Humanoid Robots Lab
Introductory Meeting

Prof. Dr. Maren Bennewitz
Xuying Huang
14th October 2025

Course No.:
BA-INF 051 Projektgruppe
MA-INF 4213 Seminar
MA-INF 4214 Lab

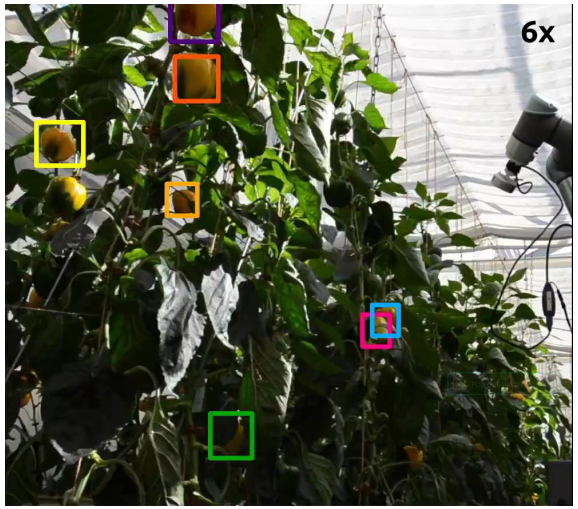
Humanoid Robots Lab

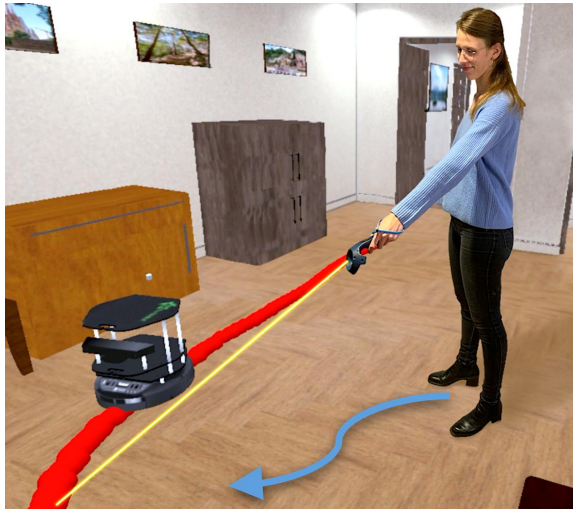
Group leader
Prof. Dr. Maren Bennewitz

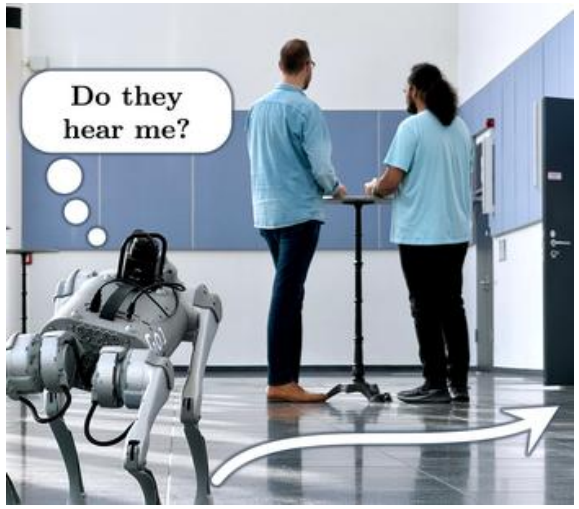
Our research topics:

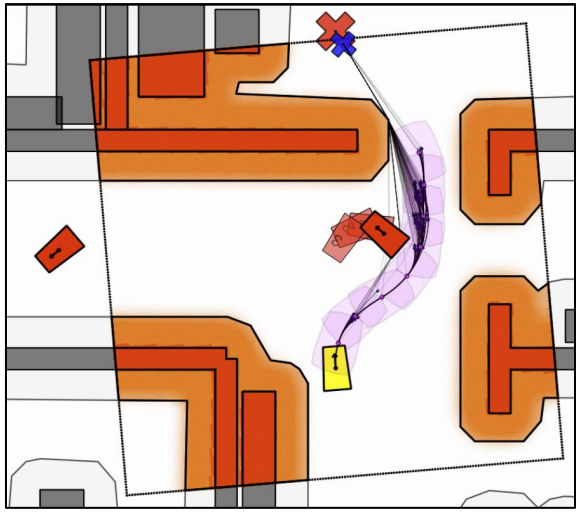
- Robotics & autonomous systems
- Active perception
- Intelligent manipulation
- Human-robot interaction
- Machine learning

HRL Research Projects









Courses

	Bachelor PG			Master	Master
	Lab	+	Seminar	Lab	Seminar
ECTS points	6	+	3	9	4
Workload	180 h	+	90 h	270 h	120 h

- **Seminar:** Presentation and discussion of relevant scientific work
- **Lab:** Programming robots in simulation and on real hardware
- **Project Group:** Lab (70%) + Seminar (30%)

Course Deliverables

	Bachelor PG			Master	Master
	Lab	+	Seminar	Lab	Seminar
Presentation	X		X	X	X
Lab report	X			X	
Paper summary					X

Seminar

Seminar Overview

- **Presentation and discussion** of relevant scientific work (conference/journal papers)
- Aspects to cover:
  - Contribution of the work?
  - Technique/Methodology used?
  - Strengths & Weaknesses of the approach?
- Presentation: 20 minutes + 5 minutes Q&A
- Paper summary (M.Sc. only): **Written summary and discussion** of the work (7 pages excl. figures and references, LaTeX template provided on web page)

Seminar Timeline

- **Prepare** during the semester
  - Understand the paper
  - Write paper summary (M.Sc. only)
  - Prepare your presentation
- **Seminar Day**
  - **Everybody must be present**
  - It’s a full day event! (depending on the number of participants)

Seminar Grade

- B.Sc. Students:
  - Presentation: 100%

- M.Sc. Students:
  - Presentation: 70%
  - Paper summary and discussion: 30%

Seminar Papers
(Only BA-INF 051 Projektgruppe)

B.Sc. Students:
Paper will be assigned to you by your supervisor

Seminar Papers
(Only MA-INF 4213 Seminar)

M.Sc. Students:
You can choose from the following selection

Identifying Terrain Physical Parameters from Vision

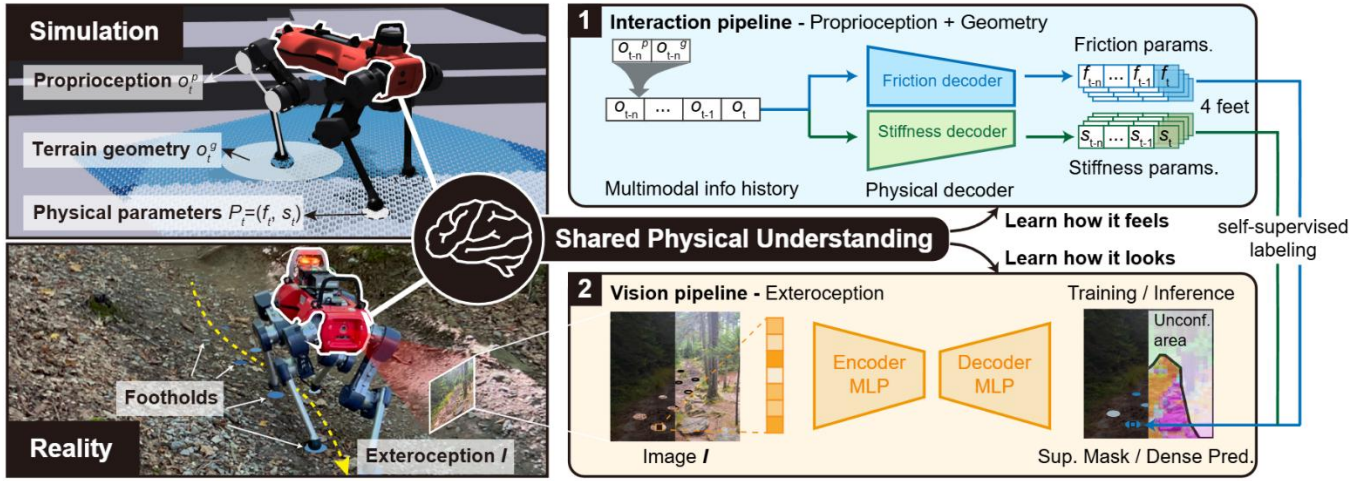
Towards Physical-Parameter-Aware Locomotion and Navigation

Chen et al.

RA-L 2024

Supervisor: Shahram Khorshidi

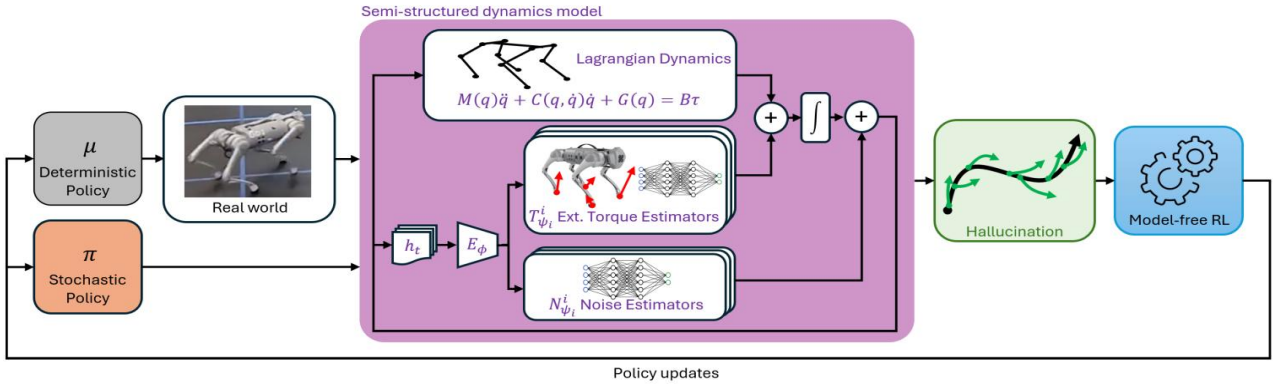
- **Goal:** Estimating the physical parameters of the environment from vision.
- **Problem:** How to know the friction and stiffness of the different terrains before contact.
- **Approach:** Using vision data and self-supervised learning to predict these parameters.



Learning to Walk from Three Minutes of Real-World Data with Semi-structured Dynamics Models

Levy et al.
CoRL 2024
Supervisor: Shahram Khorshidi

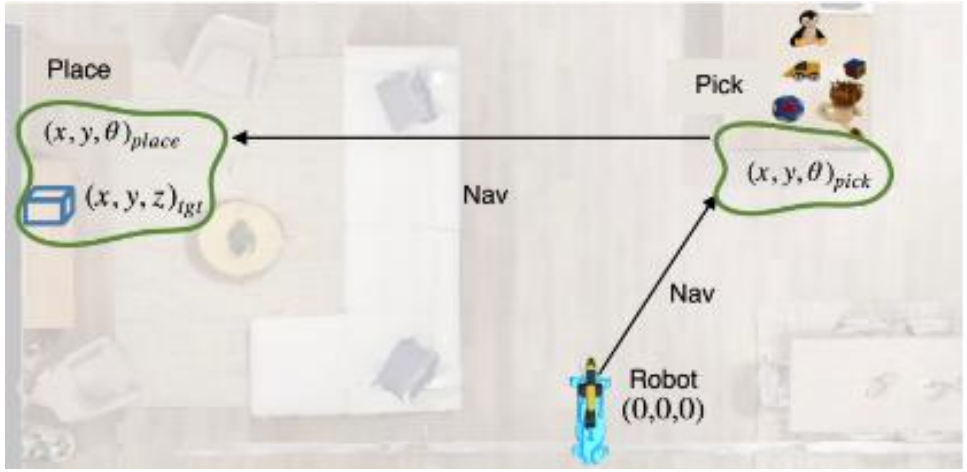
- **Goal:** Learning semi-structured dynamics models for contact-rich systems.
- **Problem:** Black-box RL models often fail to generalize, and training data is scarce.
- **Approach:** Leveraging an ensemble of probabilistic models to estimate external forces, and integrate predictions using known Lagrangian dynamics.



Skill Transformer: A Monolithic Policy for Mobile Manipulation

Huang et al.
ICCV 2023
Supervisor: Ahmed Shokry

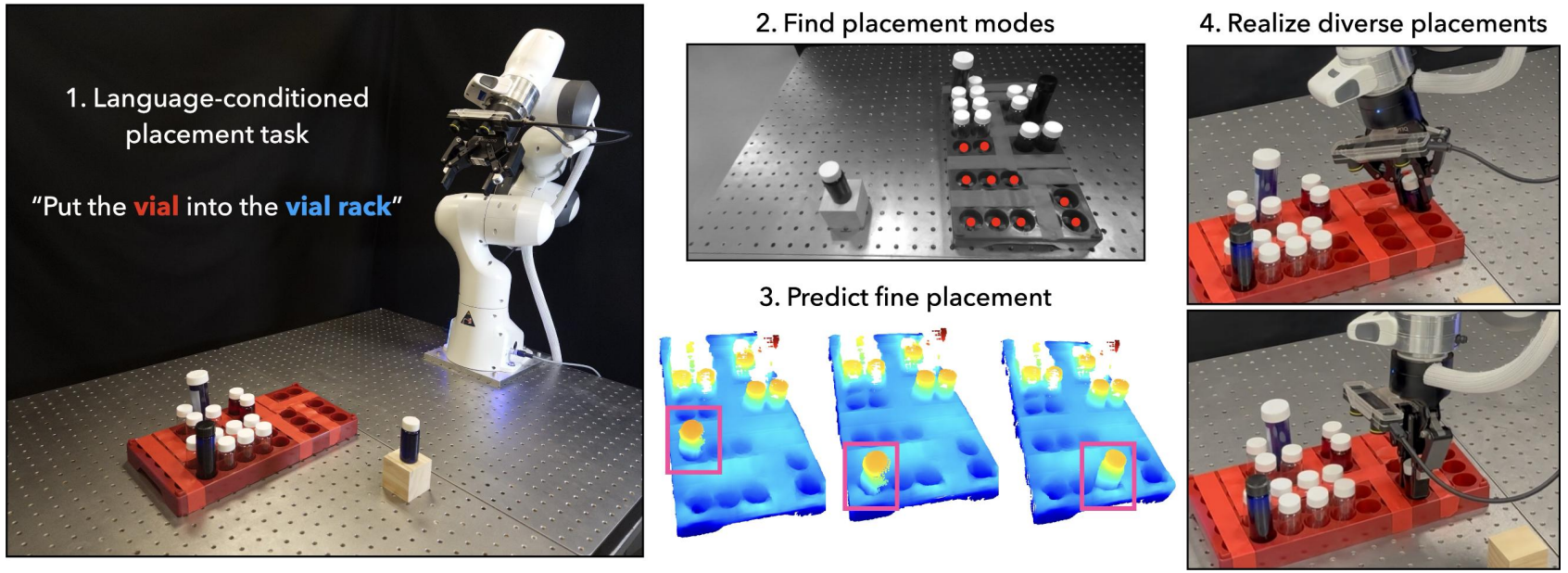
- **Goal:** Perform long-horizon mobile manipulation tasks using onboard sensors.
- **Problem:** Different sub-tasks, such as navigation and picking, require different behaviors and are sensitive to hand-off errors.
- **Approach:** Use demonstration data and a transformer-based policy.



AnyPlace: Learning Generalized Object Placement for Robot Manipulation

Zhao et al.
CoRL 2025
Supervisor: Benedikt Kreis

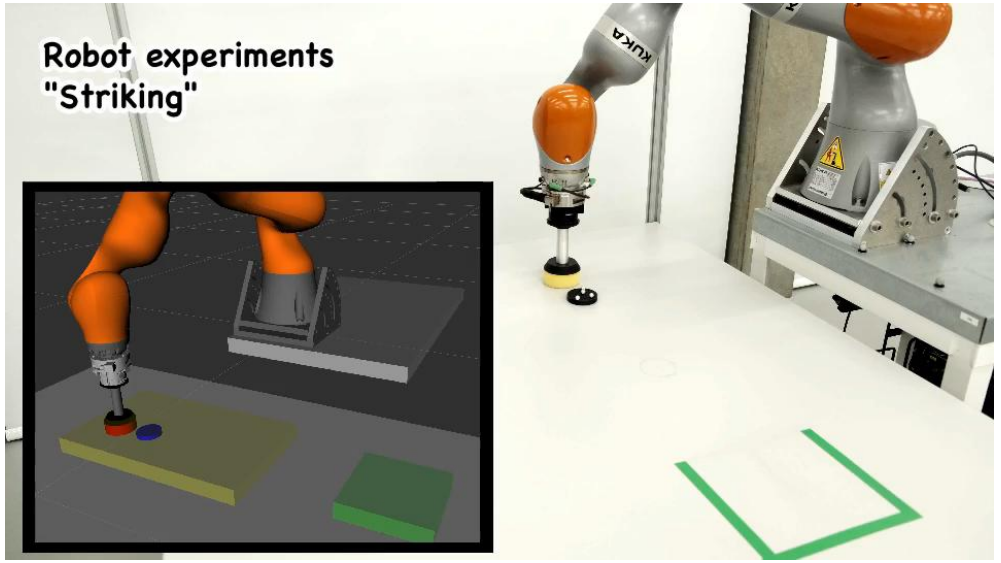
- **Goal:** Place objects into receptacles using natural language.
- **Problem:** Transfer language into suitable robot actions.
- **Approach:** Use foundation models and fine tune on a synthetic dataset.

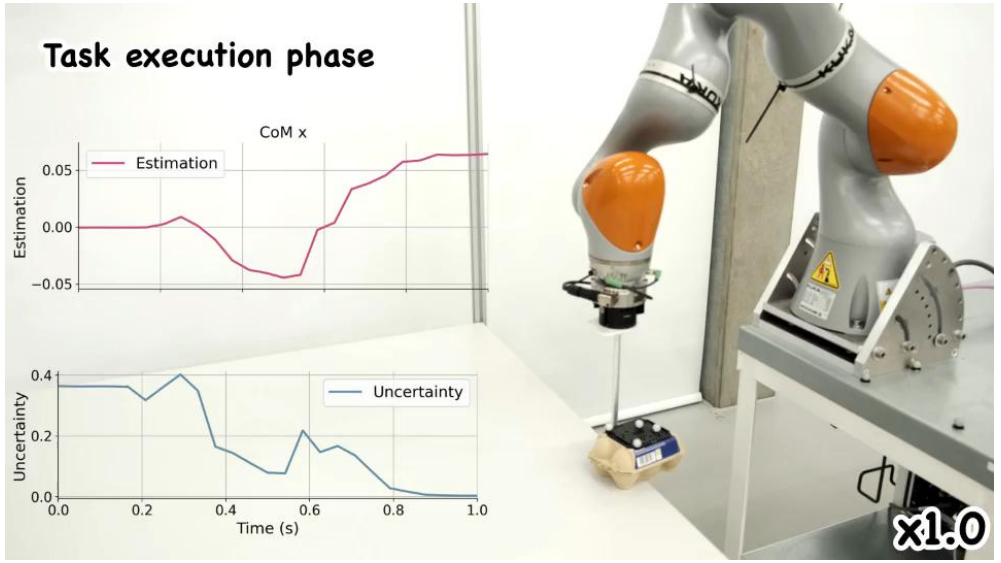


Poke and Strike: Learning Task-Informed Exploration Policies

Aoyama et al.
CORL 2025
Supervisor: Nils Dengler

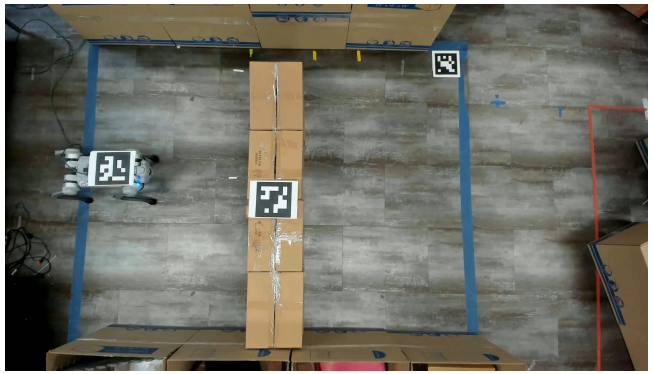
- **Problem:** the robot must first identify the relevant physical properties of the object for successful task execution, as it is unable to recover from failure or retry without human intervention
- **Approach:** task-informed exploration approach, based on reinforcement learning, that trains an **exploration policy using rewards automatically generated from the sensitivity of a privileged task policy to errors in estimated properties**.





PROBE: Proprioceptive Obstacle Detection and Estimation while Navigating in Clutter

Ramesh et al.
ICRA 2024
Supervisor: Nils Dengler

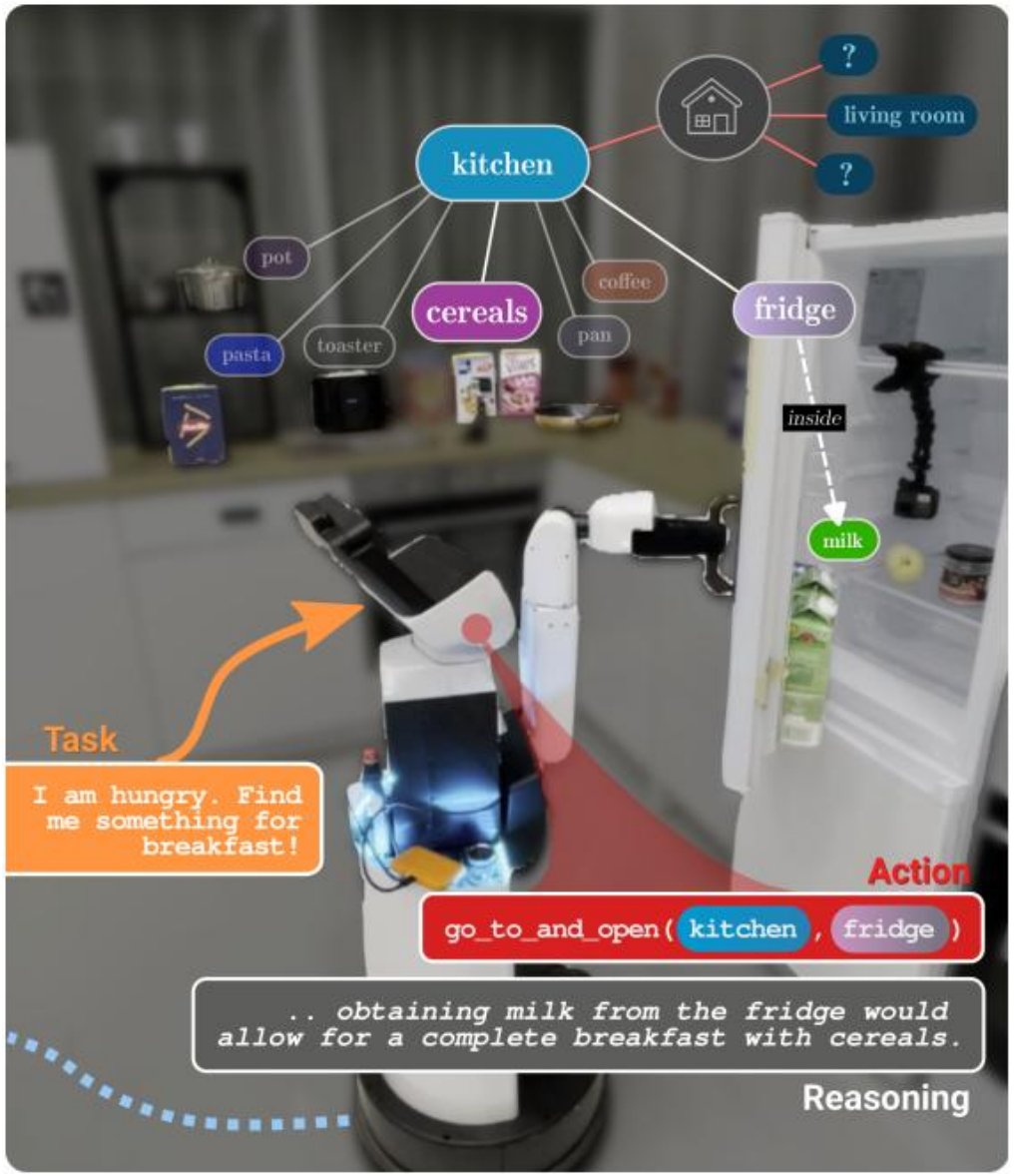


- **Goal:** Reconstruct a scene given only proprioceptive data
- **Problem:** Inferring the shapes of objects in cluttered scenes is extremely challenging because of occlusions, which only permit a partial view of the surrounding environment
- **Approach:** A Transformer-based Obstacle Reconstruction Module (ORM) reconstructs the environment at each timestep using only proprioceptive feedback, which is gradually fine-tuned as the robot navigates in its environment

Language-Grounded Dynamic Scene Graphs for Interactive Object Search with Mobile Manipulation

Honerkamp *et al.*
RAL 2024
Supervisor: Rohit Menon

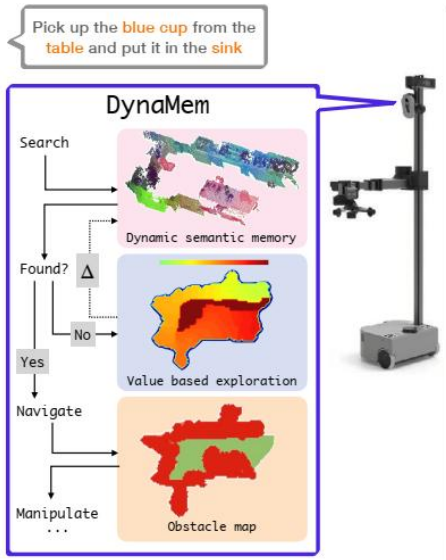
- **Goal:** Enable robots to complete long-horizon tasks in unexplored environments using language-grounded scene graphs
- **Problem:** Traditional planning methods produce impractical plans in dynamic, partially observable settings
- **Approach:**
  - Integrate large language models with dynamic, open-vocabulary scene graphs
  - Extract compact textual representations for efficient high-level planning

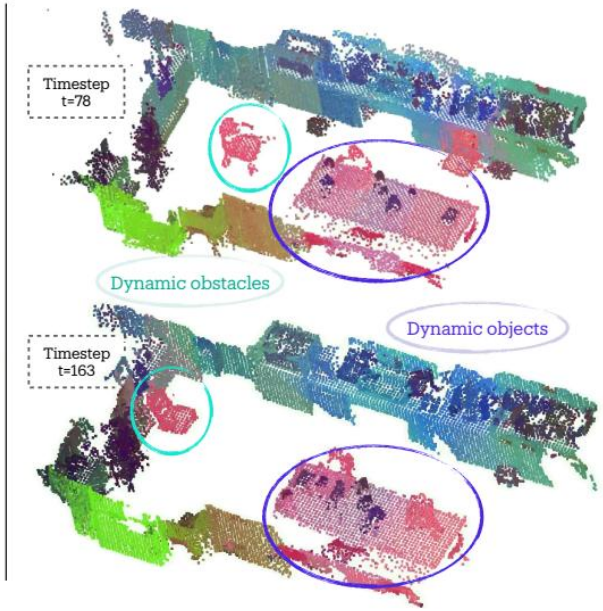


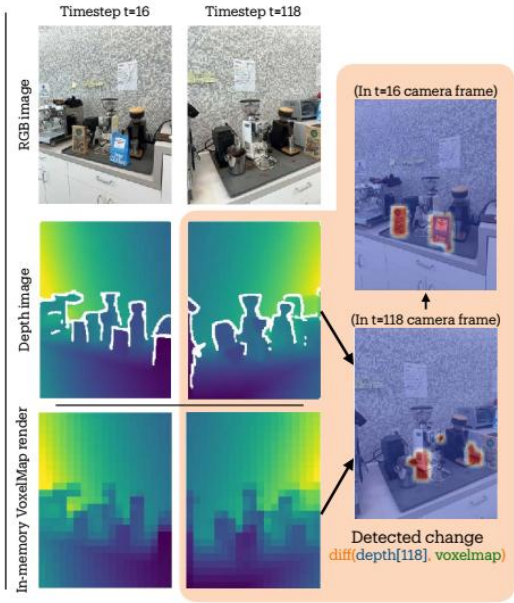
DynaMem: Online Dynamic Spatio-Semantic Memory for Open World Mobile Manipulation

Liu *et al.*
ICRA 2025
Supervisor: Rohit Menon

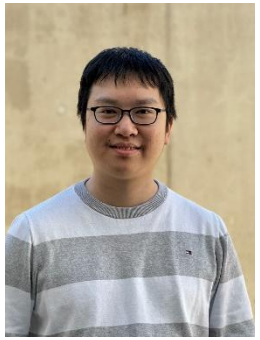
- **Goal:** Develop dynamic spatio-semantic memory for open-vocabulary mobile robot manipulation
- **Problem:** Static assumptions hinder robots operating in evolving, human-altered environments







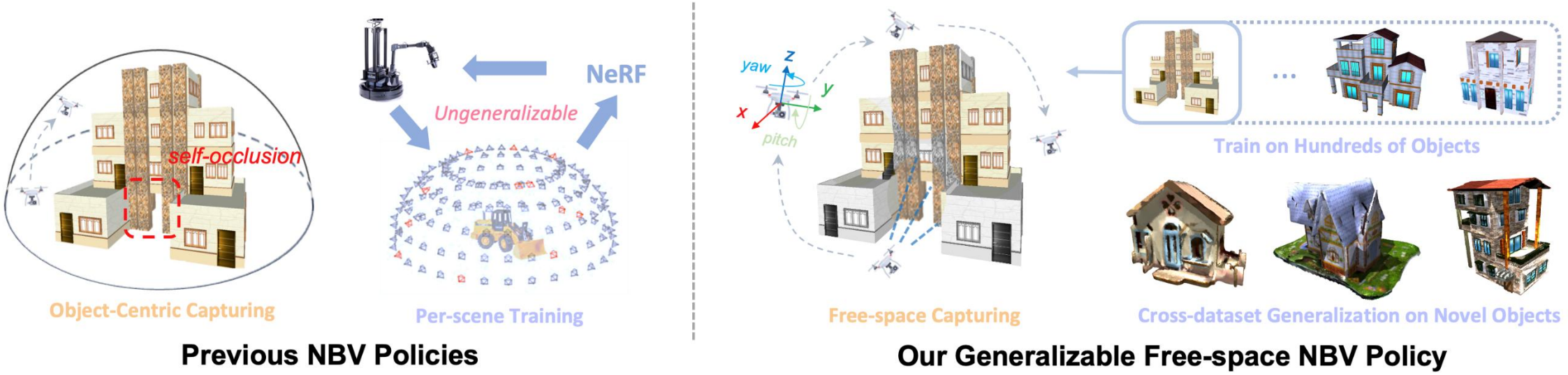
- **Approach:**
  - Maintain online voxelized memory that updates with appearing/disappearing objects
  - Support open-vocabulary localization via vision-language features and multimodal LLMs

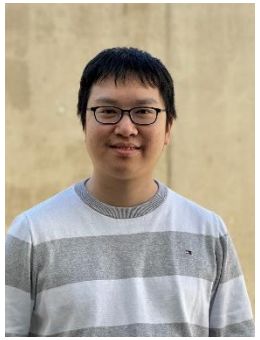


GenNBV: Generalizable Next-Best-View Policy for Active 3D Reconstruction

Chen et al.
CVPR 2024
Supervisor: Sicong Pan

- **Goal:** Generalizable active 3D reconstruction.
- **Problem:** Existing object-centric NBV policies are tied to discrete candidate views and lack cross-dataset generalization.
- **Approach:** Learning a continuous free-space NBV policy that transfers across objects and datasets.

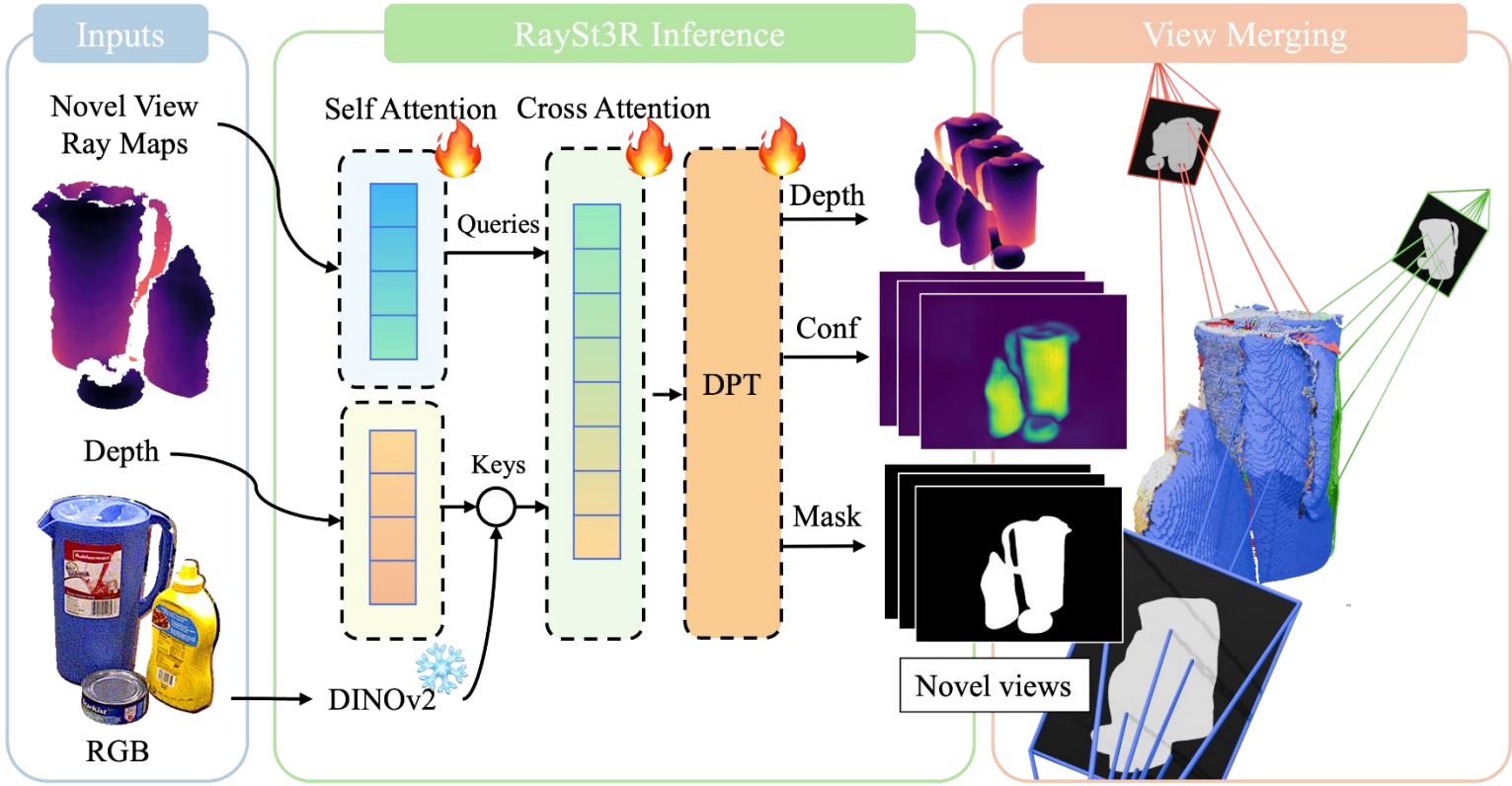




RaySt3R: Predicting Novel Depth Maps for Zero-Shot Object Completion

Duisterhof et al.
Arxiv 2025
Supervisor: Sicong Pan

- **Goal:** Consistent and efficient 3D shape completion.
- **Problem:** Existing methods are costly and lack sharp boundaries.
- **Approach:** Recast shape completion as novel view synthesis, avoiding explicit resolution-limited shape reconstruction.



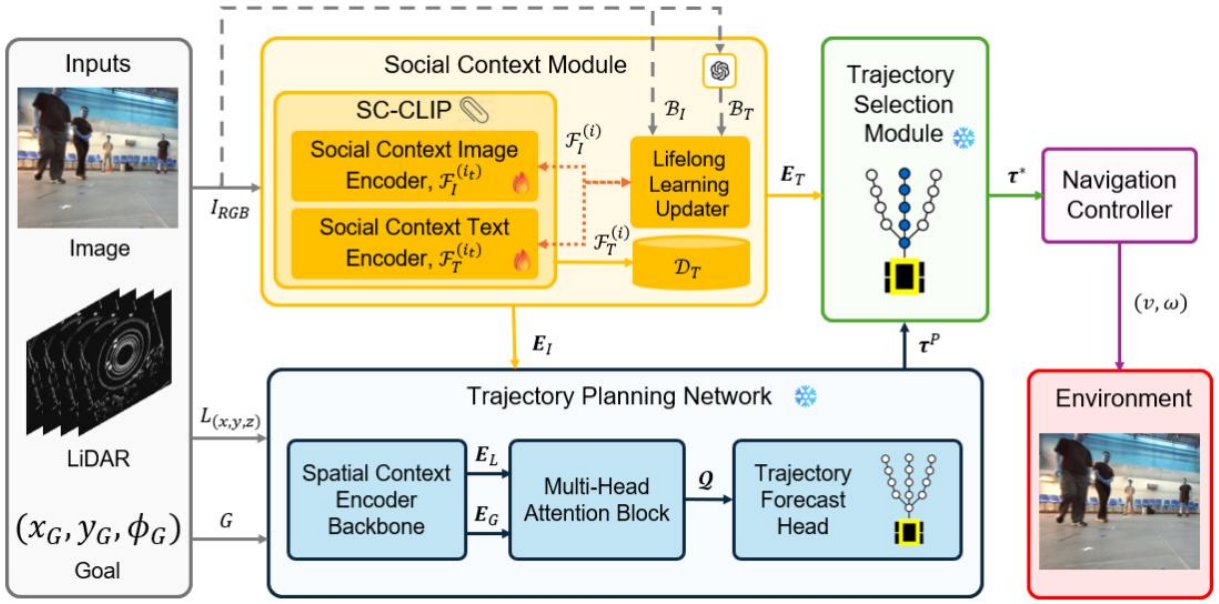
OLiVia-Nav: An Online Lifelong Vision Language Approach for Mobile Robot Social Navigation

Narasimhan et al.

ICRA 2025

Supervisor: Subham Agrawal

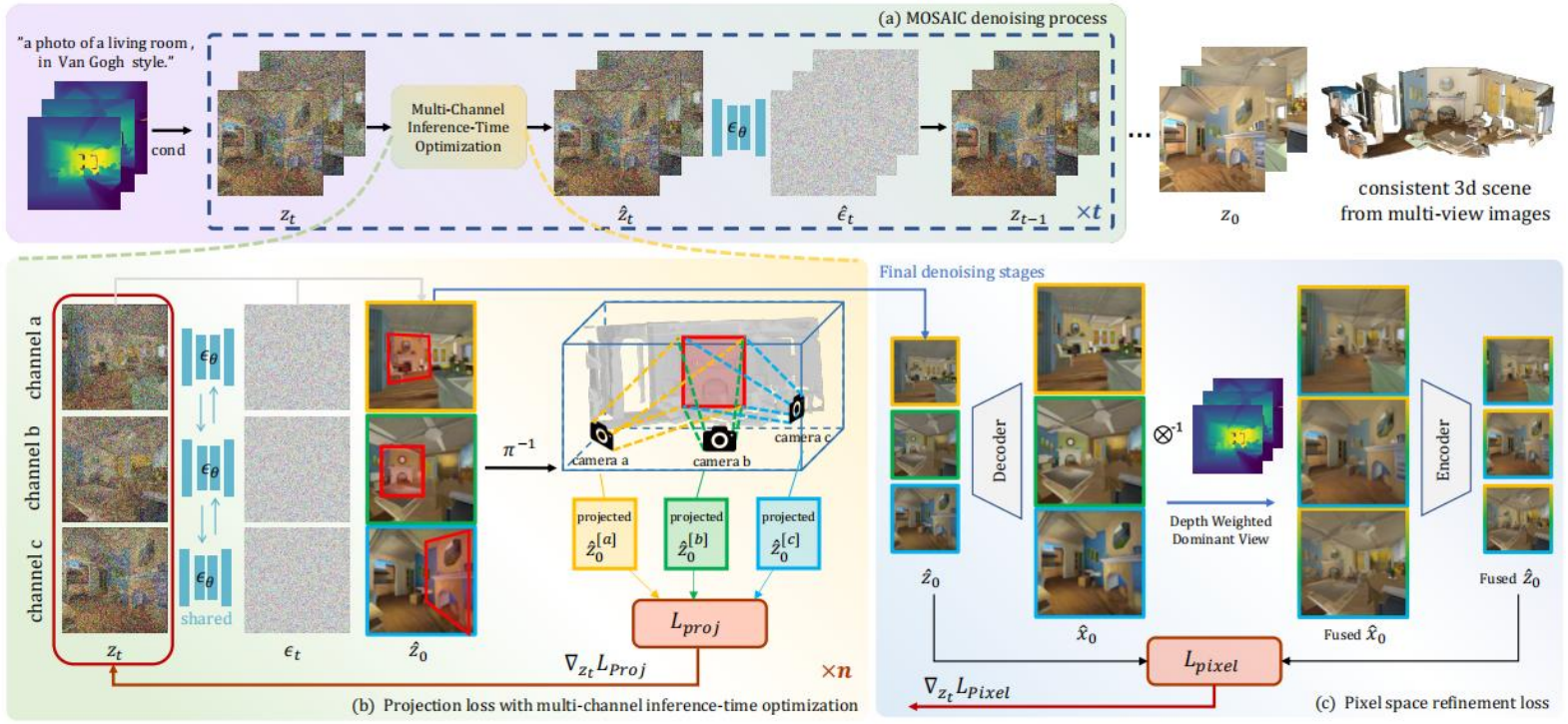
- **Goal:** Enable robots to navigate in human environments in a socially aware and context-sensitive manner.
- **Problem:** Existing methods fail to incorporate rich social context and cannot adapt to new unseen scenarios.
- **Approach:** OLiVia-Nav, an online lifelong vision-language architecture that distils social reasoning from large VLMs into lightweight models. These lightweight models are used to produce socially compliant robot paths.



MOSAIC: Generating Consistent, Privacy-Preserving Scenes from Multiple Depth Views in Multi-Room Environments

Liu et al.
ICCV 2025
Supervisor: Xuying Huang

- **Goal:** Reconstruct privacy-preserving 3D scenes.
- **Problem:** Existing approaches cannot ensure multi-view consistency when generating images from depth.
- **Approach:** Propose a diffusion-based method through multi-channel inference-time optimization to solve inconsistency problem.



MA-INF 4214 Lab
&
BA-INF 051 Projektgruppe
(Lab Part)

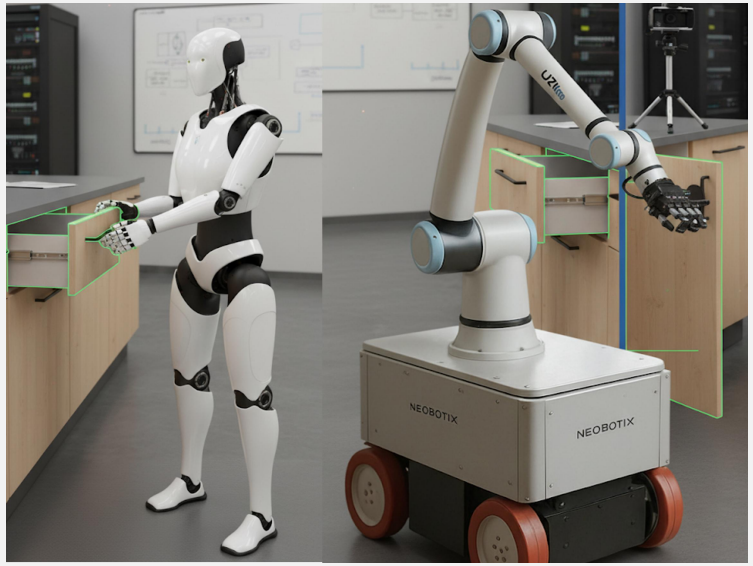
Available Lab Projects

ADAPTIVE ROBOTIC ASSEMBLY (B.Sc.)

Goal: Use reinforcement learning for robotic assembly.

Challenge: Reinforcement learning, sim-to-real

OPEN SESAME! (B.Sc./M.Sc.)



Goal: Vision-driven whole-body control for furniture opening.

Challenge: Reliable perception, whole-body control, dexterous grasping

OPEN-VOCABULARY MOBILE MANIPULATION (B.Sc./M.Sc.)

Goal: Enable open-vocabulary pick-and-place on a mobile manipulator.

Challenge: Perception integration, command grounding, manipulation and control, deployment and evaluation

AUTONOMOUS RACING (B.Sc./M.Sc.)

Goal: Learn and apply autonomous racing methods by designing and implementing solutions on a real car.

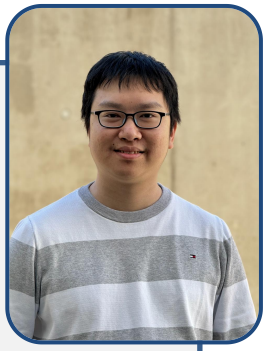
Challenge: Perception (track & obstacles), trajectory planning, and real-time control at racing speed.

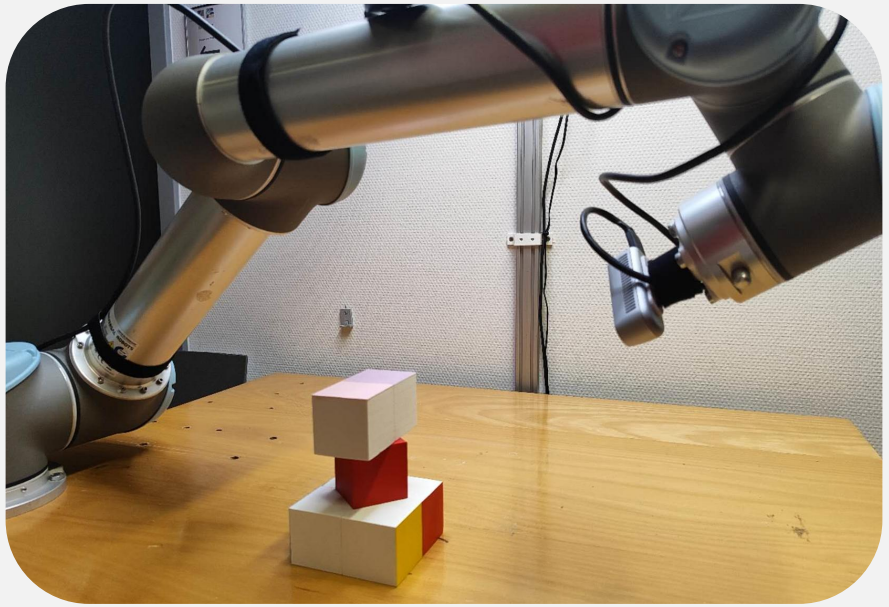
AUTONOMOUS RACING (B.Sc./M.Sc.)

Learning Phase (6 weeks): Crash course in autonomous racing. ROS2 basics, software stack and vehicle control.

Project Phase: Apply your knowledge on the real car by developing your own approaches for the final race.

FIND THE VIEWPOINT! (B.Sc./M.Sc.)

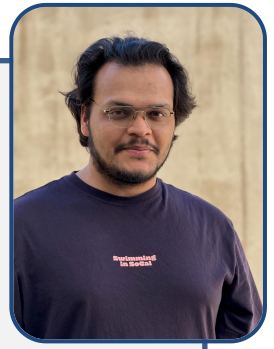




Goal: Find the viewpoint of the given RGB image

Challenge: Suitable active search method, computational complexity → speed of the search

SOCIAL FORCE MODEL (B.Sc./M.Sc.)



Goal: Implement the social force model for crowd simulation

Challenge: Complex scenarios, 3D visualization, photorealistic environment, several metrics

LLM-BASED ROBOT NAVIGATION (B.Sc./M.Sc.)

Goal: Teach a robot to navigate given spoken instructions

Challenge: Spoken instructions, navigation, environment perception

Lab Overview

- Small groups of **2-3 people**
- A selection of projects involving perception, reasoning and action generation for different robots
- Recommended experience: Python, C++, ROS 1/2, OpenCV
- **Midterm presentation**: Progress feedback
- **Demonstration** and written lab **report**
  (7-10 pages incl. figures and references,
  LaTeX template provided on web page)

Lab Timeline

1) Project work
   - Plan how to achieve the project goal
   - Program the simulated/real robot(s)
2) Midterm presentation
   - Present your progress, problems and plans
   - Get feedback from all supervisors and peers
3) Demonstration day
   - **Everybody must be present the whole day!**
   - Show both (if available), simulation and real robot
   - Prepare a video as backup

Bi-weekly supervisor meeting:
Talk about progress, problems and plan the next steps

Lab Grade

- **Individual grade** for each group member
- Depends on **participation** during the semester and the performance of the system in the final demonstration
- Lab report is a precondition!
- **Written lab report** of the work
  (LaTeX template provided on web page)

Registration

Next Steps

- **Two** separate registrations are necessary!

1) Registration on our web site (first-come-first-serve!)
   until Sunday, 19.10.2025

➡ Project, topic and group assignment
   until Wednesday, 22.10.2025 (notification via e-mail).

2) Registration on **BASIS until Sunday, 26.10.2025**

Website Registration

Responsible HRL Lecturers:

Prof.Dr. Maren Bennewitz

M.Sc. Xuying Huang

Important dates:

All interested students have to attend the Introductory Meeting. In the Introductory Meeting, we will present the projects, the schedule, the registration process, and answer your questions.

14.10.2025, Tuesday, 10:00-11:00hs, Room:2.025	**Introductory Meeting (mandatory)**
19.10.2025, Sunday	Registration deadline and topic selection on our website
26.10.2025, Sunday	Registration deadline in BASIS
TBA	Midterm lab presentation
02.02.2026, Monday, 10:00-13:00hs	Lab presentation and deadline for lab documentation

After the Introductory Meeting, each participant arranges an individual schedule with the respective supervisor.

Registration

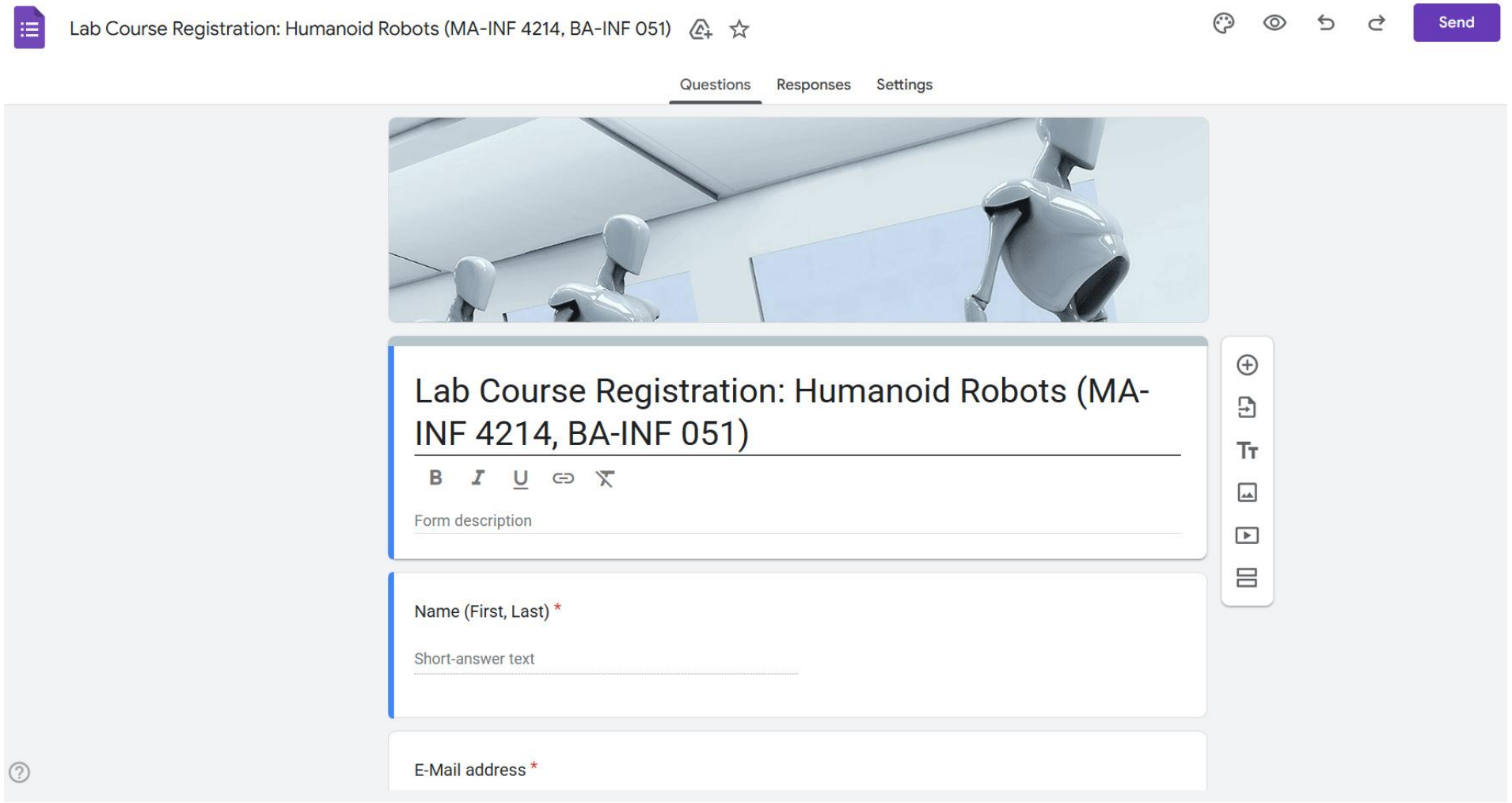
The registration is open. Register here.

Report and presentation template

Please use the following template for the written summary:
[Report template]

Please use the following template for midterm and final presentation:
[Presentation template]

Website Registration



Schedule

Date	BSc Project Group	MSc Lab Course	MSc Seminar
Sun, Oct 19	Registration deadline		
Wed, Oct 22	Participation confirmation and topic assignment		
Sun, Oct 26	BASIS registration deadline		
	Supervised lab course in groups during the whole semester		Individual supervision
Thu, Dec 18	Midterm lab presentation (in person)		
Thu, Jan 22	Seminar presentation (in person)		• Seminar presentation (in person) • Deadline for the summary
Mon, Feb 02	• Lab demonstration (in person) • Deadline for the lab report		

Thank you!

Questions ???