

DTU



Robotics - 31383

Compulsory project assignment

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Introduction

- The project assignment is compulsory for admission to the written exam
- The assignment should be executed in groups, where a group preferably consists of 3-4 people.
- **Let's finalize the group formation!**

Introduction

- Alto Robot from the Ramsta Robotics Company.
- Automatic water jet cleaning of livestock buildings
- Electrically driven spherical robot with 4 DoF
- 21 exercises/questions

Topics covered in the assignment:

- Direct kinematics,
- Inverse kinematics,
- Singularities,
- Trajectory planning
- Dynamics and simulation
- Motion control



Extra material

- 4 annexes to support the execution of the project tasks.
 - Annex A: description of the Alto Robot used in the project assignment,
 - Annex B: dynamic calculations related to the Alto Robot,
 - Annex C: description of the 'independent joint control principle',
 - Annex D: description of simulation blocks for robot simulation in Matlab/Simulink (for solving problem 17-21)

Problems

- Problems 1 and 2: direct- and inverse kinematic transformations of the Alto Robot
- Problem 3: use inverse kinematic transformation to calculate four joint angles corresponding to 5 given Cartesian knot-points, located on a tool path for the robot to follow.
- Problems 4 and 5: determine Cartesian and Joint-space trajectories required for the robot to do a simple cleaning task
- Problem 6: check singularities of knot points
- Problem 7: determine the inertia tensor of the robot (necessary to compute the dynamics of the robot, done in Appendix B)

Problems

- Problems 8: deals with joint-level control of the robot, given DC motors
- Problem 9: calculate a linearized, decoupled dynamic model of the robot (start from appendix B)
- Problem 10, and 11: control in Laplace domain
- Problem 12: Simulation (use SIMULINK, necessary for problems 17-21)
- Problem 13: consider the gravitational effects of the manipulator into the model as worst case torque load
- Problem 14 and 15: PID controller is implemented into the model in

Problems

- Problem 16: enhancing performance adding a pre-filter.
- Problem 17-18-19-20-21: Simulation of the robot (dynamic, fwd/inv. kinematic, control)

How to report:

- Support the answers to the problems with sufficient text and number of intermediate calculation. Goal is to make sure that your explanation is clear, showing the principles and methods used to solve the problems
- All authors of the report should sign the last page
- Indicate the individual contribution (in %) of each co-author, for each of the 21 problems

Deadlines

- Submission of project report via DTU Learn
- The reports will be collected on the 8th of December, at 5pm.

Make sure you submit by that time

Groups

- Do you have problems with your group? (e.g. group members not showing up, not taking the course, etc.)...

We will now spend some minutes fixing groups that do not function well

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