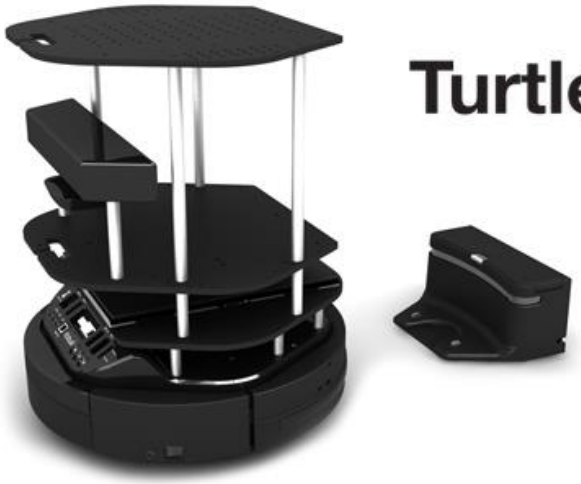
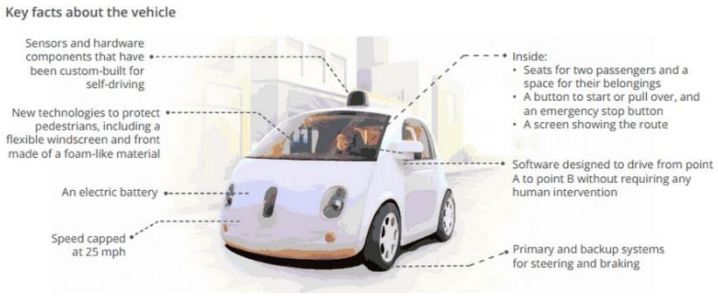
Autonomous Mobile Robots

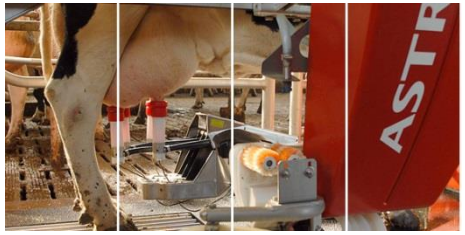


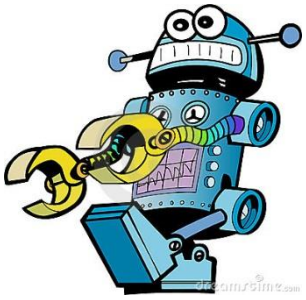
Course Intro

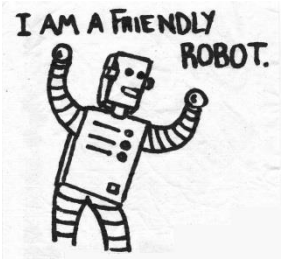
- Lecturers
  - Peter Ahrendt and Mads Dyrmann
- Course content
  - Robotics theory + Matlab exercises
  - Robotic software development + Turtlebot exercises
- Group exam based on final report (passed/not passed)
- 30 min. oral defence (presentation+questions)

What is robotics ?









Robots

- One definition :

  ”A goal-oriented machine that can sense, plan and act”

- Robota – (slave) work, hard work
  - Dirty, Dangerous and Dull (?!)

Industrial robots

Autonomous Mobile Robots

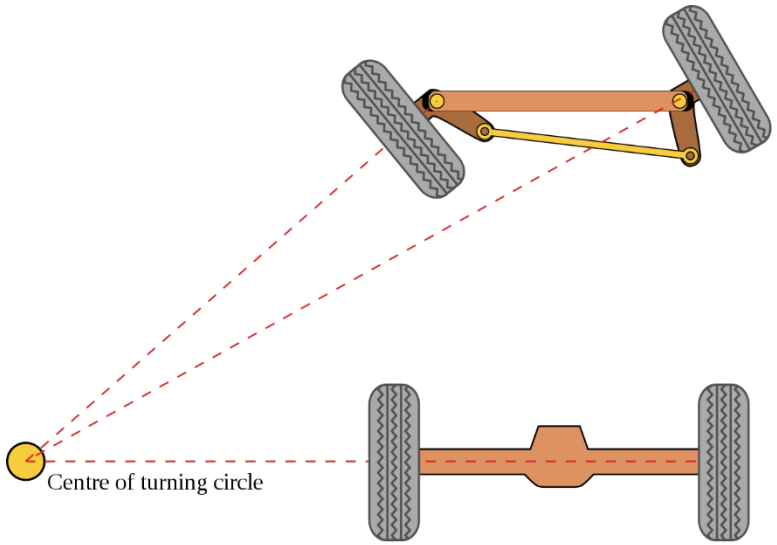
Turtlebot

Gazebo + Turtlebot

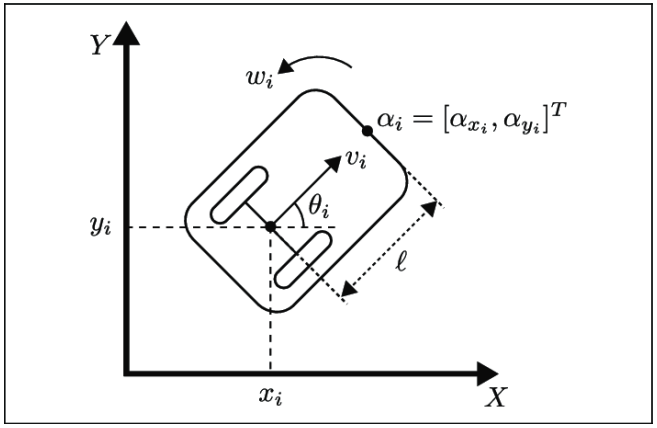
Autonomous Mobile Robots - overview

- Kinematics / dynamics
- Motion planning / navigation
  - Map-based planning / trajectory tracking
  - Motion control
- Localization
- Map building and updating
- Sensors and actuators
  - Vision-based, IMUs, tactile, ..

Kinematic models

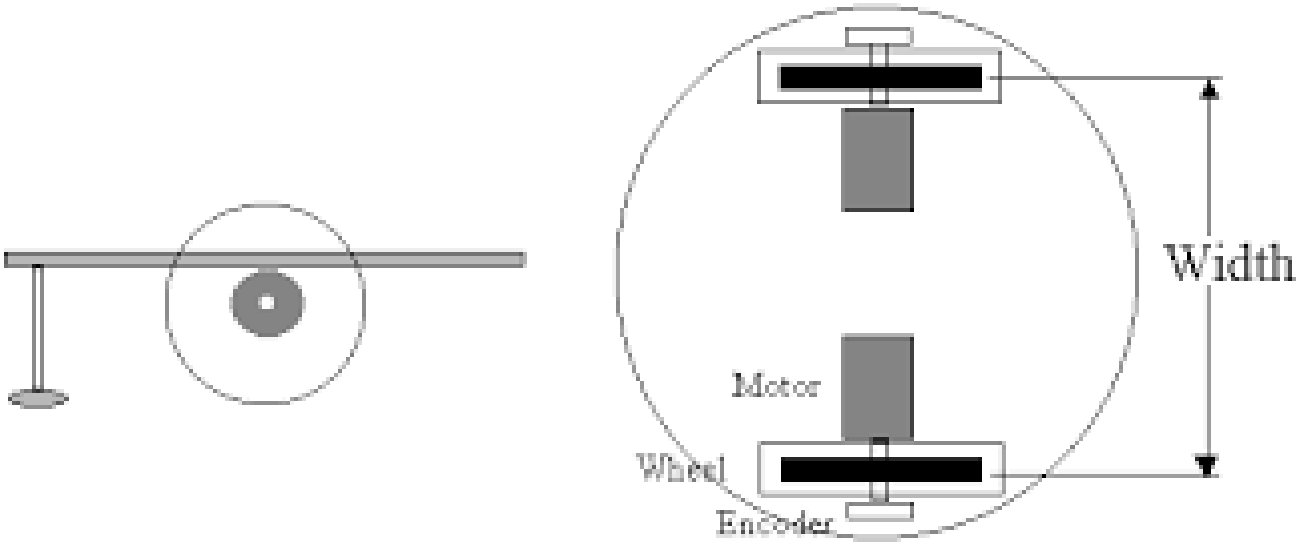


Ackermann steering



Differential drive steering

Turtlebot kinematics and dynamics

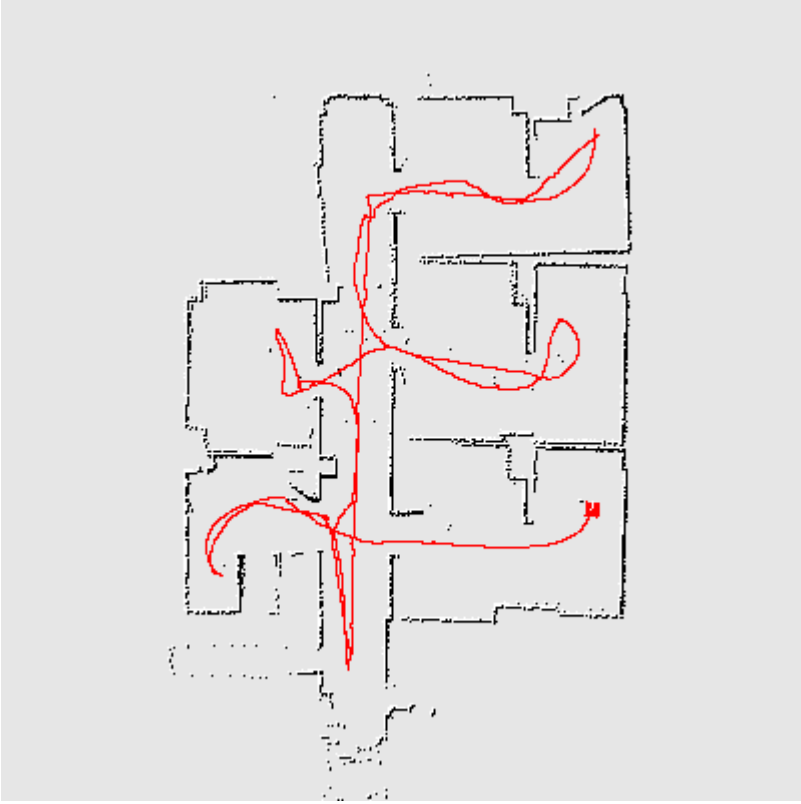


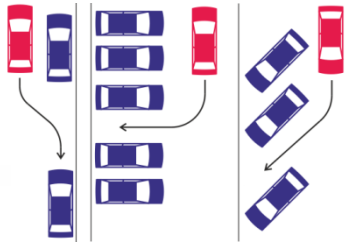
Path vs. trajectory

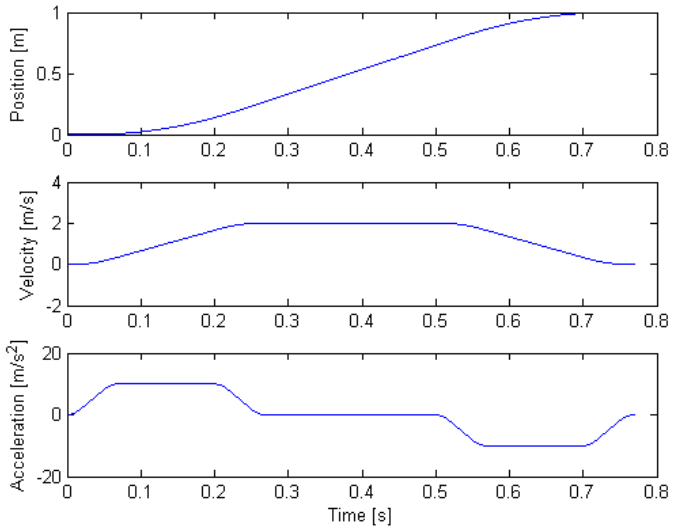
- Path - List of positions
  - [[x1, y1], [x2, y2], ..]
- Trajectory – List of positions with time information
  - [[t1, x1, y1], [t2, x2, y2], ..]

- Note – Pose for turtlebot is [x, y, θ] (in world coordinates)

Trajectory generation



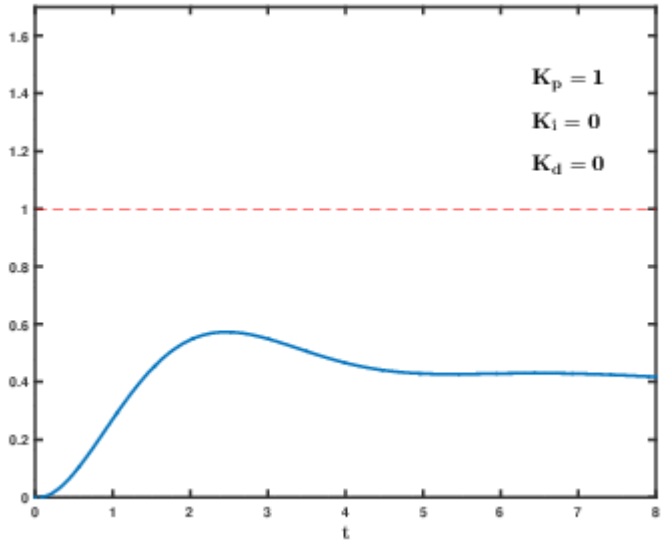




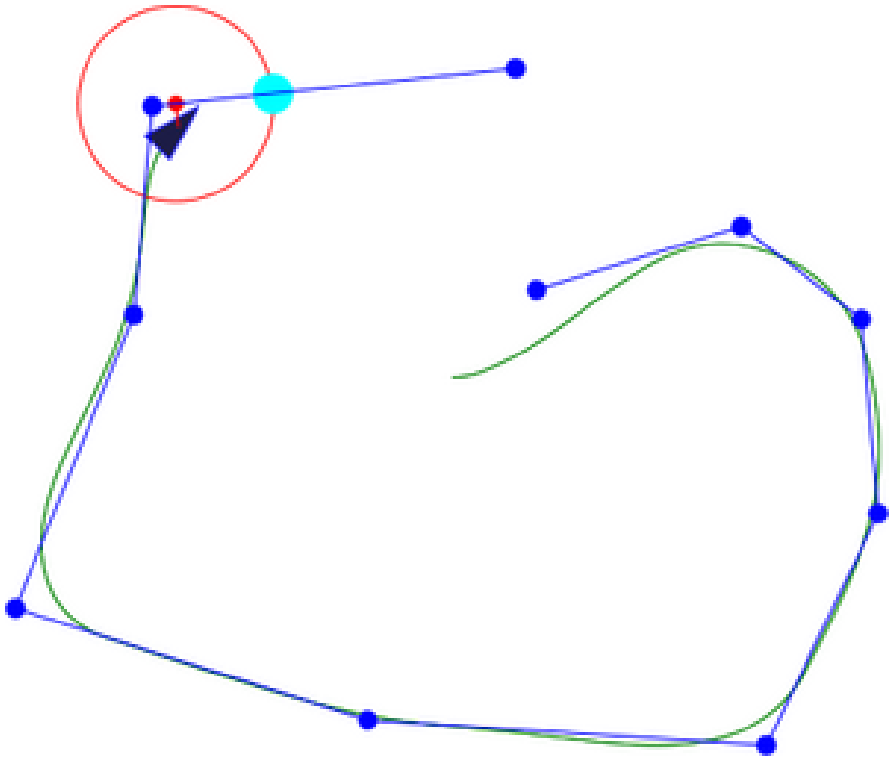
Path tracking – PID basics

- PID = Proportional-Integral-derivative

$$u(t) = K_p e(t) + K_i \int_0^t e(t)dt + K_d \frac{de(t)}{dt}$$



Pure Pursuit algorithm



http://se.mathworks.com/help/robotics/ug/pure-pursuit-controller.html

Exercises

- Form groups of 3-4 persons (ideally multi-disciplinary)
- Download and examine Peter Corke's Robotics Toolbox and Machine Vision Toolbox (http://www.petercorke.com/Toolboxes.html)
- Have a look at Mathworks Robotics Systems Toolbox (http://se.mathworks.com/help/robotics/index.html)
- BB exercises (including 1 mandatory!)