IDP HUSKY: Mobile Manipulators for Construction Applications

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Start Date: Winter Semester 2025
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ROS 2

GAZEBO

Overview

IDP HUSKY: Mobile Manipulators for Construction Applications develops a unified, modular software stack for a Clearpath Husky base equipped with a 6 DOF arm—tailored to the challenges of dynamic, unstructured construction sites. Students can work on the following topics:

Available Topics

1. **Language-Grounded Mobile Manipulation**

   Develop a "language → action" pipeline that interprets simple English instructions—tailored to on-site construction tasks—into full pick-place-navigate plans (e.g. "Deliver the red brick to the marked pallet," "Pick up the toolbox and bring it to the assembly table"). Building on the MORE framework (https://arxiv.org/abs/2505.03035).

2. **Traversability Analysis for Rough Terrain**
   Build a spatiotemporal-attention network in PyTorch to classify heightmap patches as "traversable." Collect or synthesize terrain data, train, and integrate into a local planner to guide the husky through difficult terrains (https://github.com/Ikhyeon-Cho/LeSTA).

3. **Real-Time Trajectory Optimization with Dynamic Obstacles**
   Wrap TrajOpt in a ROS/Gazebo feedback loop for re-planning around moving obstacles. Implement simple obstacle prediction, integrate with the optimizer, and benchmark latency and collision-avoidance performance (https://rll.berkeley.edu/trajopt/doc/sphinx_build/html/).

4. **Whole-Body MPC for Dynamic Tasks**
   Design a QP-based Model Predictive Controller for a Husky mobile manipulator that coordinates the base's wheel velocities and the 6 DOF arm joints to achieve unified, whole-body motion control for dynamic tasks (https://arxiv.org/abs/1912.01870).

Timeline & Application Details

- **Application Deadline: 15.09.2025.**
- **Duration:** 1 semester.
- **Each topic can be selected by a group of 2 students.**
- **Active (in-person) participation in the project is required.**
- **Required Skills:**
  - Proficiency in Gazebo, C++/ROS2, and Python.
  - Good understanding of control theory, sensor fusion, Motion Planning, and SLAM.
  - Previous experience with real robots is a plus, though not mandatory.

Please send your CV along with a short paragraph explaining why you are a good candidate to panagiotis.petropoulakis@tum.de. **We value clean and maintainable code.**