

ME/AER 676 Robot Modeling & Control

Spring 2023

Sampling-Based Motion Planning

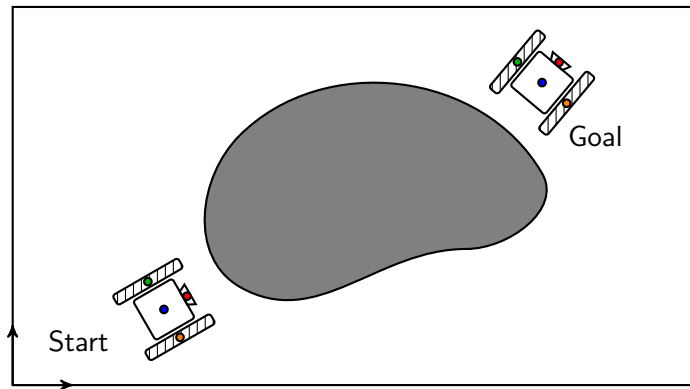
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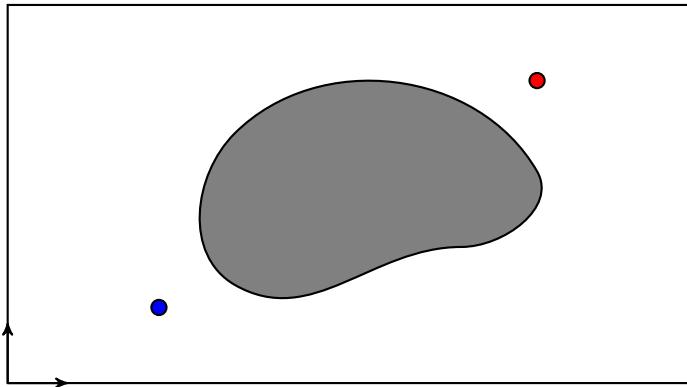
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Motion Planning



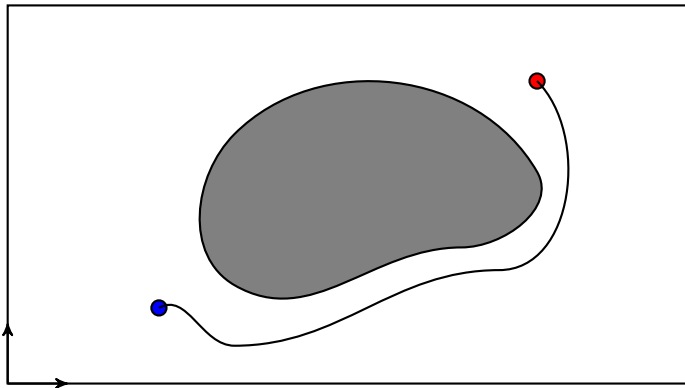
Motion Planning Problem

Motion Planning



Over-simplify the problem

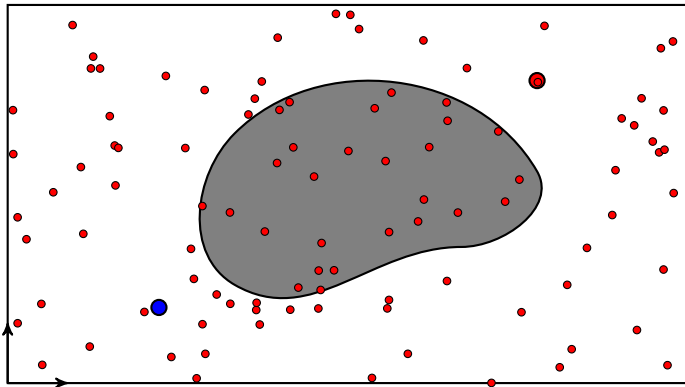
Motion Planning



A valid continuous path

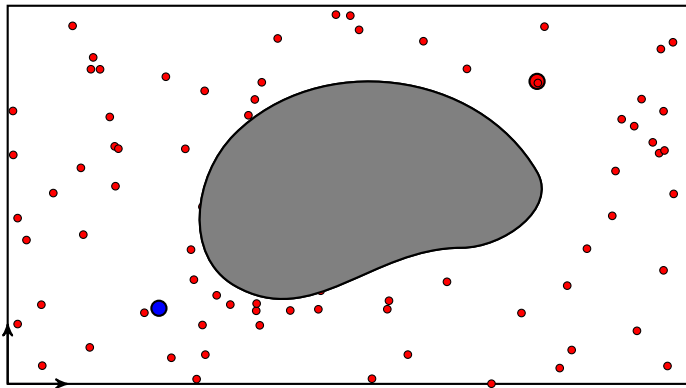
How would we obtain such a path using graph search?

Motion Planning



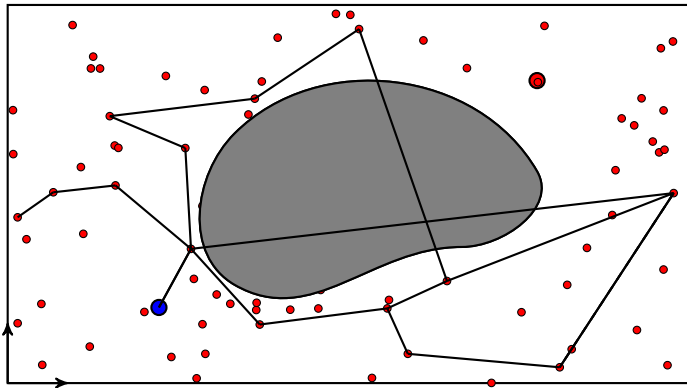
Randomly pick configurations to be nodes

Motion Planning



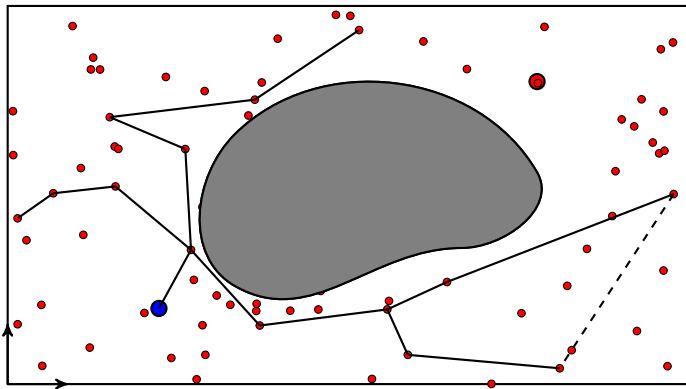
Randomly pick configurations to be nodes
Discard nodes in obstacles

Motion Planning



Randomly pick configurations to be nodes
Discard nodes in obstacles
Build graph by adding edges

Motion Planning



Randomly pick configurations to be nodes

Discard nodes in obstacles

Build graph by adding edges that can be physically realized

Motion Planning Continuous Space

Sampling-based motion planning (MP) algorithms define nodes/edges for continuous space and then develop a graph (PRM/RRG) or a tree (RRT).

- ▶ PRM: Probabilistic Road Map
- ▶ RRT: Rapidly-Expanding Random Tree
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The large variety in sampling-based motion planning algorithms are variations of the two following steps.

1. Randomly sample configurations to create 'nodes'
2. Use motion models/constraints to 'connect' samples

Motion Planning Continuous Space

Every algorithm has

- ▶ Sampling mechanism + collision check for creating nodes
- ▶ Select existing nodes to try and connect new samples to
- ▶ Local planner to check if we can connect new sample with selected existing nodes (dynamics, obstacles along path, local planner, etc.)

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- ▶ RRT*: rewire connections so that all paths in **tree** are optimal
- ▶ RRG: Connect to multiple neighbors, use shortest-path algos later.