Riassunto papers

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1 "Collaborative Multi-Robot Exploration" - Burgard

In this paper is considered the problem of exploring an unknown environment by a team of robot. The main focus is on the coordination of a team of multiple robots by the definition of target points for the exploration.

Mainly two previous approaches concerning multiple robots exploration are presented. First one consists in separating the environment into stripes and then explore them by moving just one robot and keeping the other stationary. This reduces odometry error but robots are forced to stay close to each other. Second one considers the use of a common map built as the exploration goes on and as a robot discovers an opening to an unexplored area, which can't reach due to its size, it chooses another robot to achieve this task. The selection is performed taking into account the number of areas to explore, size of the robot and the distance of the robot and the target location. This approach moves robots to the closest unexplored frontier but neither provide a coordination mechanism to avoid the selection of the same frontier by multiple robots nor it uses an accurate distance measure, using straight line distance rather than a computation on the current map.

The approach presented in this paper uses occupancy grid maps to represent the environment and assumes robots to know their relative position during the whole exploration process. This assumption is useful to allow a simple computation of the integrated occupancy grid map. The selection of target points to explore is based on two concepts: the cost of reaching it and the utility it provides. Cost for traversing a cell is proportional to the occupancy value of that cell and through that definition, the minimum cost path between two cells can be computed. The utility of a target point is calculated as the expected visible area from that point. To find out this value, it exploits an heuristic based on the observation that a robot exploring a big open terrain can cover much larger areas than a robot exploring a narrow part of the environment. This is achieved by counting the number of times $h(d_i)$ the distance d_i was measured by any of the robots. The value of $h(d_i)$ is then used to compute the probability that the robot's sensors covers objects at distance d. A great advantage of the algorithm

introduced is that two robots never choose the same target point because once a robot is assigned to it, utility of that point is decreased accordingly.

The provided experimental results only deal with an office-like environment and show that the coordination always provides better performances. Moreover, two coordinated robots have performances similar to three uncoordinated robots and the improvement introduced by the coordination is almost the same both with two and three robots.