

# HiWi in safe reinforcement learning on a real robot.



Technische Universität München



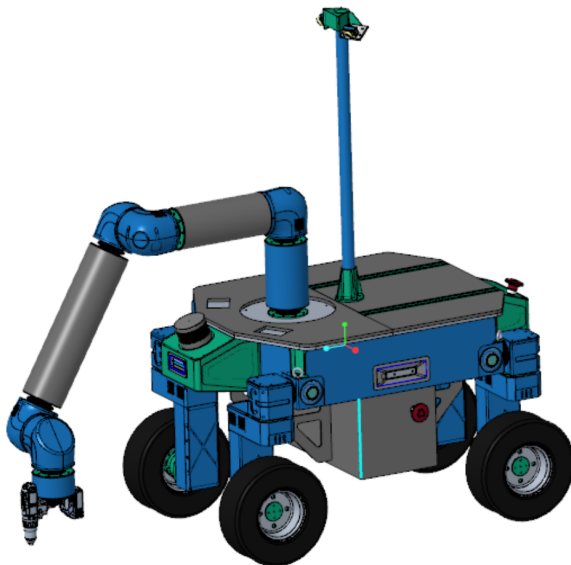
Fakultät für Informatik

Lehrstuhl für Echtzeitsysteme und Robotik

## Background

In the near future, we would like robots to be fully integrated into our everyday life. This requires robots to actively make dynamic decision based on the current desires of humans. Such an intelligent behavior cannot be hard-coded into a classical controller. Ideally, the robot should learn the correct motions from human input over time. Recent advances in AI, such as reinforcement learning (RL), show promising first results in dynamic robot control. However, RL-based methods are notoriously unreliable in safety-critical scenarios due to their black-box character. It would therefore be irresponsible to deploy an RL agent on a real robot, such as a full-scale manipulator, when working together with humans.

Our group has developed a sophisticated safety shield for robotic manipulation in human environments in the past years. Recently, we extended this shield to ensure safety during training of arbitrary RL agents on manipulators [1]. Now, we would like to deploy our safety shield on a real robot! To ensure real-time capabilities, we want to deploy the safety shield on the newly developed XBot2 framework <https://advrhumanoids.github.io/xbot2/index.html>. For this, we are looking for a talented master's thesis student, who is interested in robotics, safety, and control.



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**Supervisor:**

Prof. Dr.-Ing. Matthias Althoff

**Advisor:**

Jakob Thumm

**Research project:**

CONCERT

**Type:**

HiWi

**Research area:**

Safe RL, ROS, Human-Robot Coexistence, Robot Control, Human Safety

**Programming language:**

C++, ROS

**Required skills:**

Knowledge of working in Linux  
C++ experience  
Experience in ROS

**Language:**

English

**Date of submission:**

28. November 2022

## Description

Your main task will be the implementation of the safety shield in XBot2 and the testing in simulation. You will then deploy the safety shield on our real-world robot. To show the suitability for RL-based methods, you will test the safety shield with an RL agent on the real hardware. This project is in close cooperation with our project partners from Fraunhofer Italia and Istituto Italiano di Tecnologia. If desired, you will have the opportunity to travel with us to Italy and test your software on the project's robot.

We offer flexible working hours and work from home.

## References

- [1] Jakob Thumm and Matthias Althoff. Provably safe deep reinforcement learning for robotic manipulation in human environments. In *Proc. of the IEEE Int. Conf. on Robotics and Automation (ICRA)*, pages 6344–6350, 2022.

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