MOTION PLANNING IN THE PLANE WITH POLYGONAL OBSTACLES

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In robot motion planning the robot should pass around the obstacles, from a given starting position to a given target position, touching none of them, i.e. the goal is to find a collision-free path from the starting to the target position. This task has many specific formulations depending on the shape of obstacles, allowable directions of movements, knowledge of the scene, etc. Research on path planning has yielded many fundamentally different approaches to its solution that can be classified as roadmap methods (visibility graph method, Voronoi diagram) and methods based on a cell decomposition. In the paper, an approach based on Voronoi diagrams is proposed, considering point, straight line and polygonal obstacles in a completely known scene.

Key words: *motion planning, roadmap method, computational geometry, visibility graph, Voronoi diagram*

1. Introduction

The task of planning trajectories of a mobile robot in a scene with obstacles, has received considerable attention in the research literature [2], [11], [12]. A robot is usually represented as a single point or a circle. There are three basic types of robot motion planning algorithms [7].

The first type is the *potential field method*. The goal has an attractive potential and the obstacles have a repulsive potential. The robot moves in the direction of the gradient of a potential field produced by the goal configuration and the obstacles. Unfortunately, this algorithm often converges to a local minimum in the potential field and therefore we will not deal with it.

The second type is the *cell decomposition method*. Here, the scene is decomposed in cells and the outcome of the search is a sequence of adjacent cells between start and target from which a continuous path can be computed. The square cell decomposition can be used for 8-directional (horizontal, vertical and diagonal) robot motion in the plane with static rectangular obstacles. Unfortunately this approach has many drawbacks such as combinatorial explosion, limited granularity and generating infeasible solutions. This approach can be combined with a case-based reasoning procedure [5].

The third type of motion planning algorithm is a so called *roadmap method*. The roadmap is built by a set of paths where each path consists of collision free area connections. There are several different methods for developing the roadmap, e.g. visibility graphs and

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