

Project work / Laboratory exercise

Develop a real-time control interface for a multi-axis industrial collaborative robot

Motivation:

Multi-axis collaborative robots are becoming more and more present in our daily environment. Also, a versatile and safe real-time control interface is needed to efficiently develop and test novel robot control concepts.

This project work (+ optionally lab exercise), therefore, consists of designing, extending and validating a Python/MATLAB platform for control applications of a commercial multi-axis collaborative robot (Universal Robots UR3e). The platform serves as a plug-and-play interface between the low-level embedded robot controller(s) and any desired controller to be tested, such as feedforward, feedback, predictive or impedance controller structures.

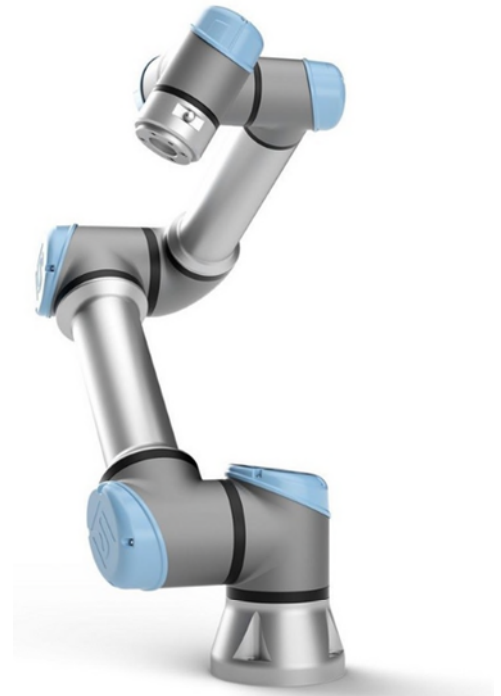
Application: sloshing reduction for liquid goods, impedance control studies.

Tasks:

- Get to know the system and the currently existing control interface structures (MATLAB, Python).
- Improve, robustify and tidy up the existing interface code. Performance optimization.
- Investigate trajectory following errors (low-level embed controller behaviour).
- Robot performance analysis: sampling frequency choice, safety constraint fulfilment, ...
- Test the platform with different controllers (FF, FB, 2DoF, predictive) and parametrization (sampling time, joint space vs. cartesian space).
- Work out and document results and example problems to support university teaching/courses (PowerPoint, LaTeX)

Requirements:

- Good **programming skills** (primarily MATLAB and/or Python); basic skills in technical software engineering or other programming languages (C, C++, Java, ...) or in a microcontroller context are helpful.
- Previous knowledge of control, such as feedback or feedforward.
- Mechanics / Multi-body dynamics / Robot dynamics fundamentals are helpful.



Outcomes for the student:

- Learn about interfaces between low-level and high-level controllers for real-time applications
- Work and develop on a modern, high-quality, industry-grade robotic system
- Apply knowledge from control theory lectures in interesting application problems
- Gain experience in applying advanced and creative control ideas and make them work in a relevant practical setting
- Opportunities: Master thesis/PhD research at our institute

Ansprechpartner:

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