation Hierarchy and Course Chapters



Course Organisation

Lecture + exercise lessons	Group project	Lab at Siemens
11 x (2 + 1) h	20h	7h

All components are part of the course. Project to be completed in groups.

Course Material on Moodle:

- Course slides and questions to prepare for exam
- Link to lecture notes
- Exercises (not mandatory, no submission)
- Link to recordings of lectures from 2021 (SWITCHtube)

Teaching Assistant: Guokai Chen

Course Timeline

Week	Date	Lecturer	Topic
1	18-Feb-25	PS	Introduction: Automation & Plants, Sensors & Actuators
2	25-Feb-25	PS	PLCs + Control
3	4-Mar-25	JCT	Human Interface and Supervision (SCADA) + Project presentation
-	11-Mar-25		School Trip
4	18-Mar-25	PS	Industrial communication networks, field bus
5	25-Mar-25	PS	Industrial Communication Protocols
6	1-Apr-25	PS	Programming PLCs
7	8-Apr-25	JCT	Dependability Analysis 1
8	15-Apr-25		Siemens Workshop (Option 1)
-	22-Apr-25		Easter Break
9	29-Apr-25		Siemens Workshop (Option 2)
10	6-May-25	JCT	Dependability Analysis 2
11	13-May-25	JCT	Dependable Architecture
12	20-May-25	JCT	Real-Time + Safety Evaluation
-	26-May-25		Siemens Workshop (Option 3)
13	27-May-25	JCT + PS	Project Presentation

Lab @ Siemens

Lab at Siemens in Renens:

- Hands-on introduction to PLC programming
- The lab is offered on three different dates:
  - April 15th, April 29th and May 26th
  - approx. 08:30 – 16:30 (to be confirmed later)

- Students need to be registered for one date
  - Registrations through Moodle, will be announced later
  - Please let us know asap when you cannot make it / need to reschedule

Project (Group work)

Project assignment to be presented in Week 3

- Propose the architecture of the automation system for a chocolate powder factory:
  - Select sensors, actuators, controllers, network architecture, etc.
  - Give guidelines for the user interface (mock-up)
  - Dependability analysis of the plant

To probe further

- Stamatios Manesis, George Nikolakopoulos, “Introduction to Industrial Automation”, CRC Press