Configuration Space

Lozano-Pérez 1981, 1983
Lozano-Pérez & Wesley 1979

Cspace  
Space of possible configurations of the robot.
Dimension = degrees of freedom of the robot

Cobstacle  
Constraints imposed on the robot's motions by obstacle's in the robot's workspace.

Free Space  
Possible configurations of the robot which are collision free.
General Idea:

- Construct configuration space obstacles.
- Search the free space for a path from the start to the goal configuration.
Pick a reference point on $A$. That determines a coordinate frame origin.
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$C_{space}$ obstacle arising from $B$ is:

$$C_{OA}(B) = \{ (x, y) \mid A(x, y) \cap B \neq \emptyset \}$$
Pick a reference point on \textit{A}. That determines a coordinate frame origin.

Cspace obstacle arising from \textit{B} is:

\[
\text{C}_{\text{O}_A}(B) = \{ (x,y) \mid A(x,y) \cap B \neq \emptyset \} = \{ \vec{b} - \vec{a} \mid \vec{b} \in B, \vec{a} \in A(0,0) \} = B \ominus A(0,0)
\]
Pick a reference point on $A$. That determines a coordinate frame origin.

Cspace obstacle arising from $B$ is:

$$ CO_A(B) = \{ (x, y) \mid A(x, y) \cap B \neq \emptyset \} $$

$$ = \{ \hat{b} - \hat{a} \mid \hat{b} \in B, \hat{a} \in A(0,0) \} $$

$$ = B \Theta A(0,0) $$
Pick a reference point on $A$. That determines a coordinate frame origin.

C-space obstacle arising from $B$ is:

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Algorithm:

- Sort $\Theta A$ & $B$ edges by angle
- Join up in order

$O(n+m)$
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Special Case:
2D, with convex polygonal objects.

- Construct 2D polygonal cspace obstacles.
- Search Vgraph.

graph of vertices with visibility edges.

SHAKEY 1969
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