Safe Reinforcement Learning for Robotic Manipulation in Human Environments

Background

Reinforcement learning (RL) has shown high potential in solving complex robotic manipulation tasks. In the future, we would like robots to be deployed in human environments to perform a variety of supportive tasks. Here, it is crucial that the robot does not hurt any human in the vicinity. In order to deploy RL agents on robotic manipulators, we need to address the safety of the system. In the past few years, many approaches have been proposed to increase the safety of RL-controlled robots. We in our group believe that the controlled robot should guarantee safety at all times. So we developed a provably safe RL method for robotic manipulators.

The high safety guarantees of our proposed system will come with the drawback of restricted movement next to humans. Other safe RL approaches that do not provide full safety guarantees may not suffer from these restrictions. We therefore want to compare our method with approaches proposed by other research groups to analyze the drawbacks of our method and the potential of less safe methods.

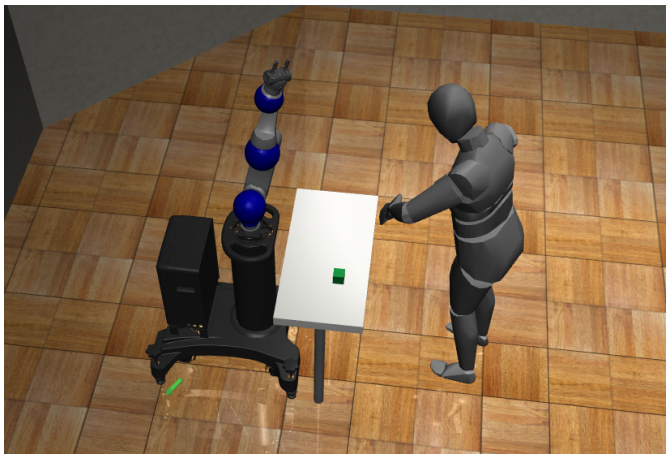

figure 1: Robot manipulator in a human environment.

Description

In this thesis you will first conduct a thorough literature review on safe RL for robotic manipulation with a special focus on human environments. You then decide for one promising safe RL method to implement in our simulation environment. The chosen approach most likely need adaption to the use-case at hand and our simulation environment. After the implementation phase, you can evaluate and compare your method against our provably safe RL approach. You will evaluate the advantages and disadvantages of both approaches in regards to learning speed, final performance, safety, and applicability to the real world. Finally, we can also try to combine both methods to get the best of both worlds.

Key learnings

- Get to know different ways of handling safety in RL.
- Get to know RL approaches in robotic manipulation.
- Definitions of safety in an RL context.
- Challenges in RL for robotics.
- Implementation and evaluation of a state-of-the-art safe RL method.

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Research project:
CONCERT

Type:
MA

Research area:
Safe RL, RL in Robotics, Human–Robot Coexistence

Programming language:
Python and/or C++

Required skills:
Knowledge of working in Linux
Python and C++ experience
Knowledge of basic RL ideas

Language:
English

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