Autonomous Mobile Robots

Exercise 6 : Dijkstra’s Algorithm and the Dynamic Window Approach for Motion Planning

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Input: Obstacle Map, Start Pose, Goal Pose
Output: Feasible Robot Path
Algorithm:
1. Create distance field with Dijkstra
2. While (not at goal):
   1. Follow gradient with DWA
- While queue is not empty and not at goal…
- Pop front node from queue
- Expand and add new nodes to queue
- Resolve double insertions

Sorted by cost
Recap Dijkstra

...
Recap Dijkstra

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Closed:
(2.2)
(1.2)
(2.1)
Recap Dijkstra

- Optimal solution in case of positive edge costs
- $O(|V| \log(|V|) + |E|)$
- Speed up with heuristic (A*)
Recap Dynamic Window Approach

Input: Obstacle Map, Current State, Goal Pose  
Output: Next Control Input  
Algorithm:
1.  Sample feasible inputs  
2.  For all feasible inputs:  
   1.  Compute trajectory over horizon  
   2.  Score trajectory  
      \[ G(v, \omega) = \alpha \text{heading}(v, \omega) + \beta \text{dist}(v, \omega) + \gamma \text{velocity}(v, \omega) \]  
3.  Pick trajectory with best score
Recap Dynamic Window Approach

Local: Heading towards goal

Global: Heading towards gradient
Recap RRT

Input: Obstacle Map, Current State, Goal Pose
Output: Feasible Robot Path

Algorithm:
1. Sample random pose
2. Try to link random pose to nearest pose in graph.
3. Repeat until goal pose is in graph

Extra - Not exam material
Recap Kinodynamic RRT

Input: Obstacle Map, Current State, Goal Pose
Output: Feasible Robot Path
Algorithm:
(Same as RRT, step 2 in linking sample with graph is kinetic/dynamically constrained)

Extra - Not exam material