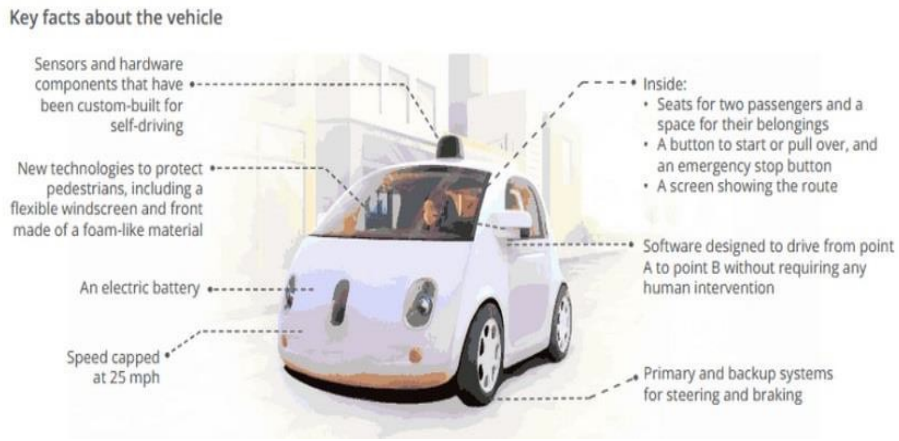
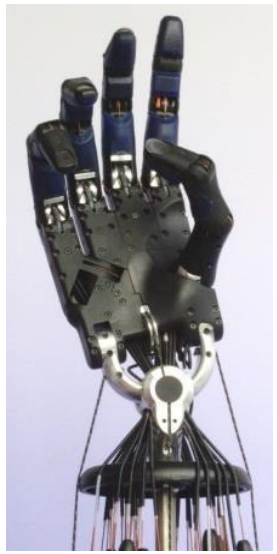
AUTONOMOUS MOBILE ROBOTS

COURSE INTRO

- Lecturers
  - Mirgita Frasheri & Andryi Sarabakha
- 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 ?





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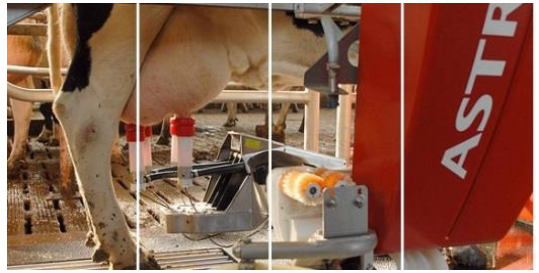

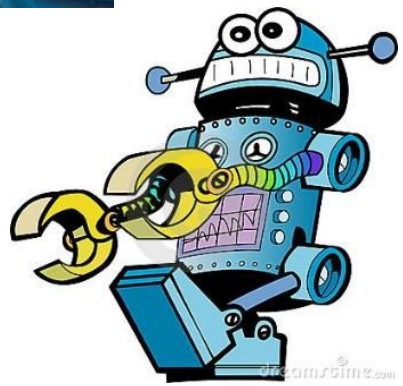

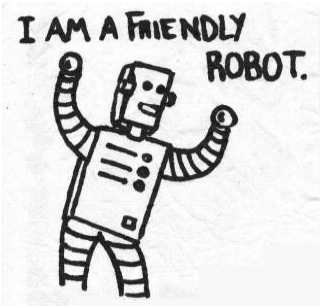

ROBOTS

- One definition :

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

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

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

EXAMPLE 1

Imperial College London

https://physicsworld.com/a/team-of-flying-robots-builds-structures-using-3d-printing/

Imperial College London

Flying drones that mimic ants &bees

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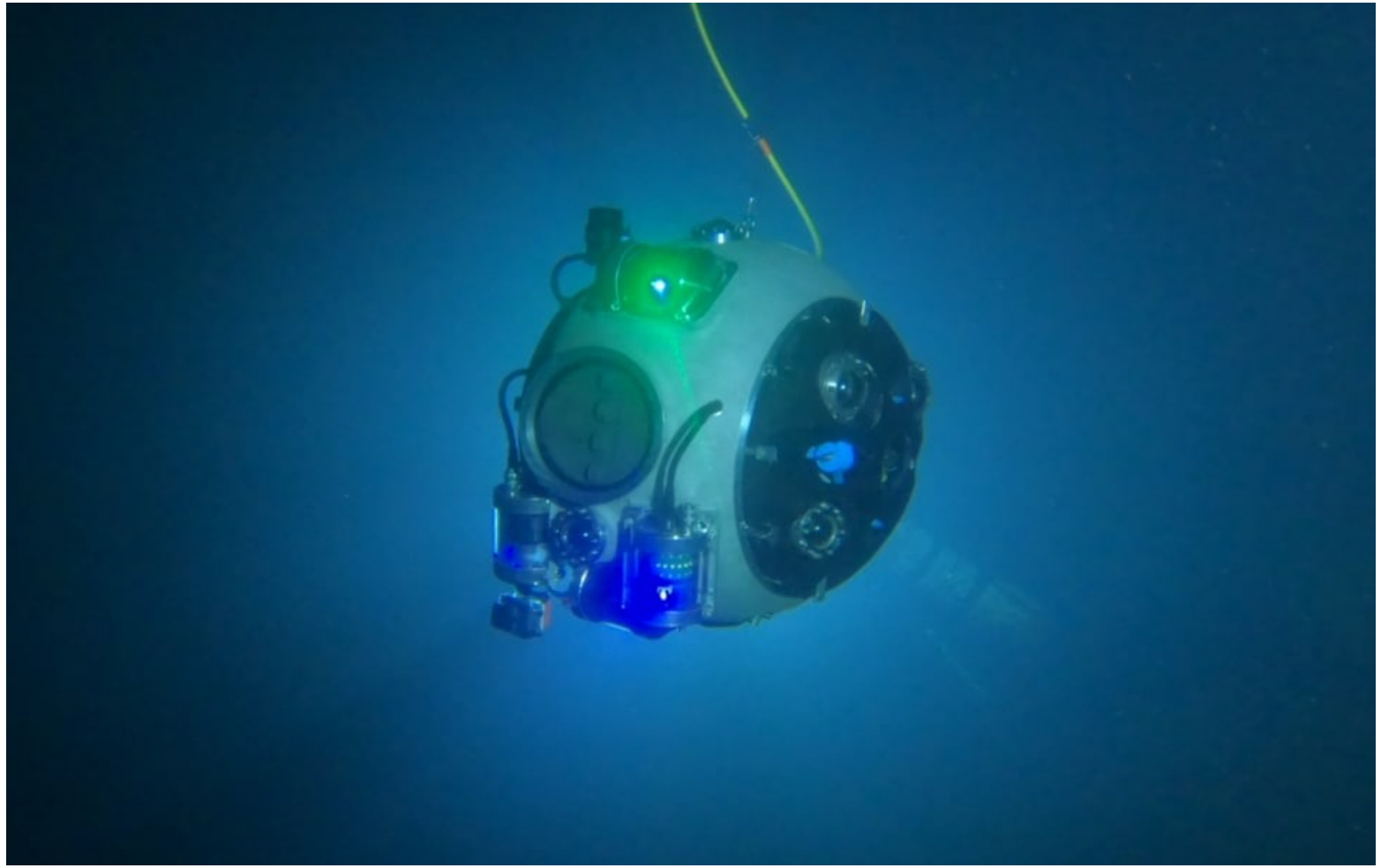
Imperial College London

Flying drones that mimic ants &bees

Dangerous, unreachable environments

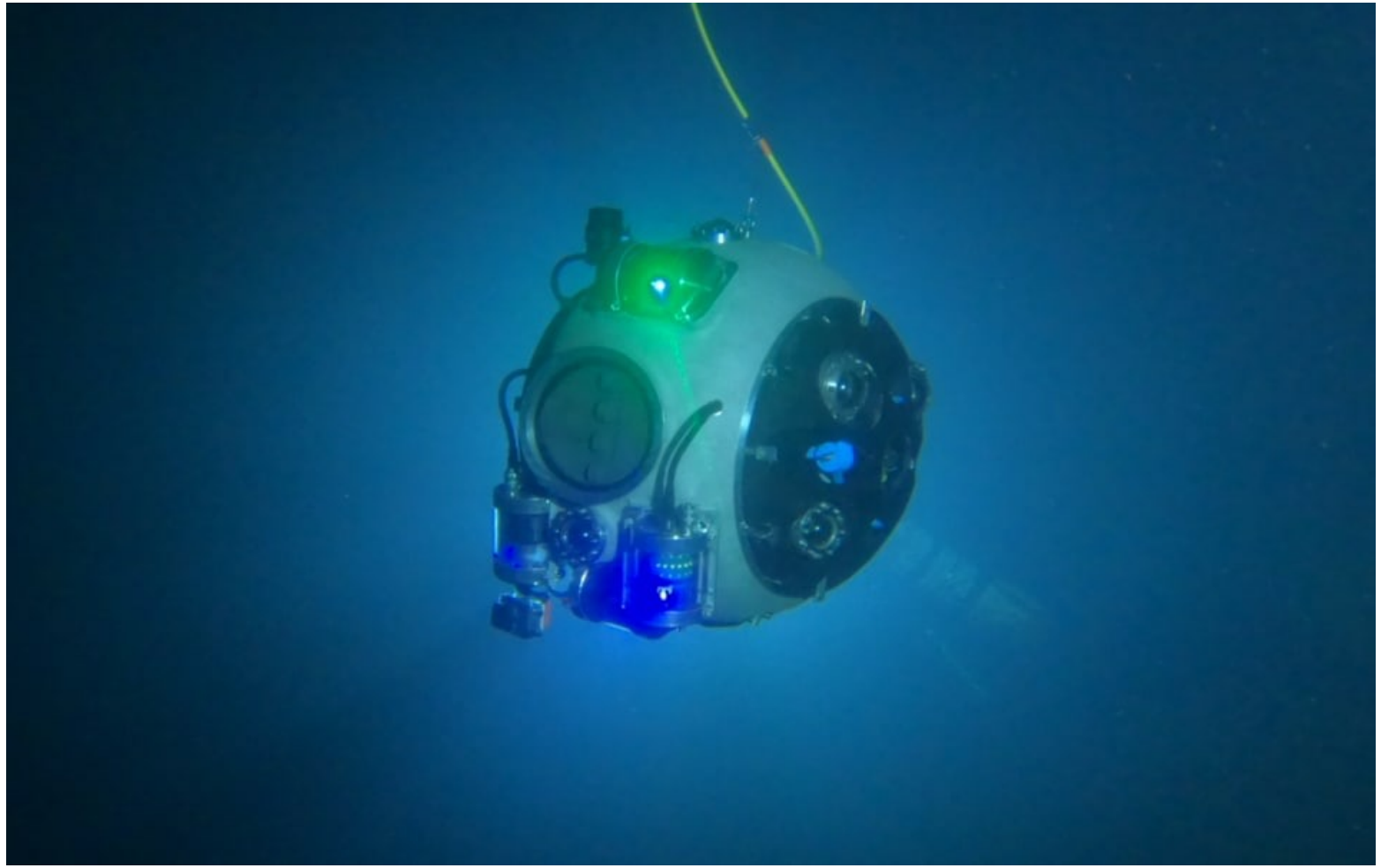
https://physicsworld.com/a/team-of-flying-robots-builds-structures-using-3d-printing/

EXAMPLE 2



La Palma Research Centre

https://physicsworld.com/a/swimming-robots-help-europe-rediscover-its-mining-mojo/



La Palma Research Centre

3 robots for surveying the area

https://physicsworld.com/a/swimming-robots-help-europe-rediscover-its-mining-mojo/

INDUSTRIAL ROBOTS

OMRON ADEPT QUATTRO

EPSON

KUKA

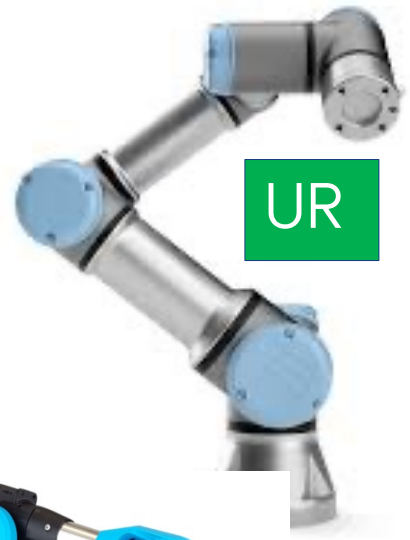
SCARA

MOTOMAN

INDUSTRIAL ROBOTS

OMRON ADEPT QUATTRO

EPSON



UR

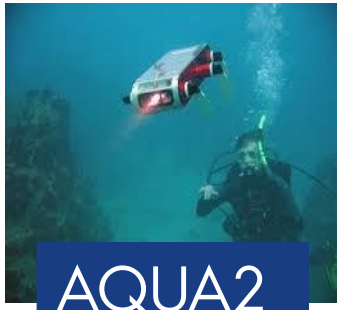
KUKA

SCARA

MOTOMAN

NED2

AUTONOMOUS MOBILE ROBOTS



AQUA2

Phantom 2

ASIMO

iRobot roomba

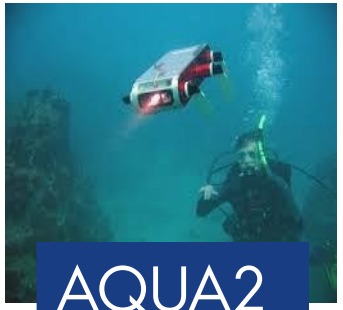
Intelligent one

MIR100

Capra robotics

Robotti

AUTONOMOUS MOBILE ROBOTS



AQUA2

Phantom 2

ASIMO

Desktop Robotti

iRobot roomba

Intelligent one

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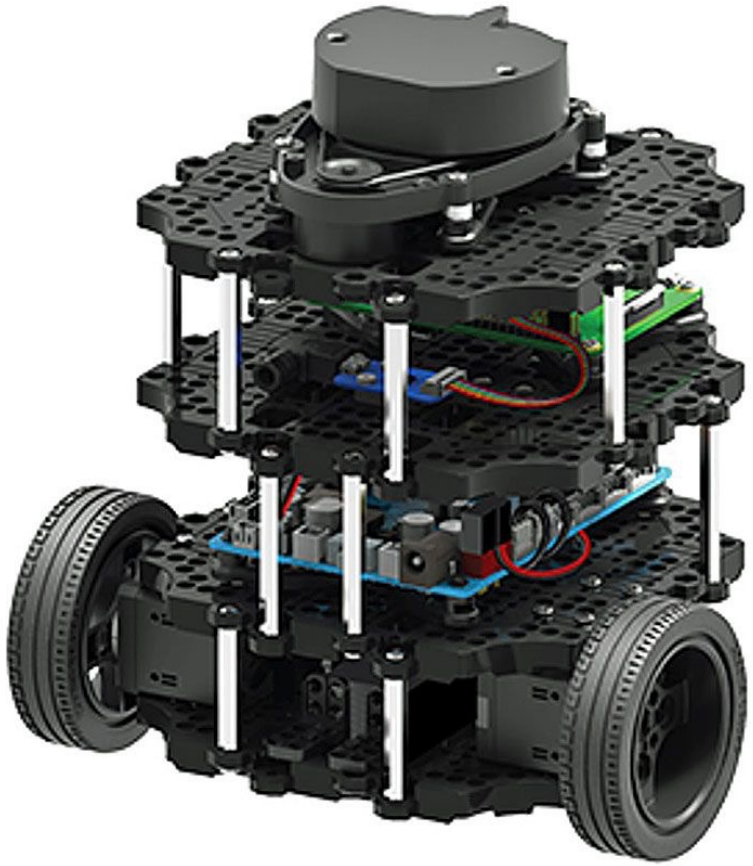
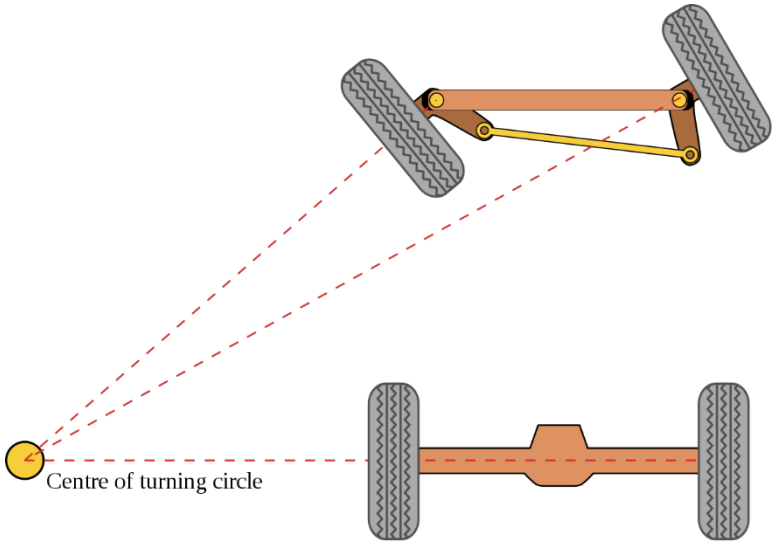
TURTLEBOT3 – THE BURGER



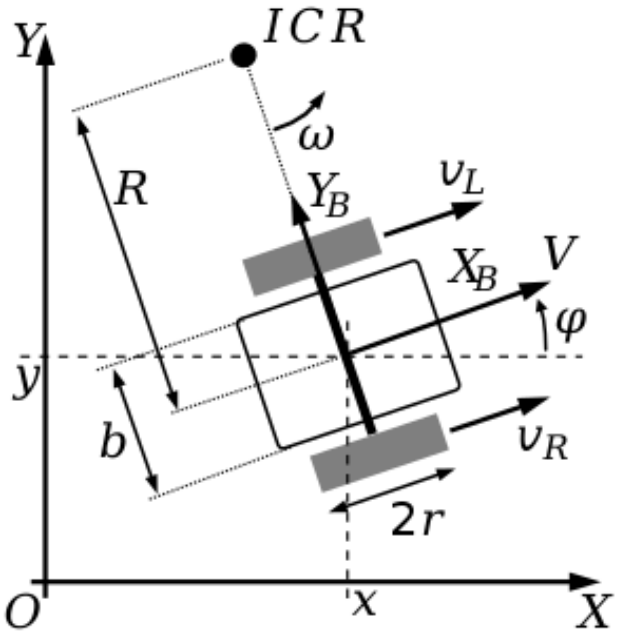
AUTONOMOUS MOBILE ROBOTS - OVERVIEW

- 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

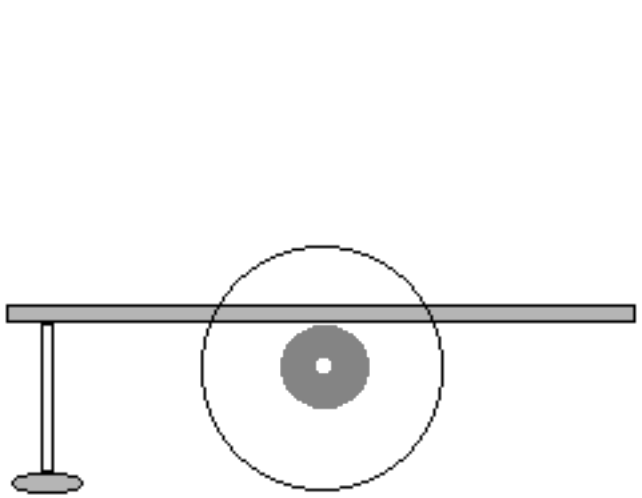


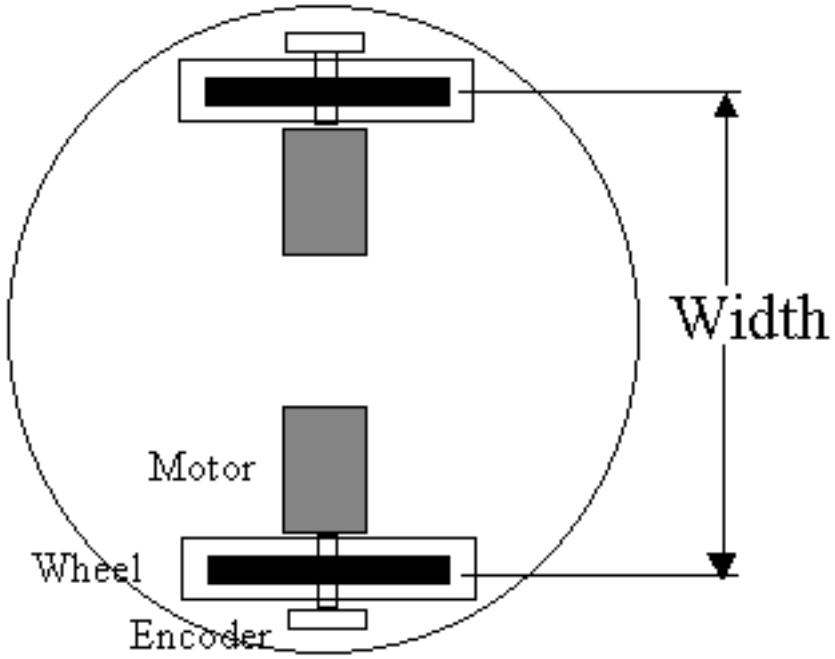
Ackermann steering



Differential drive steering

TURTLEBOT KINEMATICS &DYNAMICS



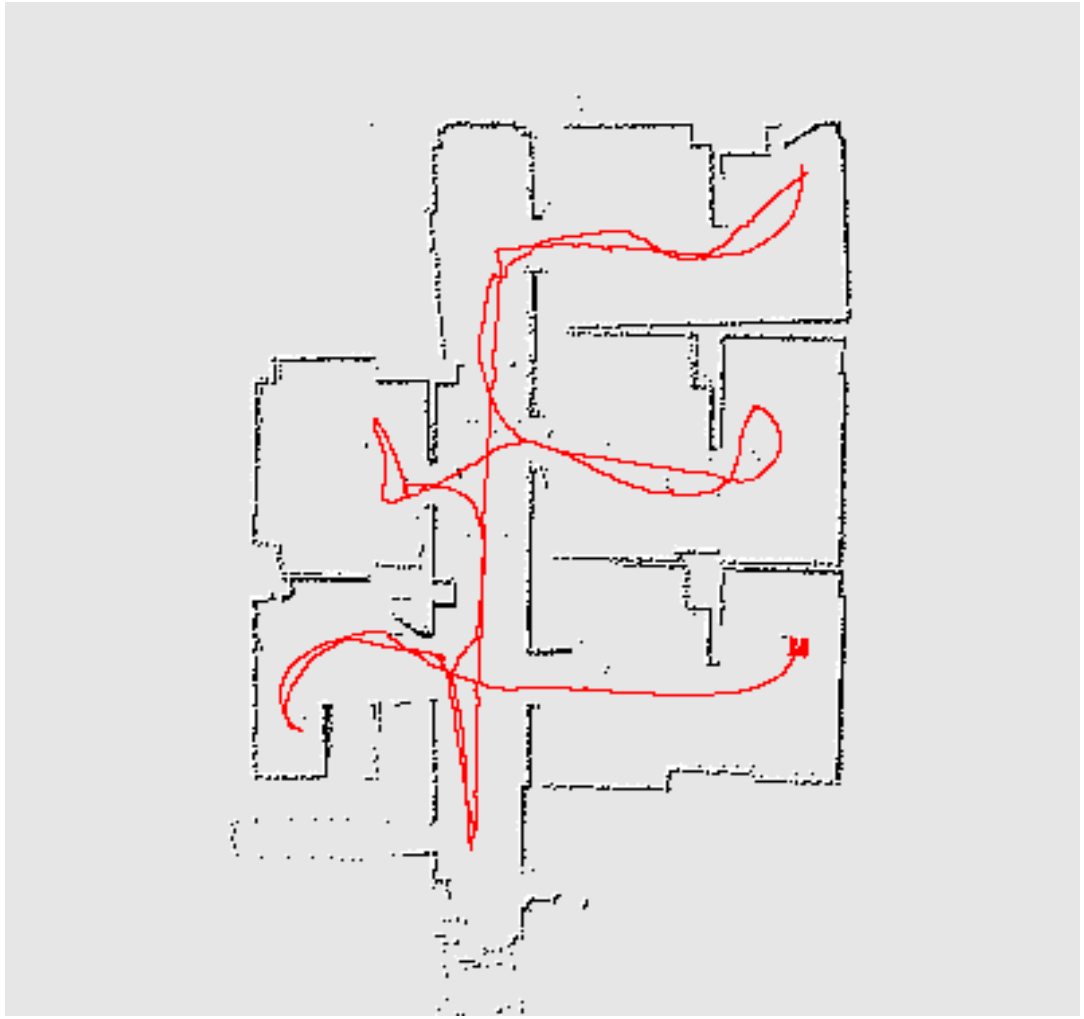


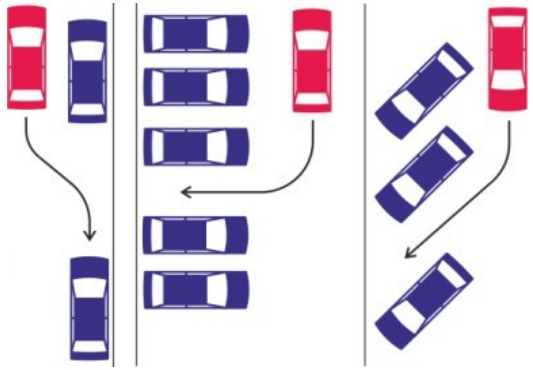
MATLAB DEMO

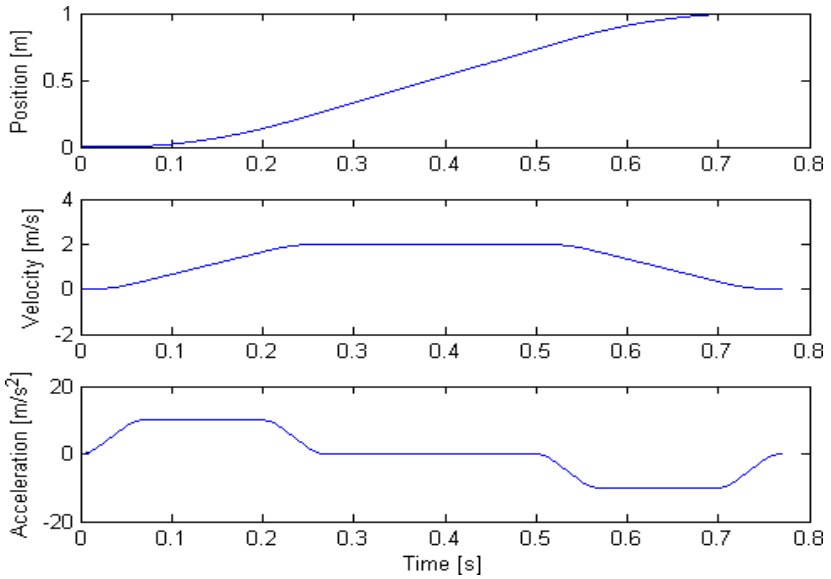
PATHS, TRAJECTORIES & POSES

- 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







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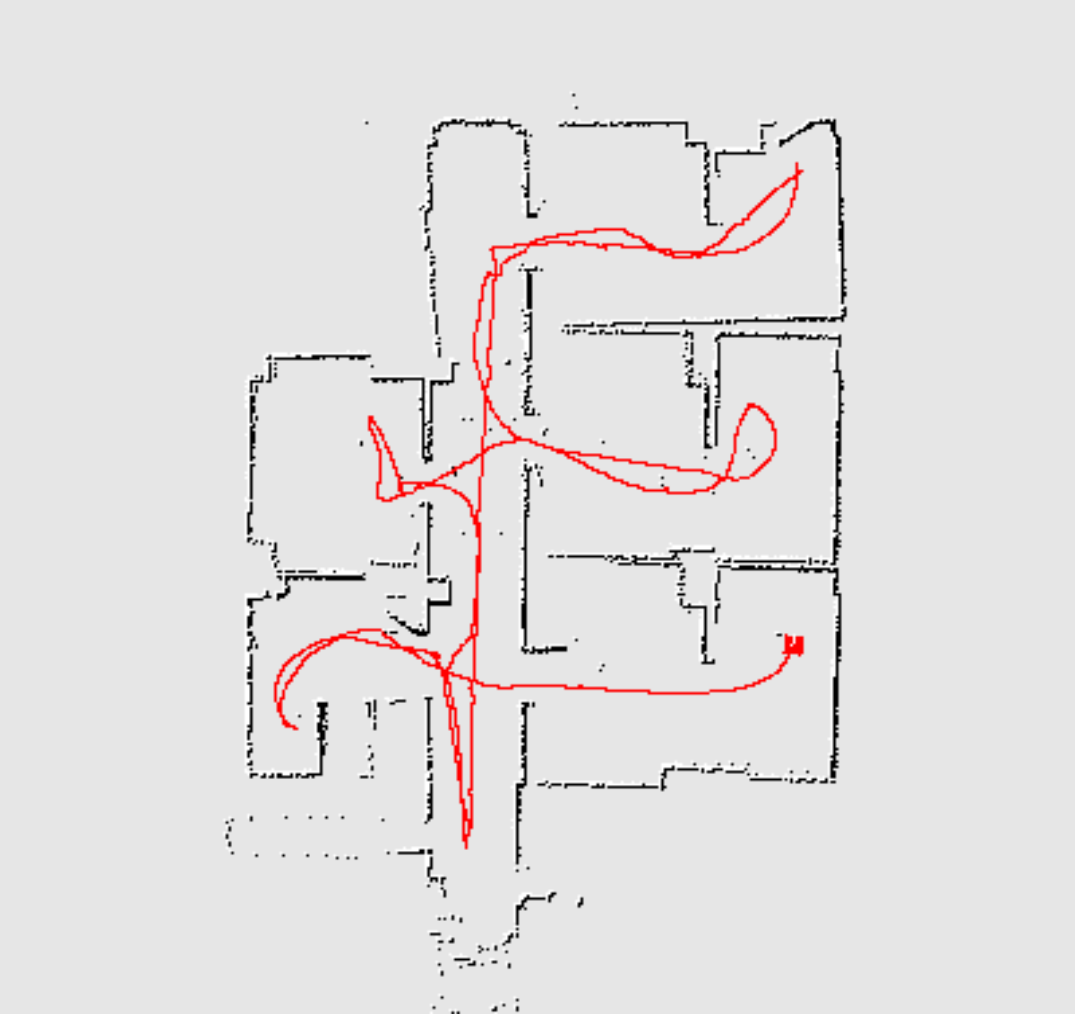
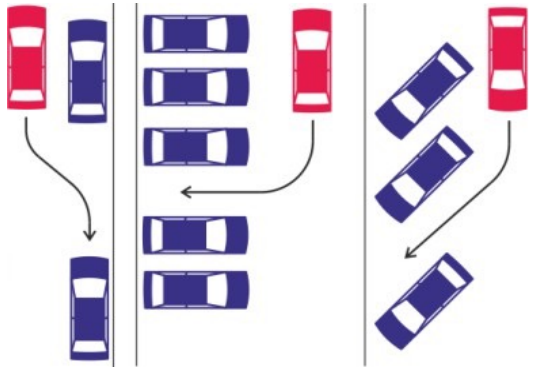
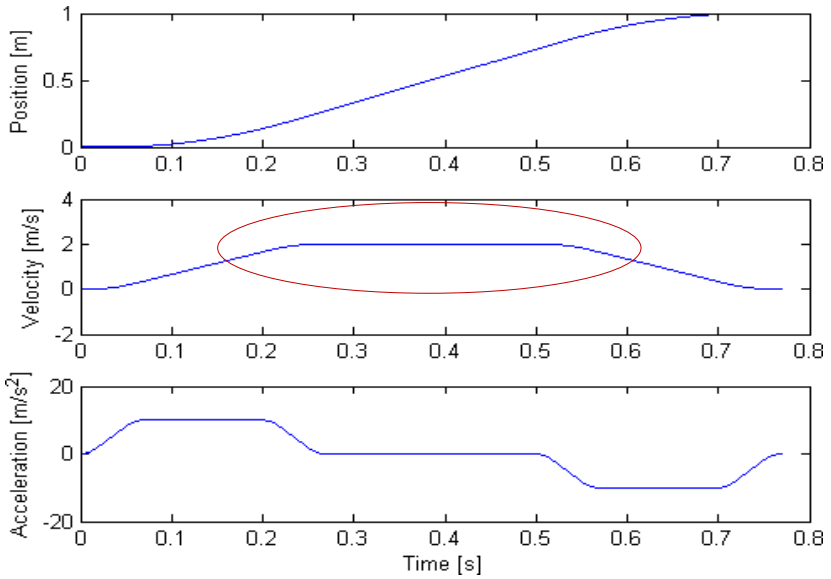


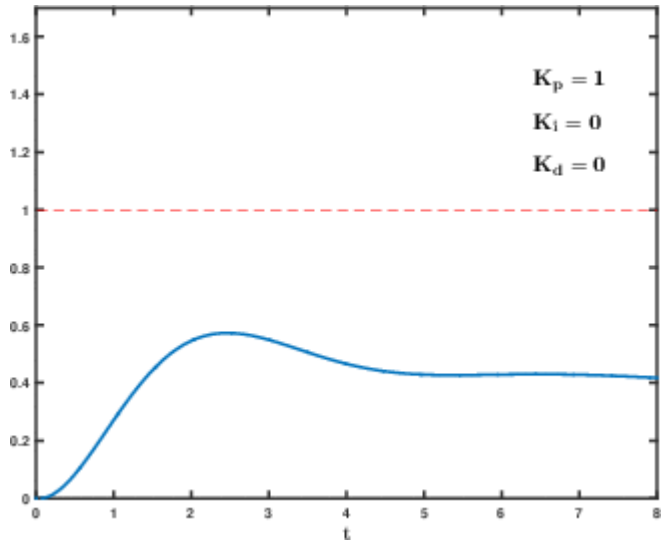




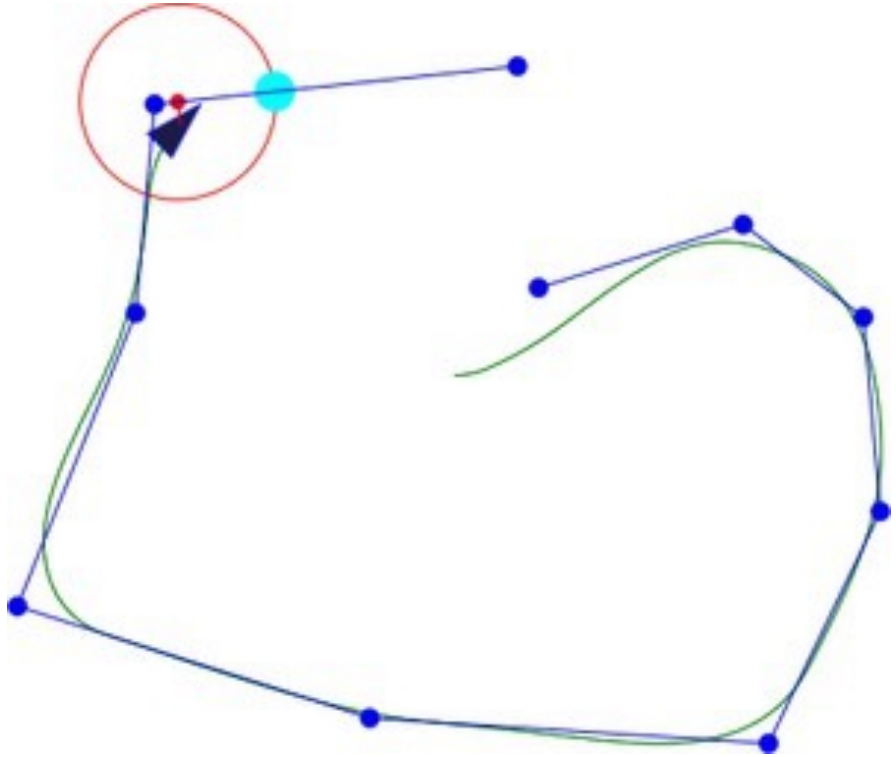
Chapter 3.3.1

PATH TRACKING

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



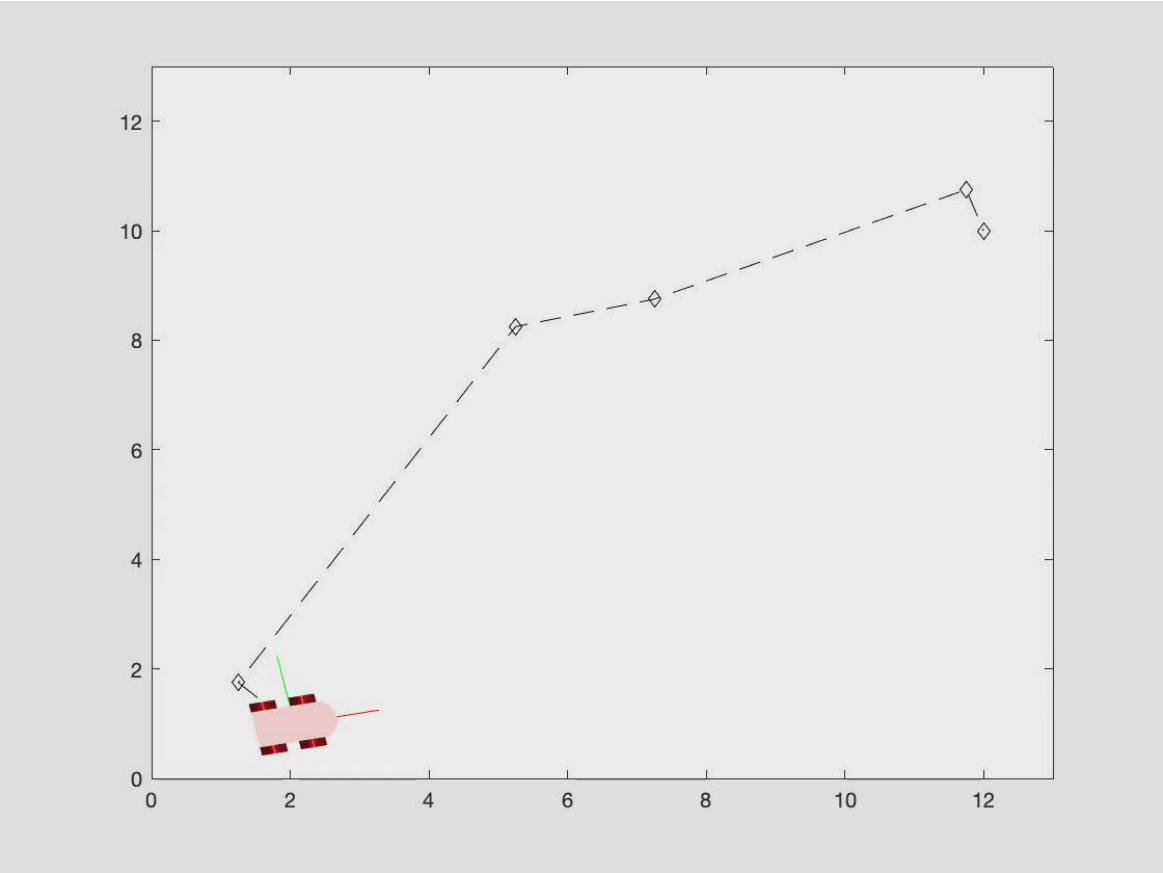
PURE PURSUIT



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

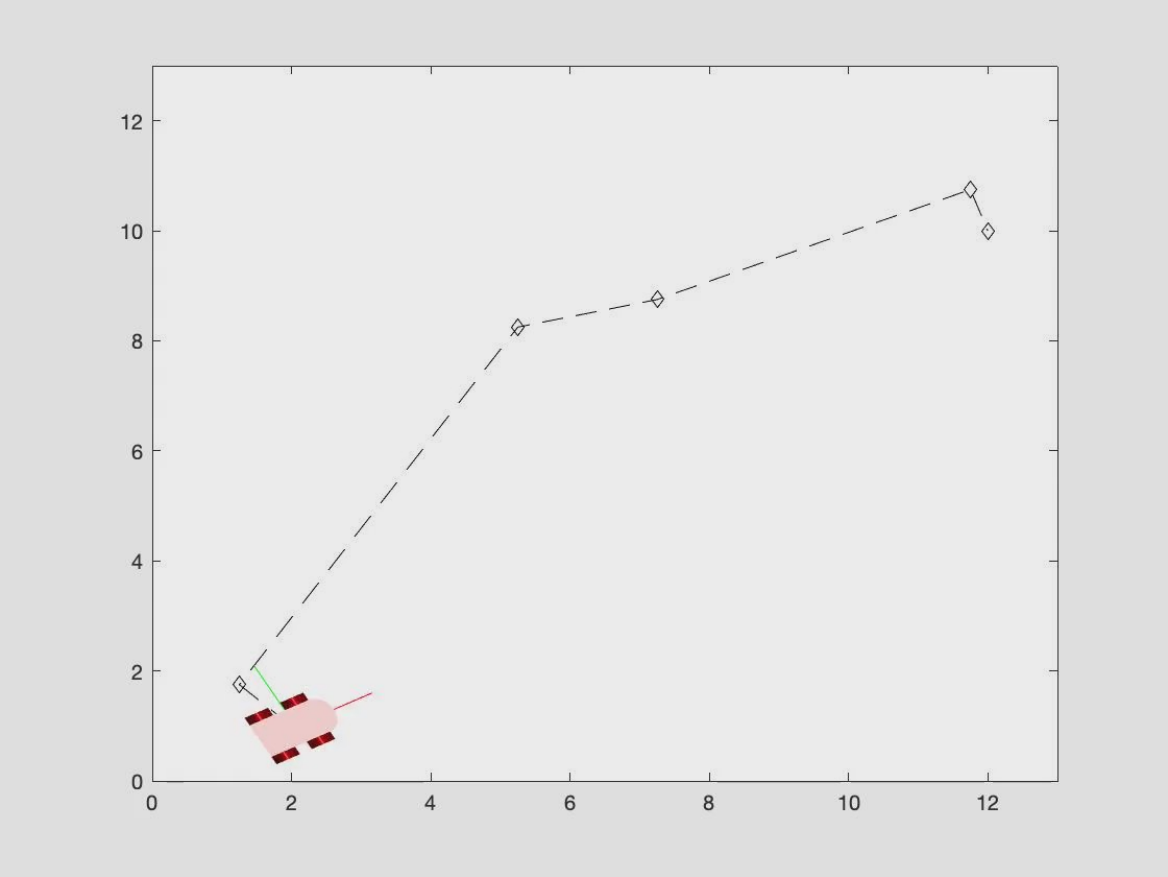
PURE PURSUIT – MATLAB EXAMPLES

- Stable



PURE PURSUIT – MATLAB EXAMPLES

- Unstable



MATLAB DEMOS

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)

Brightspace exercises (including **1 mandatory!**)

mirgita.frasheri@ece.au.dk

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UNIVERSITET