AUTOMATIC CONTROL
REGLERTEKNIK
LINKÖPINGS UNIVERSITET

Mail Robot

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The robot

Background

This project is a part of the CDIO-course TSRT10 at Linköping University and is performed in collaboration with ABB CRC. The goal of the project is to develop a system for an autonomous robot which shall be able to navigate from point A to point B in an office environment. The robot is able to autonomously navigate in an office-landscape using a pre-defined map, which it also can update when changes are detected. The long term goal of the product is to augment the robot with a robotic arm to enable the delivery of objects. The project group consists of eight students with expertise within automatic control and sensor fusion.

Mapping

The idea is to find pairs of poses (positions and orientations) with laser range scans that are strongly correlated. In other words, this means that pairs of poses, from which the laser detects the same physical objects, has to be found. Estimated robot poses, together with their corresponding laser scans, form a data set from which maps can be constructed. Using the extracted data set one can plot every measurement in a global coordinate system forming a point map.

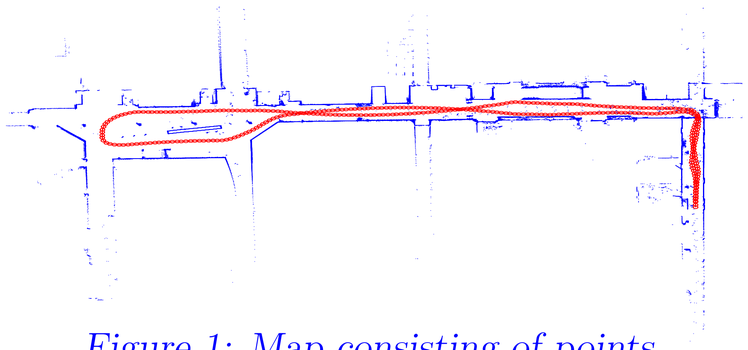

Figure 1: Map consisting of points.

Two other maps are extracted from the point map, one line based map to be used in localization and one grid map used for path finding.

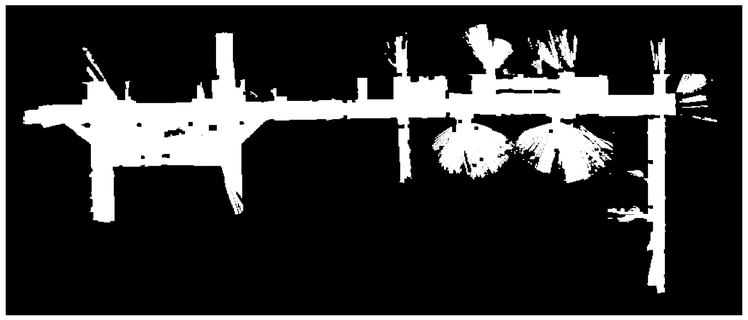

Figure 2: Occupancy grid mapping.

Localization

The robot localizes itself using a Monte Carlo Localization (MCL) algorithm. The MCL uses a collection of samples (also known as particles) to estimate the robot's pose. These particles are spread out on the predefined map which is built as described above. All particles describe a possible pose for the robot and the possibility that the robot actually have that pose.

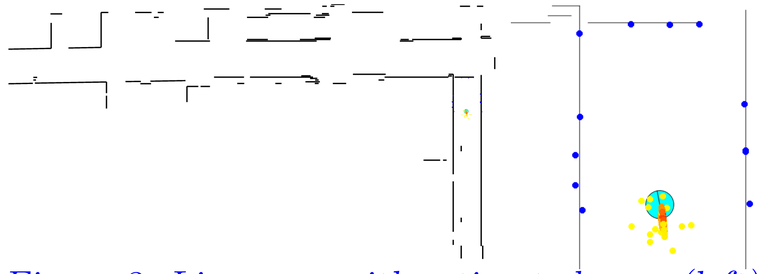

Figure 3: Line map with estimated pose (left) and enlargement of the robot pose (right).

Path finding

The robot plans a route from the current position to a given point in the map and considers forbidden zones when planning the route. The algorithm is used on a supplied grid map, where each cell corresponds to a node. The cost of moving between two adjacent nodes is given by a predefined value, as long as the movement is possible. If a cell is blocked by an obstacle, the cost of traveling to the node it represents will be set to infinity. The same applies to a node to which the robot does not yet know a path.

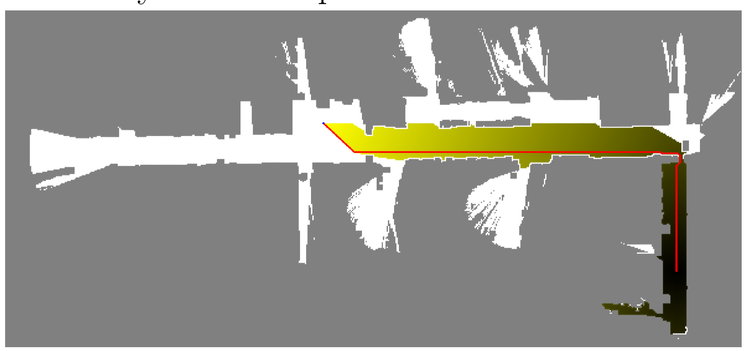

Figure 4: Path finding algorithm.