Global Mobile Robot Path Planning using Laser Simulator

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Abstract— **This paper presents the utilization of novel laser simulator search graph approach for global path determination in unknown environment using MATLAB. The environment of the robot is represented in 2D map and the laser simulator is used to find the collision free path within this environment without prior knowledge about the visiting cells. By using the laser simulator row points procedures, the point that determine the planned path in front of robot can be generated continuously and this process is repeated until the robot reaches the goal position. Two kinds of environments are used to test laser simulator; the first one is represented with cleared borders and polygons whereas the other includes some noises and uncertainties. The developed laser simulator is implemented successfully in these environments and the simulation results are compared with the classical A* algorithm. From the results, the laser simulator has advantages in computational time and low collision possibility in comparison with A* algorithm while the path cost of laser simulator is always greater than path cost of A* algorithm.**

Keywords—Laser Simulator; Path Planning; Mobile Robot; 2D Environment Map

I. Introduction

The most important elements for autonomous mobile robot to achieve its tasks is the path planning. The path planning of autonomous robot is used to search for a collision free path of the robot that must be followed in order to pass from start to goal positions in the environment. This path is a plan of geometric locus points in a given space where the robot has to pass through them. There are two common methods of path planning of a mobile robot; namely global planning and local planning. For global planning, the surrounding terrain of a mobile robot is known totally and the collision free path is determined off-line. Whereas in local path planning, the surrounding of mobile robot is partially or totally unknown and the sensors with suitable feedback are needed for real-time plan of path through environment step by step [1].

In general, the problems of path planning for mobile robots are covered three prospects: modeling the robot's environment in the useful way, foundation of collision-free path from start to the goal position of robot's motion [1], and seeking of goal. Most of path planning approaches have been used to search for the shortest path or optimal path to reach goal, avoiding static and dynamic obstacles and navigate in a complex environments. However, most existed approaches of path planning in almost are only suitable to specific environment and conditions. This study innovate a novel path planning algorithm to determine the most optimum travelling path in a complex environment with applying multiple constrains for the motion.

Before a robot can find a collision-free path, the robot needs a complete model of the objects in its environment. There are many different ways for objects representation in robotic environments [1], which are the grid, cell tree and the polyhedral. In the grid representation, an array of identical cells is setup, and the cells are marked according to the occupancy (usually 1 (dark), if occupied; 0 (white) otherwise). This type of representation simplifies the computation, but it requires a large amount of memory [1]. The cell tree method overcomes this disadvantage of grid representation by using a small number of cells. Cells that are completely inside or outside the objects have a fixed size; whereas the cells which are partially occupied by objects are further divided into smaller cells. The process is repeated until all cells are completely inside/outside the objects or the maximum resolution is reached. The 2D quadtree is the most useful representation of the Cell tree class. This class representation is particularly efficient in environments that contain large objects; however, when the environment is occupied by small objects, this representation is wasteful due to the overhead of computing the adjacency of the cells. In the polyhedral representation, a description of each object is given by its set of vertices. This representation is popular, since it allows many items in environments to be closely approximated. Furthermore, this representation enables many existed efficient algorithms for computing the distance and line segment intersections which are the most important issues in path planning.

The most used approaches for solving the path planning problem include the following approaches; namely, roadmap, the cell decomposition, vertex graph, free space, superimposed grid and the artificial potential field approaches [1]. The