Configuration Spaces

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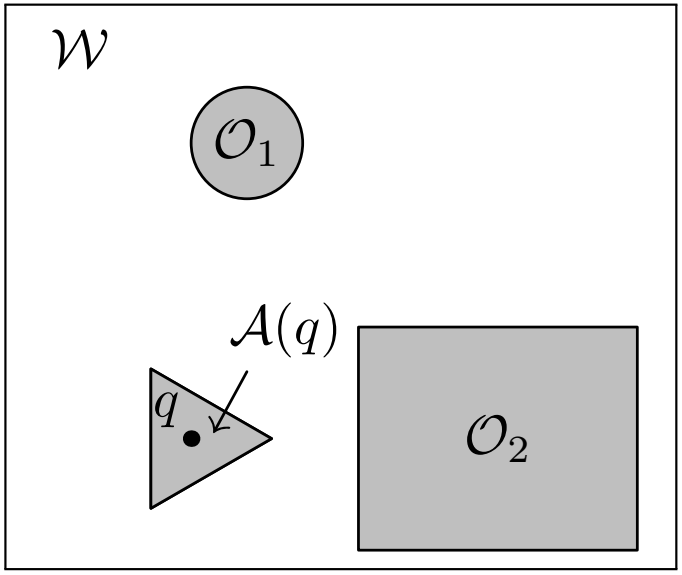
Configuration Spaces

- A configuration $\mathbf{q} \in \mathcal{C}$ is a vector that contains all of the information necessary to specify the location of a robot and all of its constituent parts.
- Turtlebot configuration: $\mathbf{q} = [x, y, \theta]$.
- $\mathcal{A}(\mathbf{q}) \subset \mathcal{W}$ is the space occupied by the robot in configuration $\mathbf{q}$.
- $\mathcal{C}_{obs} = \{\mathbf{q} \in \mathcal{C} \mid \mathcal{A}(\mathbf{q}) \cap \mathcal{O} \neq \emptyset\}$
- $\mathcal{C}_{free} = \mathcal{C} - \mathcal{C}_{obs}$

Example C-Space

Triangular non-rotating robot:

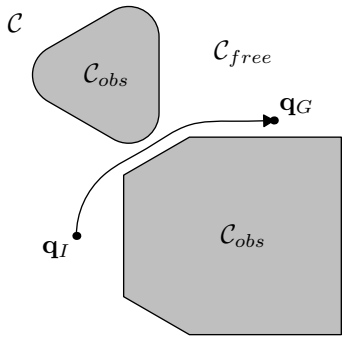


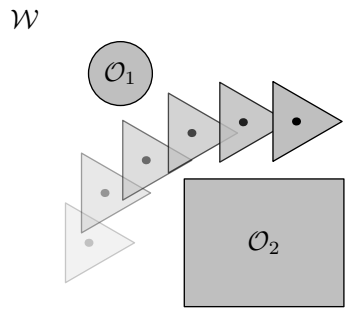
Video

Looking Ahead... Planning

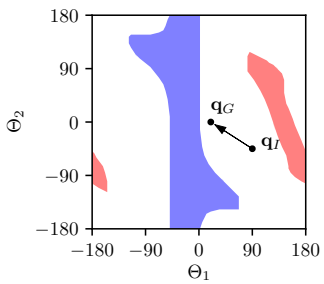
- Path planning - Finding a continous path from $\mathbf{q}_I$ to the goal configuration $\mathbf{q}_G$.

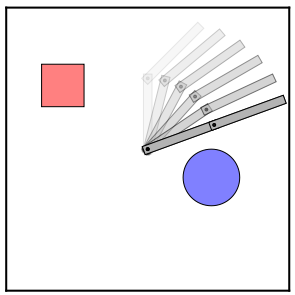
Triangle robot:





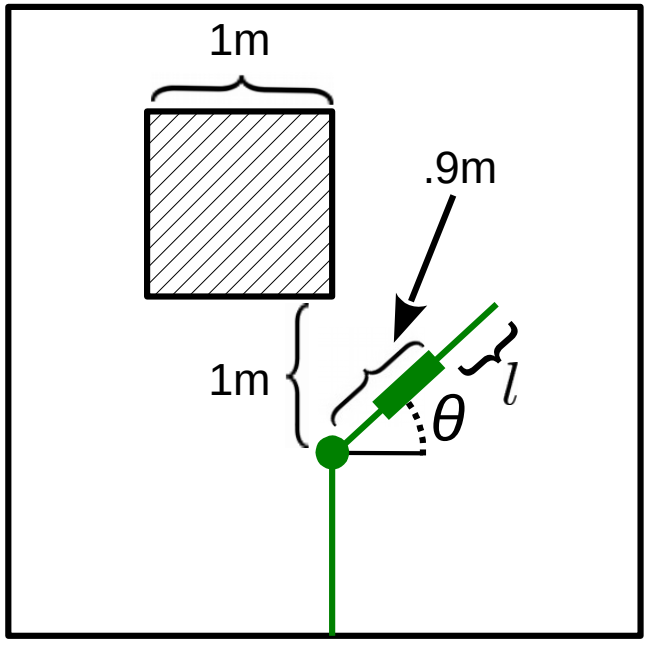
Two link arm:

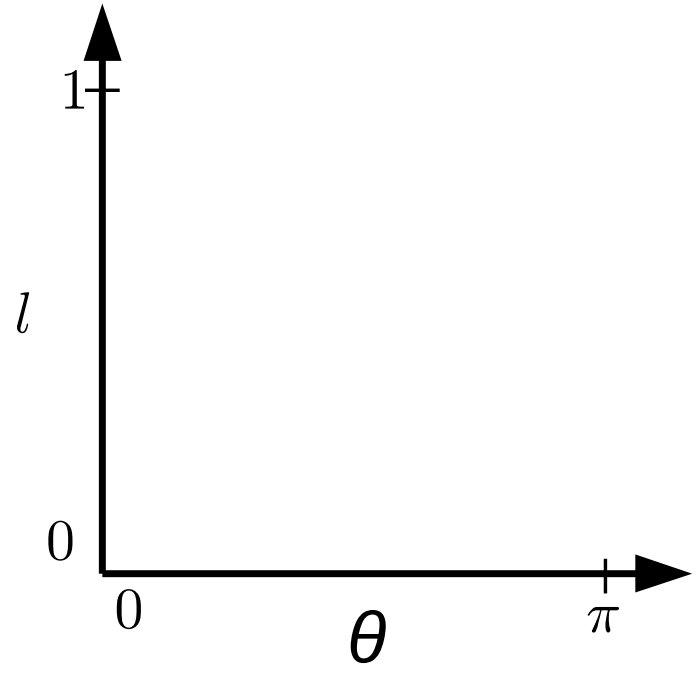




Exercise

Draw $\mathcal{C}_{free}$ for this robot:





- Robot arm with a single rotational joint and a single prismatic joint
- l - prismatic joint extension in meters
- θ - angle of rotational joint ($\Theta \approx \pi/4$ in the image)

Holonomic vs. Non-Holonomic Constraints

- Holonomic - Constraints on configurations
- Non-Holonomic - Constraints on trajectories (which may make some configurations unreachable)