University Research Group:	tbd
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Candidates:	tbd
Project Type:	Master Thesis
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Master Thesis

Enhancing Robot Navigation and Coverage Tasks by Moving Obstacles Autonomously

Task Description

Robots are increasingly used in unstructured environments, such as homes and factories, where they are required to navigate the environment reliably and efficiently. Among other tasks, mobile robots are expected to perform coverage when it comes to tasks like cleaning, inspection, or the likes. Common metrics for coverage tasks are the time it takes to cover the area, the distance traveled, and the percentage of the area that has been covered [1]. Current robots struggle at navigating in particularly cluttered environments, where they drive suboptimal trajectories to avoid obstacles and, in the worst case, they get stuck due to the lack of space to drive to the next goal and trigger recovery strategies to free themselves [2]. The aim of this thesis is to extend the coverage task with obstacle interaction, to allow the robot to push selected obstacles a few centimeters when they prevent the robot from cleaning efficiently with a good coverage. Additionally, the implemented method should be integrated into a robotic platform and tested in a real-world scenario. A collection of existing methods for obstacle pushing can be found in [3, 4, 5, 6, 7].

Objective

The objective of this thesis is to develop an algorithm that alternates the execution of driving and pushing skills, to increase coverage, and move obstacles that might be on the robot's way. The algorithm should be able to decide when and where the robot should move an obstacle, and minimize the number of times such an action is required. Additionally, an algorithm that performs the moving action should be implemented to be integrated into a robotic platform and the capabilities of the developed algorithm should be demonstrated in a real-world scenario.

Work Items

- Literature Review: Conduct a comprehensive review of existing coverage solutions in cluttered environments.
- Design an algorithm that computes the trade-off between driving and moving an obstacle.
- Integrate the algorithm into a complete coverage pipeline.
- Test the algorithm in a real-world setting using an existing robotic platform.

Prerequisites

- **Education:** Bachelor studies in the field of Computer Science, Robotics, Artificial Intelligence, or similar.
- **Personality and Working Practice:** Highly motivated, flexible team player.
- **Experience and Knowledge:** Affinity with programming in Python and C++17, knowledge of ROS and Behavior Trees is a strong plus.
- **Languages:** Fluent in English.

References

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