

# Summer School 2017

## ***Robot based warehouse automation and iterative learning control for autonomous race robots***

### **Background**

Modern warehouse systems can take advantage of using robots. An example for two-dimensional warehouse systems is the Kiva System, that uses robots to relieve humans from tedious transport tasks. The path following accuracy of the robots is assured by simple feedback control with magnetic tracks in the floor.

A human that drives a racing car through a race track is limited by reaction time and other human limitations. Using controllers for autonomous driving to follow the path can improve the performance of the vehicle by far.



**Figure 1: Kiva warehouse robots**  
© Joel Eden Photography / Kiva Systems



**Figure 2: Autonomous car**  
© Steve Jurvetson

### **Project description**

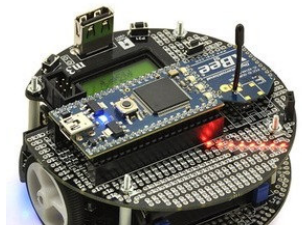
In the project the warehouse robots and autonomous cars will be approximated by a simple Pololu m3pi Robot that is shown in Figure 3. This Robot is equipped with light sensors on the bottom, which can be used to detect lines on the ground, as well as a programmable microcontroller and can therefore be used for feedback control.

In a final competition between the three student groups your robot has to solve the following tasks in a minimal amount of time.

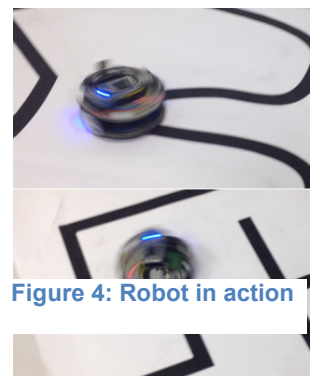
- Warehouse: executing transport tasks by following predefined ways (Tasks are transmitted via Bluetooth)
- Race track: reduced lap time of different courses by smart algorithms with feedback control

### **Schedule**

- learning Basic functions (object oriented programming c++)
- Path following with PID-controller
- System identification and PID-controller-tuning (Matlab)
- Detect and pass crossings and turns
- Design strategy for warehouse robot
- Fine tuning warehouse robot
- Fine tuning of designed controller
- Final competition: Warehouse and race track



**Figure 3: Pololu m3pi**



**Figure 4: Robot in action**

## Literature

Pololu m3pi User's Guide <http://www.pololu.com/docs/0J48>

Pololu 3pi User's Guide <http://www.pololu.com/docs/0J21>  
(The 3pi is the platform for the m3pi)

mbed Handbook <https://mbed.org/handbook/Homepage>  
(The mbed ist the programmable microprocessor)

mbed m3pi Cookbook <http://mbed.org/cookbook/m3pi>  
(The library of existing functions that can be used)

C++ Language Tutorial <http://www.cplusplus.com/doc/tutorial>  
(Tutorials for the object oriented language C++)