technische universität dortmund

computer science 12

Bachelor/Master Thesis

Autonomous Racing Using Reinforcement Learning in ROS 2

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January 12, 2024

The history of robot navigation dates back to the 1980s when robots were first developed to navigate autonomously using pre-programmed maps. Over the years, advances in technology have led to the development of more sophisticated systems. Today, the Robot Operating System 2 (ROS 2) provides a range of tools and frameworks for developing complex robot applications, such as autonomous driving and racing.

In this thesis, we aim to develop an autonomous robot navigation algorithm using a reinforcement learning algorithm, that directly processes LiDAR data to create the local trajectory and control commands. The system will use a robot simulator such as Gazebo to train the reinforcement learning algorithm in different environments. The algorithm will be designed to work in any environment, and the training process will feature randomization to improve the generalization of the algorithm. The system will be compared against classical navigation algorithms for ROS 2, such as the Navigation2 stack, to evaluate its performance.

The proposed method for autonomous robot navigation consists of the following steps:

1. Using ROS 2 and a robot simulator such as Gazebo, create a simulation environment with a robot that is equipped with a LIDAR sensor and a reinforcement learning algorithm.
2. Train the reinforcement learning algorithm to navigate the environment safely and efficiently.
3. Test the robot's ability to navigate the environment safely and efficiently, and compare the results with the Navigation2 stack.

The following skills and knowledge are required for the successful completion of this thesis:

- Knowledge of ROS 2 and the Navigation2 stack
- Familiarity with a robot simulator such as Gazebo
- Proficiency in C++ and Python programming languages
- Understanding of reinforcement learning algorithms and their implementation

Upon completion of this thesis, we expect to have developed an autonomous robot navigation algorithm that can safely and efficiently navigate any environment using a reinforcement learning algorithm. The resulting system will have the ability to quickly and safely navigate the environment.