UiO : Department of Technology Systems
University of Oslo

Introduction to TEK4030

Kim Mathiassen

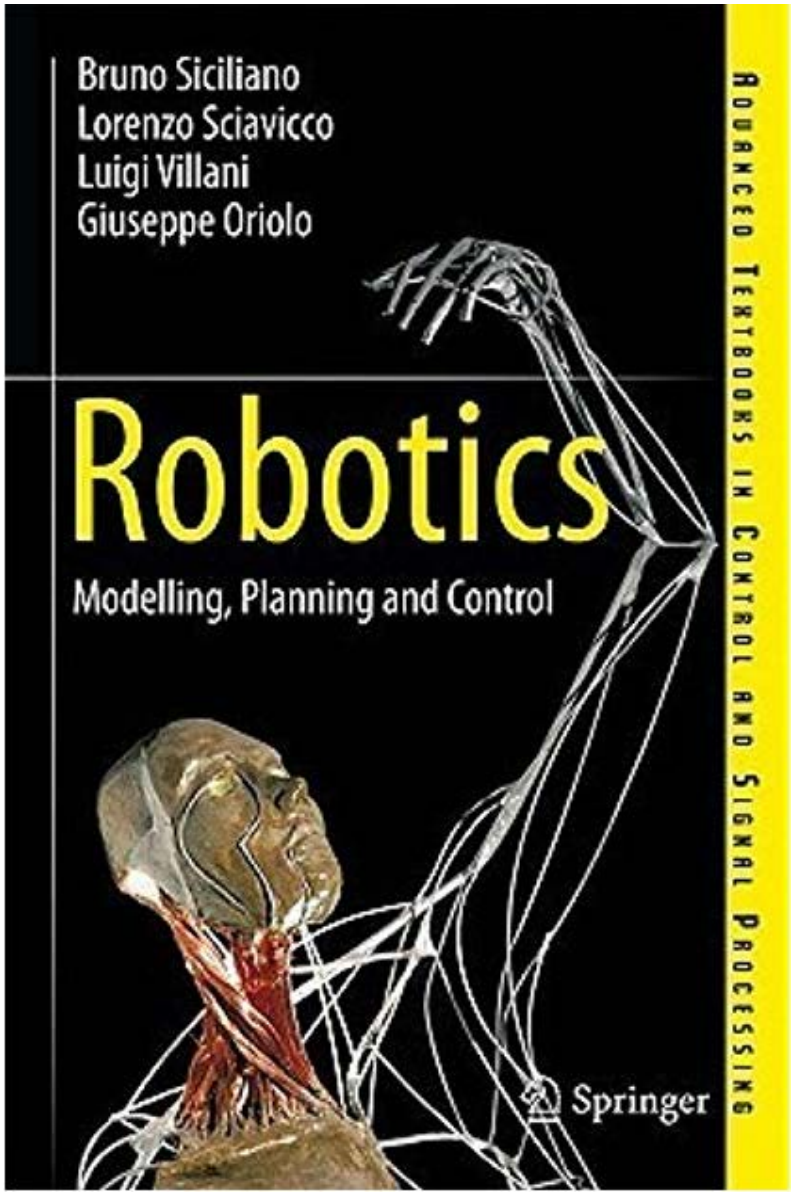
About me

- 90 % at FFI
- 20% at UiO
- Master in engineering cybernetics from NTNU
- PhD in Medical robotics at UiO
- Main research area at FFI is Unmanned Ground Vehicles and Vehicle Autonomy

Course organization

- Two hours of weekly lecture
- One hour of exercises after the lecture
- Two hours of weekly group session

- Three mandatory assignments

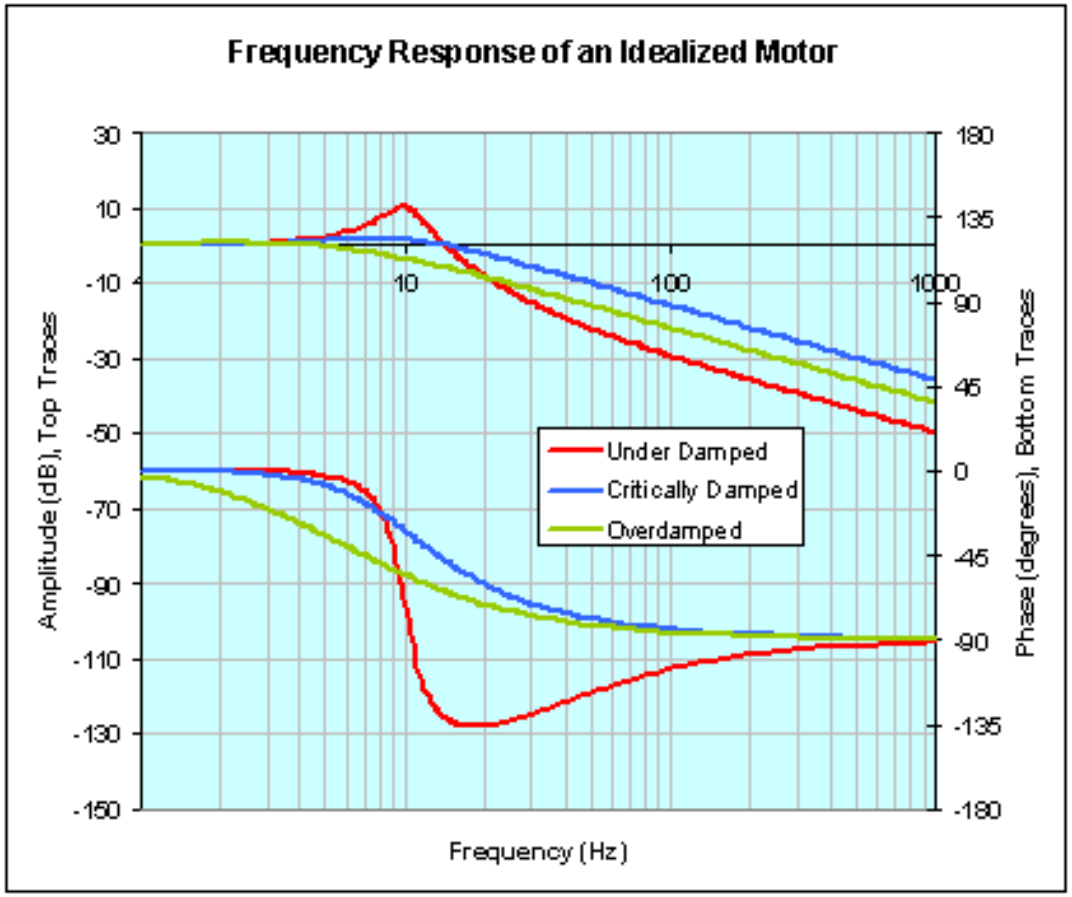


Recommended previous knowledge

- Knowledge of robotic theory (kinematics and dynamics)
  - (INF3480 - Introduksjon til Robotteknologi)
  - IN3140 - Introduksjon til Robotteknologi
  - (UNIK4540 - Matematisk modellering av dynamiske systemer)
  - TEK4040 - Matematisk modellering av dynamiske systemer
- Object orient programming (preferable C++)
- Mathematics
  - Linear algebra
  - Laplace transform

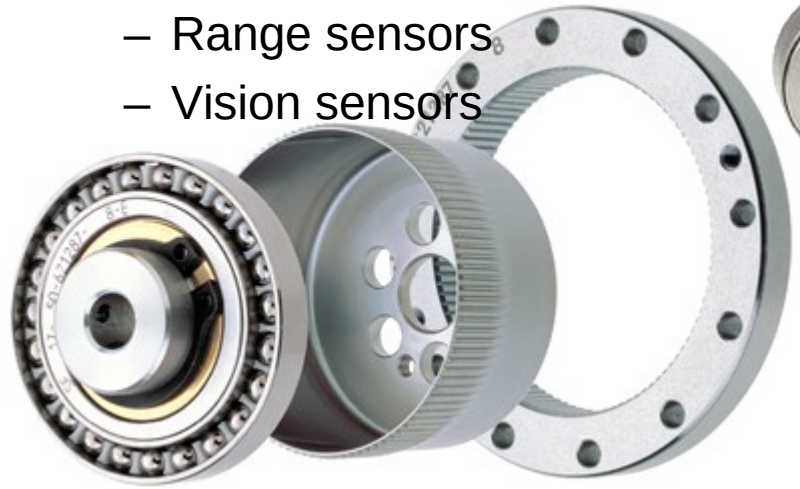
Course content – Control theory

- Laplace transform
- Frequency analysis
- State space systems
- Feedback systems
- Stability



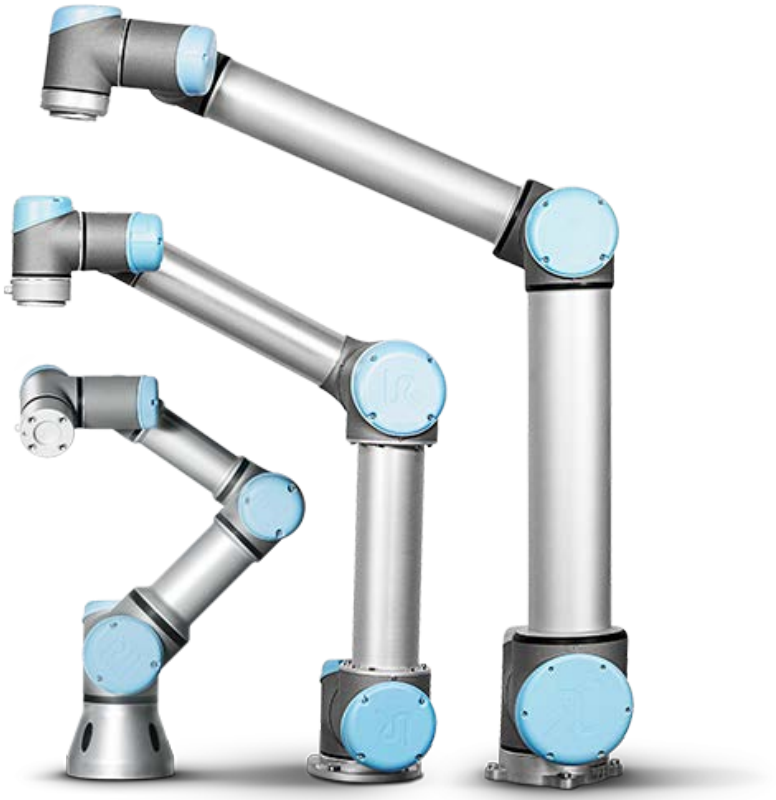
Course content – Actuators and Sensors

- Joint actuating system
- Drives
- Proprioceptive sensors
  - Position transducers
  - Velocity transducers
- Exteroceptive sensors
  - Force sensors
  - Range sensors
  - Vision sensors



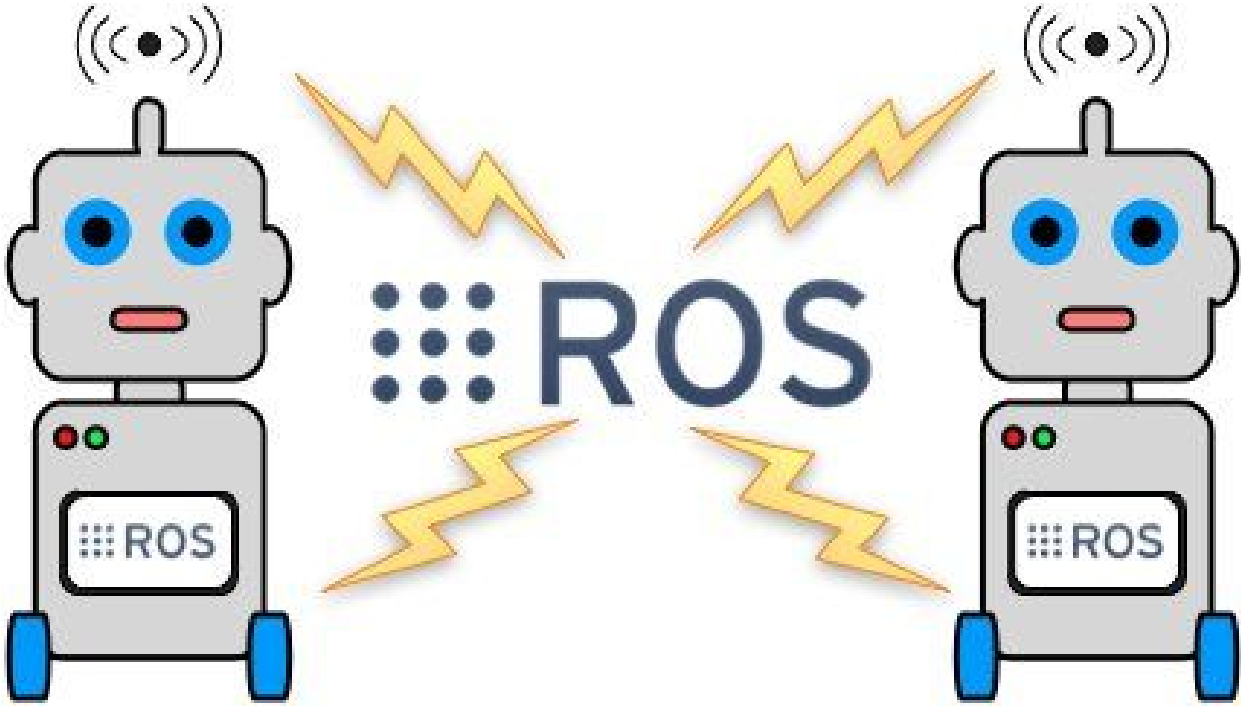
Course content – Motion Control

- Joint space control
  - Decentralized control
  - Centralized control
- Operational space control
  - Decentralized control
  - Centralized control



Course content – Robotic Operating System

- Distributed framework for robotic control
- Publisher/subscriber model
- Services
- Deployment
- Simulation



Video lecture

Course content – Force control

- Indirect force control
  - Compliance control (PD control with gravity compensation)
  - Impedance control (Inverse dynamics control)

https://www.youtube.com/watch?v=sbhiNNIxMNQ

- Direct force control

https://www.youtube.com/watch?v=O0-cC2ST5L8

https://vimeo.com/30237148#t=118s

Course content – Tele-operations

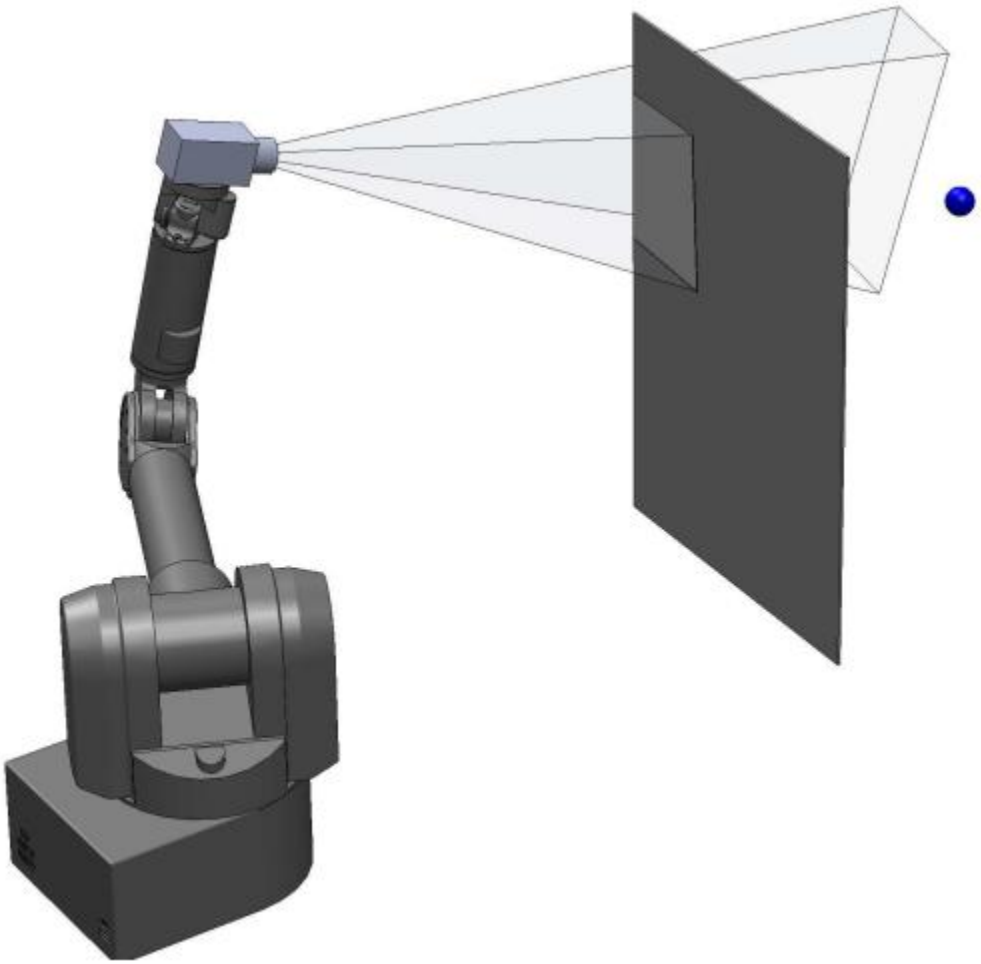
- Control architectures
- Bilateral control
- Transparency

DaVinci surgical robot

Course content – Visual servoing

- Position-based visual servoing
- Image-based visual servoing

- Will not cover the image processing aspects in depth
  - Consider taking TEK5030 Maskinsyn



Course content – Mobile robotics

- Nonholonomic contraint
- Kinematics
- Dynamics
- Planning
- Motion control
- Odometric localization
- Motion planning

https://vimeo.com/202172522

Course content – AUV and USV control

- Guest lecture

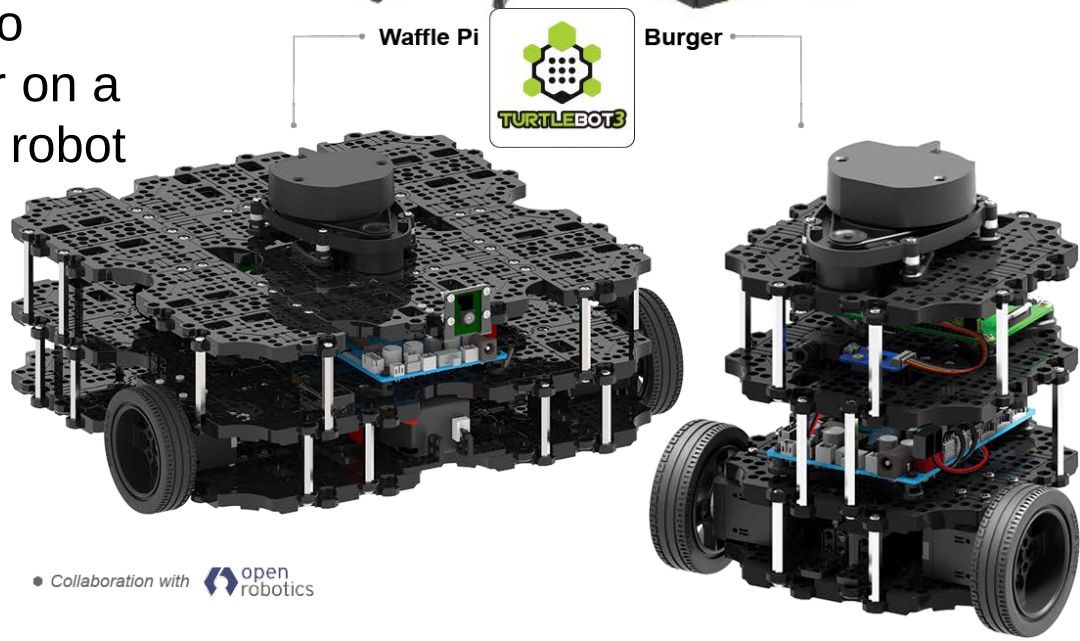
https://vimeo.com/286316704

Exam

- Written exam at the end of the semester
- 18th of December
- May change

Mandatory assignments

- Three mandatory assignments
  - Two first will mainly be theoretic and with simulations
  - Last will be a project to implement a controller on a manipulator or mobile robot



- Collaboration with open robotics

Questions?