



**Übung zur Vorlesung**

**Vernetzung autonomer Systeme (VASY)**

**Übung 2**

**Labortermin: 11. bis 18. Dezember 2017**

**Abgabe (vorläufig): 8. Januar 2018**

Die Abgabe erfolgt durch Hochladen der Lösung in Moodle. Zusätzlich wird die Lösung in der Übung nach dem Abgabetermin stichprobenartig kontrolliert.

**Bearbeitung in Dreier-Teams**

**Team-Mitglied 1:**

**Team-Mitglied 2:**

**Team-Mitglied 3:**

# Experiment: XBee Remote Controlled Car

In this exercise you’re going to implement a remote control for a car with signals being transported via XBee.

## Getting Started

1. You get a car equipped with a SparkFun Motor Driver Dual TB6612FNG that controls the two motors of the car. One controls the rotation of the wheels for going forward or backward. One controls the direction of the wheels for going straight or driving curves. The motor driver accepts 4 input signals (IN1, IN2, PWM, STBY) per motor that are translated to two output signals (OUT1, OUT2) going to the motor. For a description of the input and output signals check the data sheet of the motor driver, in particular the table “H-SW Control Function” and the figure “Block Diagram”. By the two digital input signals (IN1 and IN2) you control the motor operation and by the analogue input signal (PWM) you control the intensity of the motor activation. Btw. CW means clockwise and CCW means counter clockwise.
2. The motor driver is controlled by an Intel Edison that is also connected to an XBee radio module. A short intro on how to work with the Edison is provided in Moodle.
3. You also get an Arduino Mega with XBee module as RC.

## Controlling the Car by a Local Script

1. Get started by implementing a script running on the Intel Edison to control the car locally. In the first step activate the motor and the wheels. Try to go straight and backwards with different speeds. Try to drive more or less narrow curves with different speeds.
2. Set up different trajectories e.g. driving straight for exactly one meter or turn left in a precise 50cm circle. Keep this scripts.  
   Hint: You will learn that the car is not entirely deterministic and you cannot make it go ahead for precisely one meter. Try to get close.
3. Set up a racing course on the ground that the car should go as fast as possible. Which team is the fastest?

## Communication via XBee

1. Configure the XBee modules via XCTU.
2. Connect the Arduinos to the Mega and the Edison.
3. Establish some communication between the Mega and the Edison using transparent mode. Configure the XBee modules before connecting them to the Edison.

## Remote control the car via the Mega

1. Think about how to control the car from the Mega in particularly about the granularity, frequency, and number of commands. This determines the autonomy of the car.
   * no autonomy: the Edison just forwards controls received from the Mega to the motor controls. The Mega sends settings for the input signals to the Edison
   * full autonomy: the Mega just sends an Integer number, the Edison interprets the integer number to a complex driving pattern that is locally stored.
2. Implement a script on the Arduino that drives the car along the racing course. Can you keep the same speed?
3. Control the car from the console connected to the Arduino. Now you probably want to have a more coarse-grained control. Reconsider your choice above.

## Range test

1. Run the range test you implemented in the first lab between your Mega and the car. Run the car along the floors until no signal is received. From the programmed trajectory you should now the distance between Mega and car. Plot the RSSI over the distance. Repeat the experiment several times and comment on the statistical significance of the results.
2. Also use Pro module and check whether the distance increases.