Accomplished this week:
We are still working on finding a model of the system that later can be used for controllers using state feedback. For example we looked a bit into LQ regulation but since we don’t have a good model yet there is no use testing it on the robot. Also we have been trying to design a PID controller by plotting the step response for closed-loop system and tuning the controller parameters.

For the system identification we now have tried some different input signals, e.g. sum of sinusoids and filtered white Gaussian noise. Then we have measured the angular velocity and consumed current by using data from the encoder and hardware on the motor card. With those data available and some black box identification methods, e.g. sub-space- and predictor-error-methods, we obtained models of different orders. It resulted in some quite good high order models but the problem is that we don’t know what the states represent physically. Therefore we tried to find a suitable second order model based on physical relations and parameters given by the DC motor constructors. This grey-box identification resulted in much worse models that barely describes the data used for identification at all, especially not the current measurements.

Last week we also had a meeting with the IT-project to decide the structure for communication between the Robot PC, the motor card and other units connected to the CAN-bus. We also presented our work so far in order for them to get an insight in our project and an opportunity to come with comments and suggestions.

Current problems:
We believe that one reason for the bad results in system identification might be that there are problems with the current measurements. The values for motor A and motor B differs, but we don’t know which measurement is correct, or even if any is correct at all. Of course this complicates the system identification and the models based on only the angular velocity as output are in fact better. Another reason for our problems can be that we are using the wrong discrete model of the DC motors. We have tried to transform the continuous models to discrete models but we often get unstable systems, even with a PID regulator. Basically we are not yet sure how to obtain the discrete state space form for the grey-box identification and this can explain the bad step responses for the closed-loop system. The nonlinearities of the system may also contribute to the bad results but since we are obtaining quite good linear models with the black-box identification there should be enough to use the linear model of the DC motors and a linear regulator.

The next problem to solve is how to connect the regulators for the motors to control the whole robot and how to introduce the varying torque load and a controller compensating for differences in torque of the both motors. The basic idea so far is to use the current measurement for estimation of the torque load since they are proportional to each other.

Action points for next week:
- Get a good model of the system and design different controllers.
- Implement controller and compensate for torque changes.

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