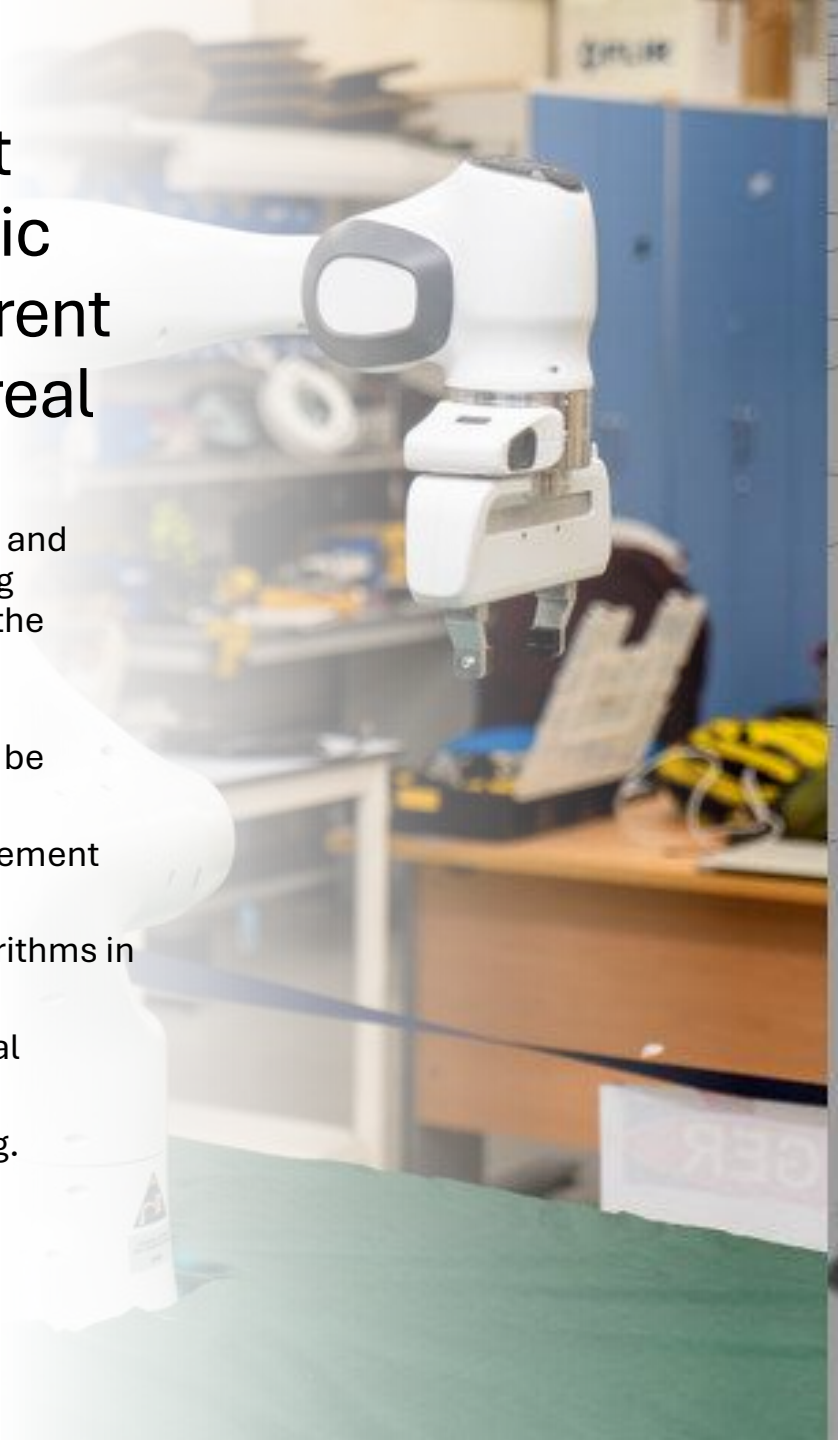
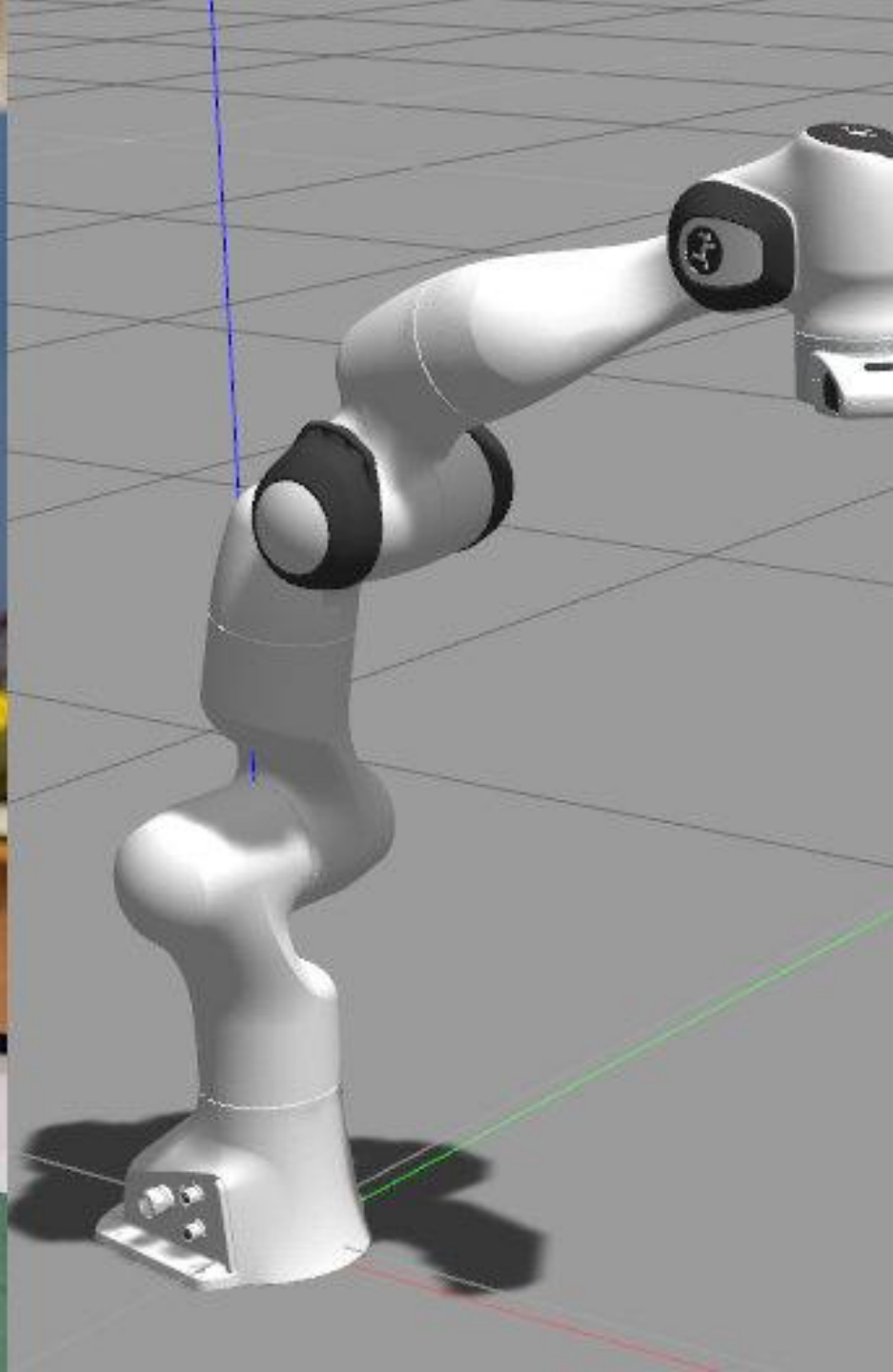
MAP: Reinforcement learning with a robotic arm comparing different algorithm in sim-to-real





- Goal of the master thesis is to compare and implement different reinforcement learning algorithms on a robotic arm. Especially in the setting of simulation and real world
- We have bachelor students making an experimental setup in which the setup will be resettable. Allowing for easier training
- Literature study of the different reinforcement learning practices and algorithms
- Implementing these practices and algorithms in the simulation
- Testing the trained algorithms on the real robotarm
- Analysing the result and further iterating.

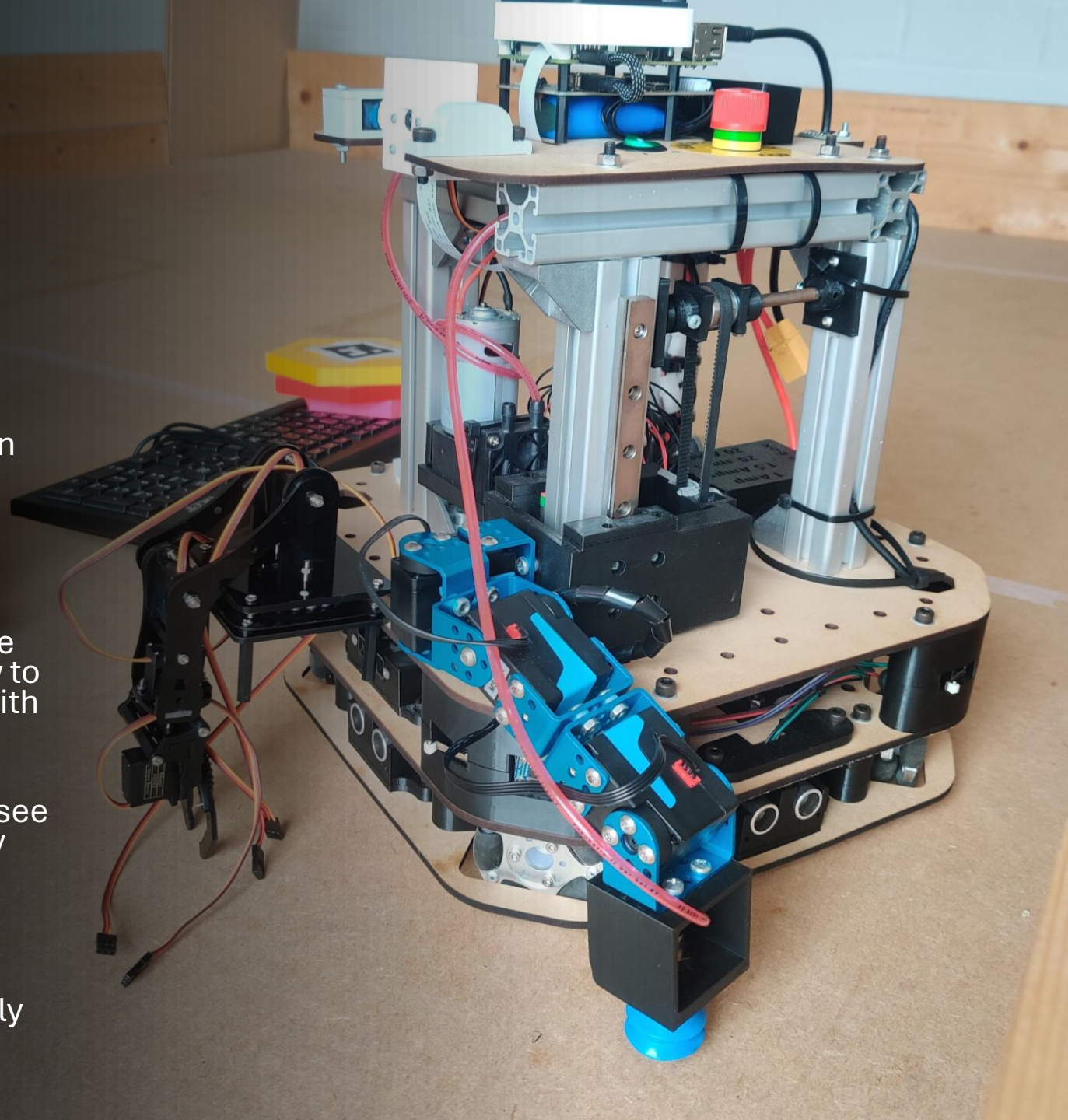
MAP: Tool handeling for self learning autonomous robots

Self-learning robots are becoming increasingly prevalent in industrial applications due to their adaptability and efficiency. One particularly compelling area of research within this field is the autonomous use of tools by such robots.

This master's thesis focuses on investigating how self-learning robots can effectively handle and utilize tools. The research will begin with a comprehensive literature review to explore the current state of the art in robotic tool usage, with a particular emphasis on autonomous learning systems.

Following the literature study, a tool-handling mechanism will be designed and implemented for a robotic platform (see figure). This mechanism will enable the robot to physically interact with and manipulate various tools.

Additionally, the thesis will potentially explore the development of object detection software capable of identifying tools within the robot's environment. This software could potentially allow the robot to autonomously recognize, locate, and grasp tools as needed.



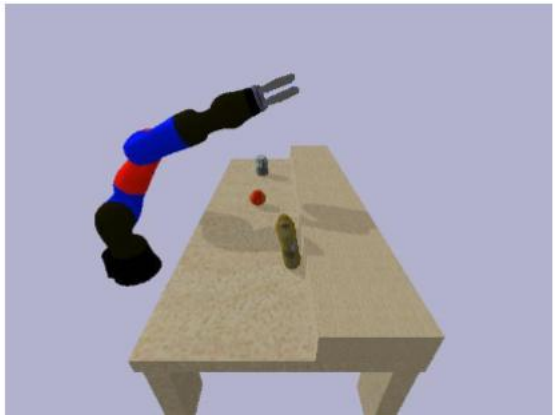
Qualitative Models for Self-learning Robots (IR, MACS, Bruface and Computer Science)

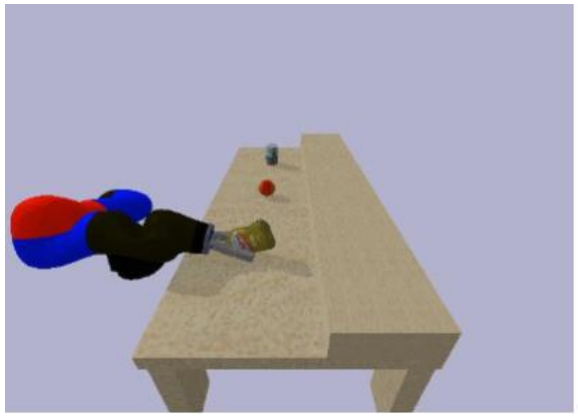
The goal is to let robots learn themselves starting from an ‘empty’ brain to control their world. This will make robots more robust and versatile since they will be able to adapt to new environments and changes in their environment. The goal is to achieve a level of self-learning by which the robot:

- learns the effect of its actions on its state and environment
- can distinguish different situations
- can achieve a predefined goal by choosing the right action in a certain situation

Our approach is based on first learning basic qualitative models, such as ‘if I touch an object, I can change its position’, before learning precise quantitative models. Understanding which actuators affect which state variables and under which conditions (e.g. I first have to grab the object before I can lift it). This will give the causal and contextual structure of the model. Next, it is augmented with how the variables are affected (in which direction) and, finally, how much.

The aim of this thesis is to apply our approach to an existing robot or a simulated one (e.g. Open AI gym), experiment with it, adapt our algorithms to the case, and compare it with existing approaches.





<u>The work includes</u>

- Literature study
- Getting acquainted with our framework (Python code)
- Learning our dynamic, qualitative model and the learning algorithms
- Learn the robot & environment
- Explore, learn, experiment, and evaluate
- Test in our Learning Robots Lab (Building K, 4th floor)

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