



Master Thesis

Zero-Shot Sim-to-Real Dexterous Manipulation *from* Vision *and* Proprioception

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*We are inviting applications for the **Master Thesis Topic** in the **Physical AI Lab** at the Chair of Imaging and Computer Vision, Faculty of Electrical Engineering and Information Technology, RWTH Aachen University. Our group develops generalist robots that autonomously solve real-world long-horizon tasks.*

Introduction of the Topic

Robots that plug in an Ethernet cable, thread a nut, or pivot an object against a wall to grasp it must master *contact-rich* manipulation, where success depends on forces and friction rather than positions alone. Reinforcement learning in simulation now transfers such skills zero-shot to real robots [1], but mostly with force/torque sensors and separate pose estimation. Recent work shows that a robot's own proprioception can stand in for force sensing [2], and that simulation-trained experts can be distilled into camera-based policies for real gripper arms [3]. However, these visual policies still fall well short of their state-based teachers. Based on these advances, this thesis investigates whether dexterous, contact-rich gripper skills can be learned in simulation from camera images and proprioception, and transferred zero-shot to robot arms without force/torque sensors.

- [1] M. Noseworthy et al., "FORGE: Force-Guided Exploration for Robust Contact-Rich Manipulation under Uncertainty," IEEE RA-L, 2025.
- [2] A. Bronars et al., "Blind Precise Assembly: Proprioceptive Sim-to-Real Peg-in-Hole for Diverse Parts," arXiv, 2026.
- [3] P. Yin et al., "Emergent Dexterity via Diverse Resets and Large-Scale Reinforcement Learning," ICLR, 2026.

Your Profile

- Background in robot learning, reinforcement learning, computer vision, or related fields
- High motivation and the ability to work independently and in a team
- Interest in sim-to-real transfer and hands-on work with real robots.
- A plus: experience with robot simulators (e.g., Isaac Lab, MuJoCo) and ROS 2

What We Offer

- An open research question rather than a reimplementation task
- Close supervision and strong support for publications
- A clear starting point: a real OpenArm robot, GPU-accelerated simulation and rendering in Isaac Lab, and published sim-to-real baselines
- Access to on-premises GPUs, high-end GPU clusters, and real robots

Application

Duration of the master thesis is 6 months. Please send your application to the following email address yuli.wu@lfb.rwth-aachen.de using the subject "**sim2real_{Name}**", and include your CV and academic transcripts.