# Control of a Robotic Manipulator with Safety Guarantees

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## Background

Due to the increasing capabilities of modern robots, their application scenarios have become much wider. In order to optimally support humans in their tasks, robots must be deployed in the same areas which are used by humans. One example is industrial production, where robots should ideally work next to and collaborate with humans, rather than be restricted to large cages or work far away from human workers. The same difficulties arise when robots are used to assist humans in their homes. In both of these cases, it is crucial to have control algorithms which guarantee safety. At the same time, these control algorithms have to act very fast and react to changing environments as well as be robust against disturbances.

## Description

In this thesis, such control algorithms should be implemented for a robotic manipulator. Two very promising techniques for safe online control of fast dynamical systems, such as robot manipulators, are presented in [1, 2]. There, the controller synthesis and verification are combined. This allows the use of optimization techniques to obtain an optimal controller which at the same time satisfies all constraints and guarantees safety.

If you have some background knowledge about robotics and control, this thesis provides a great opportunity to work on a novel control approach and actually implement these controllers for a real robotic manipulator. You are able to gain experience in the novel and exciting field of safe robot control, which is crucial for any progress in human-robot collaboration.

If you are interested in this topic, please get in touch with us and we can give you more details.

[1] Bastian Schürmann and Matthias Althoff. Convex interpolation control with formal guarantees for disturbed and constrained nonlinear systems. In *Proc. Hybrid Systems: Computation and Control*, pages 121–130, 2017.

[2] Bastian Schürmann and Matthias Althoff. Guaranteeing constraints of disturbed nonlinear systems using set-based optimal control in generator space. In *Proc. of the 20th IFAC World Congress*, pages 12020–12027, 2017.

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**Research project:**
UnCoVerCPS

**Type:**
BA/MA

**Research area:**
Control, Robotics

**Programming language:**
MATLAB

**Required skills:**
Background in robotics and control. Experience with Matlab is helpful.

**Language:**
German/English

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