

Robot Motion Planning

Sampling Based Algorithms

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Outline

Difficulty with Classical Approaches

- ▶ Curse of dimensionality
- ▶ Running time increases exponentially with dimensions of configuration space
- ▶ Several variants of the path planning problem have proven to be PSPACE-hard

Drawbacks of Combinatorial Approaches

Multiple Query Roadmaps

A multiple query approach tries to capture the connectivity of the free space as good as possible, such that multiple, different queries for paths can be answered very fast. In other words: create a roadmap that is suitable for as many use cases as p

PRM - Probabilistic Roadmaps

Basic steps to construct a PRM:

1. sample vertices and keep vertices that do not lie on an obstacle
2. find neighbour vertices - k-nearest neighbour or neighbours within a specified radius
3. connect neighbouring vertices with edges (lines) (and check for collisions on connecting line using e.g. discretized line search)
4. add vertices and edges until roadmap is dense enough

PRM Visualized

Drawbacks

PRMs don't perform well when there are narrow passages.

OBPRM - Obstacle Based PRM

Obstacle-based PRMs are constructed by sampling only close to obstacles. During sampling, the first goal is to find a point that lies inside an obstacle. Then, another point is sampled at an arbitrary distance to the first point. Using step-wise approximation, a point sufficiently close to the obstacle border is searched.