

## Home Assignment, Part II

The second assignment in the course is to control the model of the ABB IRB1600-8/1.45 robot built in part I.

The exercise contains the following parts:

- Make a simple trajectory generator with which it is possible to generate straight line trajectories in Cartesian space from one point to another. The trajectory generator should support acceleration and speed constraints in Cartesian space.
- Tune a PD-controller such that the bandwidth for the different channels is about 2Hz.
- Evaluate the controller with respect to control performance for a trajectory with programmed speed 0.1 m/s and acceleration constraint of  $1 \text{ m/s}^2$  and one with a programmed speed of 1 m/s and acceleration of  $10 \text{ m/s}^2$ .
- Include feed-forward gravity compensation in the controller but apply a non modeled additional tool load of 2.5 kg.
- Apply computed torque using a feed-forward approach and compare the control result with the pure-feedback based approach. Assume that the load still has an error of 2.5 kg.
- Verify the trajectory scaling result. This result says that if the cycle time is reduced by 50% simply by time scaling of the trajectory, then the maximum torque is increased by a factor 4 (considering only speed and acc-dependent torques).

Some additional exercises that can be solved if you have time:

- Extend the trajectory generator to also handle circles.
- The PD-controller can be gain scheduled with respect to the inertia matrix (or in practice the joint angle). An additional exercise could be to improve the behavior of the PD-controller by using gain scheduling.

Dead-line for this home assignment is given on the home page

<http://www.control.isy.liu.se/student/graduate/robot/assignment.html>