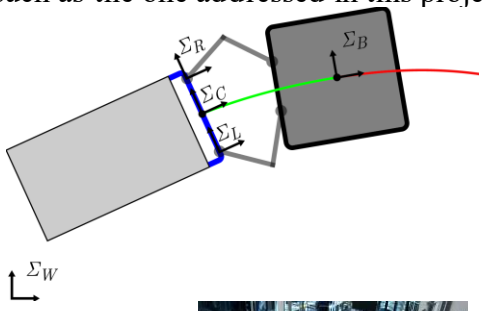
WASP Project Course 2025

Mobile Manipulation of passive-wheeled Carts

Background

This project is based on one of the two sub-tasks of the WARA Robotics Challenge – Carting, specifically the task involving the transportation of a cart filled with glassware that needs washing. The challenge is abstracted into a mobile robot navigation and manipulation problem. The robot must autonomously navigate through a mapped indoor environment to reach an initial goal location where a cart is parked. Upon arrival, the robot is required to manipulate and push or pull the cart to a second designated location. A key objective in this project is to demonstrate active cart steering, rather than treating the cart and robot as a rigid, coupled system. This introduces additional challenges in coordination, motion planning, and control under dynamic constraints.

This task aligns with a growing trend in the deployment of service robots, particularly mass-produced humanoid and quadrupedal platforms, in human-centric, dynamic environments such as hospitals, laboratories, and warehouses. These spaces are typically narrow, cluttered, and shared with people, requiring robots to move in a safe, reactive, and predictable manner. Mobile manipulators, equipped with sensors like cameras, lidars, and force/torque sensors, are well suited for such tasks. Their ability to interact with passive-wheeled carts makes them ideal for transport scenarios that demand precise and adaptive manipulation in constrained environments, such as the one addressed in this project.



Constraints: Closeness to Lund University or ABB at Västerås

Participants

Industrial partner: ABB

Industrial supervisor: Matteo Iovino, matteo.iovino@se.abb.com

Academic supervisor: Yiannis Karayiannidis, yiannis@control.lth.se, Automatic Control, Faculty of Engineering, Lund University

Coordinating WARA representative: Matteo Iovino, WARA Robotics

Suggested WASP PhD students: Sebastiano Fregnan, Abhishek Kashyap, Zheng Jia, Marko Guberina

Challenges to investigate

- Coordinated motion of mobile platform and mounted robot
- Reactive obstacle avoidance using on-board sensors
- Map generation through exploration (possibly)

Resources

Mobile YuMi available at WARA Robotics,
Mobile YuMi available at RobotLab LTH, Lund University

Deliverables

- Demonstration of mobile manipulation of a wheeled cart
- Report on methods of individual components of the system and study of their performance.

References

Dahlin, A. (2023). Reactive Motion Planning and Control under Constraints (Doctoral dissertation, Chalmers Tekniska Hogskola (Sweden)).

Haviland, J., Sünderhauf, N., & Corke, P. (2022). A holistic approach to reactive mobile manipulation. IEEE Robotics and Automation Letters, 7(2), 3122-3129.

Keywords

Mobile manipulation, Whole-body control, Reactive Navigation