Robot Motion Planning

Configuration Space and Bug Algorithms

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Outline

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Classification by concepts

Task	Robot	Algorithm
Navigate	Configuration space, degree of freedom	Optimal/nonoptimal motions
Map	Kinematic/dynamic	Computational complexity
Cover	Omnidirectional or motion constraints	Completeness (resolution, probabilistic)
Localize		Online/offline Sensor-based/world model

Classification by Task

- The most important characterization of a motion planner is according to the problem it solves. The four major tasks are `navigation`, `coverage`, `localization`, and `mapping`.
- **Navigation** is the problem of finding a collision-free motion for the robot system from one configuration (or state) to another.
- **Coverage** is the problem of passing a sensor or tool over all points in a space, such as in demining or painting.
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Classification by Robot Properties

Todo...

Classification by Algorithm

Todo...

Outline

Mathematical Notations

- $\mathcal{W}$ - Workspace
- $\mathcal{WO}_i$ - the i^{th} Obstacle
- $\mathcal{W}_{free}$ - Free Workspace
- $\mathcal{Q}$ - Configuration Space
- $\mathcal{QO}_i$ - the i^{th} Obstacle in Config Space
- $R(q)$ - Set of points in ambient space occupied by the robot at config q

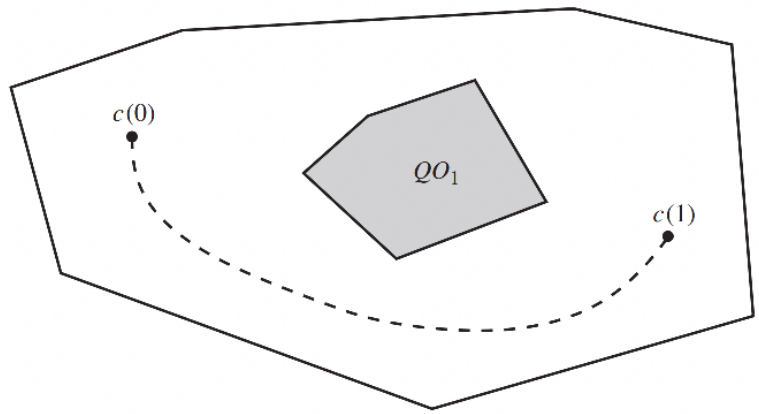

Figure: A path.

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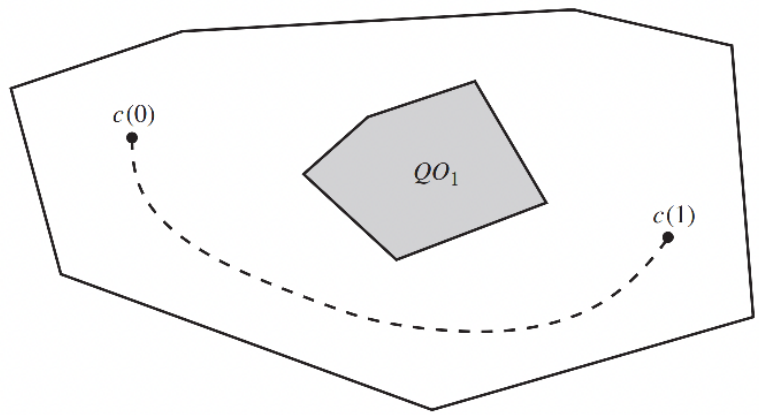

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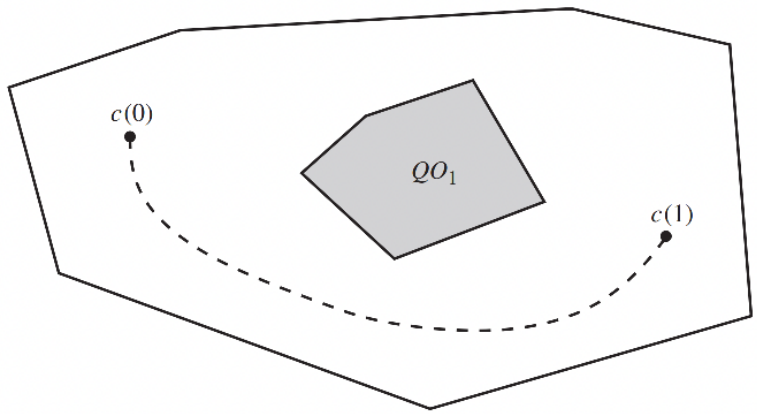

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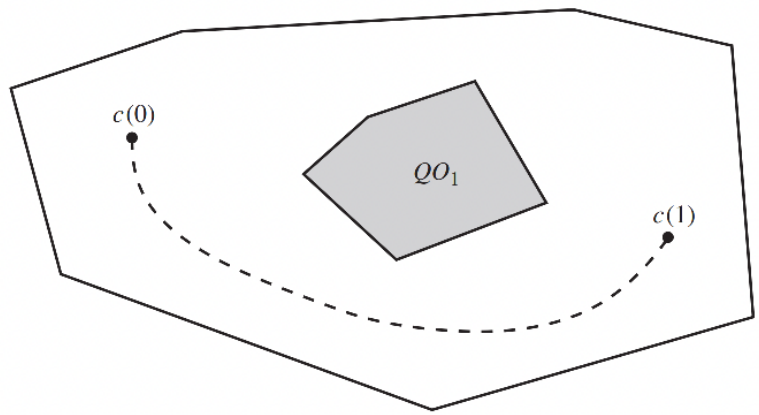

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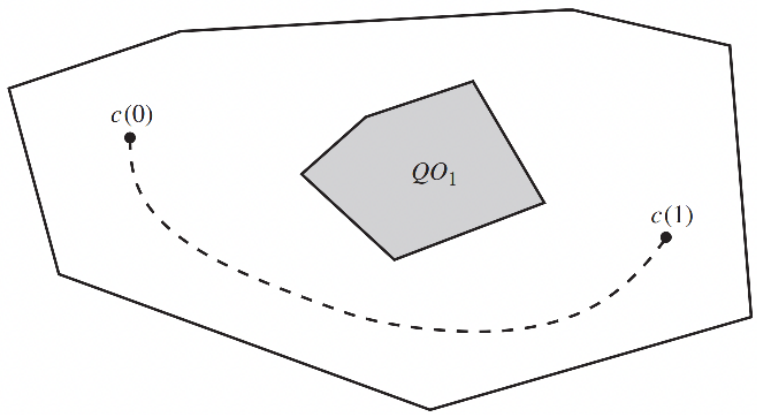

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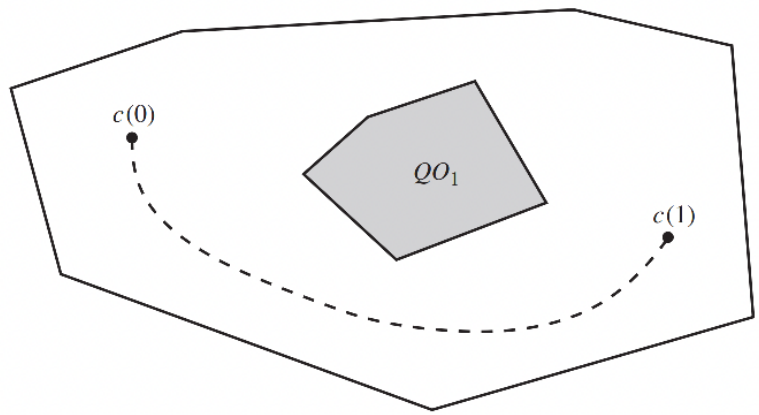

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Outline

Assumptions

- Assume a point robot
- Assume a zero range sensor
- Assume the robot can measure $d(x, y)$ between any $x \in \mathbb{R}^2$ and $y \in \mathbb{R}^2$ in a bounded workspace

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Summary

- The first main message of your talk in one or two lines.
- The second main message of your talk in one or two lines.
- Perhaps a third message, but not more than that.

- Outlook
  - Something you haven't solved.
  - Something else you haven't solved.