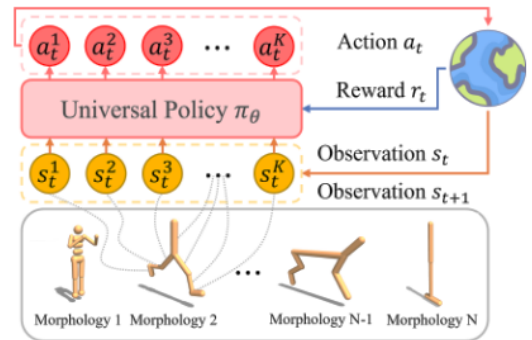


# Master Thesis – Learning Impedance Control Across Different Robot Embodiments

Reinforcement Learning (RL) has achieved impressive performance in control tasks, yet policies remain tied to a specific robot. Transferring a policy across embodiments requires retraining due to differences in morphology and sensing. Moving toward morphology-agnostic control would reduce engineering effort and enable cross-embodiment training for better generalization.

## Research Area and Background

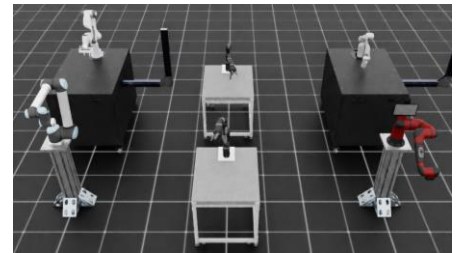
An RL agent's behavior is strongly tied to its training context, making even small differences between simulation and real-world systems challenging. While the sim-to-real gap has been widely addressed in the state of the art, the next step remains open: learning behaviors that can transfer across different robot embodiments despite differences in morphology and sensing. Building on the ideas in the literature, the goal of learning general policies can be explored in a simplified setting, such as learning impedance control across multiple robot arms.



Luo, Yingbo, Meibao Yao, and Xueming Xiao. "GCNT: graph-based transformer policies for morphology-agnostic reinforcement learning." arXiv preprint arXiv:2505.15211 (2025).

## Your Tasks and Research Challenges

- **Literature research on state of the art**
  - Impedance control
  - Multi-embodiment RL control
- **Development and Implementation**
  - Develop an RL environment for Impedance control
  - Implement
- **Evaluation and Documentation**
  - Deploy and compare your policy on different real robots
  - Use policy as low-level controller for higher level skills
  - Evaluate and summarize your results in a thesis



Showroom Image. Isaac Sim IsaacLab, NVIDIA, <https://isaac-sim.github.io/IsaacLab/main/source/overview/showroom.html>

## What we offer at the Machine Intelligence and Robotics Lab!

- You'll get to learn a lot about our current research and gain some real hands-on experience
- We use the latest robotics hardware and the newest ML libraries, as well as tools like Isaac Lab, ROS 2, etc.
- We are a team of international, motivated robotics enthusiasts and would be happy to have you join us.
- You will get encouraging support from your supervisor and honest feedback to improve your skills
- We offer a great working environment in our MaiRo Lab

**Type:** Master thesis

**Date:** As soon as possible

**Supervisors:** Prof. Dr. Arne Rönnau, M. Sc. Vincenzo Di Pentima

## Do you want to work on cutting edge robotics research?

Contact: Vincenzo Di Pentima, [vincenzo.pentima@kit.edu](mailto:vincenzo.pentima@kit.edu)

We look forward to receiving your application (incl. current grade transcript)!

