Objectives

During the lab sessions the students will be exposed to the following subjects:

Session 1 (introduction, 4h):

Learn to use Simulink, design a simple Simulink diagram, use the basic Simulink blocks to build a model of a servo motor with arbitrary parameters. Learn to use the ev3 simulink blocks, interface Simulink with the Mindstorms light sensor and servo motor. Design a basic low-pass filter and use it on the light sensor output. Use Simulink to activate a servo motor, receive position data from the encoder. Check the step response of the motor with different loads.

Session 2 (actuators ,4h):

Measure the step, ramp, frequency responses of a servo motor and use the data for model identification. Identification is done in class by simple trial and error. Instructions for more advanced identification techniques, using canonical responses, can be given as homework to the students.

Design an open loop and closed loop proportional control of the actuator, implement the positioning system using closed-loop control. At this stage students have probably not seen reachability, observability and pole placement, but instructions on pole placement can be given as homework. Possibly use root locus and motor model to drive the choice of the control parameters.

Session 3 (sensors, 4h):

By this stage students should have a basic understanding of canonical and frequency response of a linear system. Design of a low-pass filter to reject disturbances in rapidly changing light conditions (clouds, someone passing in front of the sensor). Learn to use Stateflow and design an automaton that sequentially reads the brightness of a set of points at equally distributed angles.

Session 4 (optimization, 4h):

Implement a least square algorithm to construct an approximating function to the brightness measures, test the full system.