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Tele-Experiment

Path Planning Algorithms for Mobile Robots

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1 Investigation of the Roadmap Method

1.1 Simulations

Evidence screenshots will be provided in Appendix A.

	Start	Goal	Path found?	Path optimal?
Map 1	5, 5	495, 495	Yes	Yes
	252, 127	275, 267	Yes	Yes
	90, 458	275, 113	Yes	Yes
Map 2	5, 5	495, 495	Yes	Yes
	84, 310	201, 294	Yes	Yes
	70, 110	437, 31	Yes	Yes
Map 3	5, 5	495, 495	Yes	Yes
	311, 388	366, 346	Yes	Yes
	106, 399	298, 59	Yes	Yes
Map 4	5, 5	495, 495	Yes	Yes
	369, 109	49, 321	Yes	Yes
	441, 22	142, 462	Yes	Yes
Map 5	5, 5	495, 495	Yes	Yes
	135, 256	206, 173	Yes	Yes
	94, 481	233, 68	Yes	Yes

Table 1.2: Roadmap Method Simulations

1.2 Discussion of Observations

1. The algorithm always finds a path.
2. The algotithm always finds the shortest path.
3. The alogirthm is suitable for all types of maps, provided the fact that the map is known and static.
4. Since the algorithm finds semi-free paths connecting the vertices of the obstacles, the algorithm risks colliding to the obstacles if there are control noise and minor inaccuracies in the robot's movement. To avoid this the obstacles should be grown to give some distace between the robot and the obstacles on the planned path.

2 Investigation of the Potential Field Method

2.1 Effects of Parameters

1. When the attractig potential gain is increased, the robot is attracted stronger to the goal position, sometimes even on the risk of colliding into the obstacles. When the attracting potential is reduced, the risk of robot getting trapped in local minima is increased and the robot may risk not reaching the goal.
2. When the repulsing potential gain is increased the robot will try harder to avoid the obstacles; there are observed to be sharper and stronger turns around the obstacles. When the repulsing potential is reduced, the robot tend to move closer to the obstacles.
3. When the minimal distance value is increased, the robot will move away from the obstacles from a further distace. However, when the available path between the obstacles is too narrow, the robot may consider the path as blocked and will not consider the path. When the minimal distance value is decreased, the robot will move too close to the obstacles before being effected by the repulsing potential.
4. The parameters need to be adjusted for different maps. Each of the map have different arrangement of obstacles and the robot requie different parameters to navigate them.

2.2 Simulations

Evidence screenshots will be provided in Appendix B.

	Start	Goal	Path found?	Path optimal?
Map 1	5, 5	495, 495	Yes	No
	252, 127	275, 267	Yes	No
	90, 458	275, 113	Yes	No
Map 2	5, 5	495, 495	Yes	No
	84, 310	201, 294	No	No
	70, 110	437, 31	No	No
Map 3	5, 5	495, 495	No	No
	311, 388	366, 346	No	No
	106, 399	298, 59	No	No
Map 4	5, 5	495, 495	Yes	No
	369, 109	49, 321	Yes	No
	441, 22	142, 462	No	No
Map 5	5, 5	495, 495	No	No
	135, 256	206, 173	No	No
	94, 481	233, 68	No	No

Table 2.2: Potential Field Method Simulations

2.3 Discussion of Observations

5. The algorithm does not always find a path. The algorithm does not find the path in
    - Map 2 from (84, 310) to (201, 294), and from (70, 100) to (437, 31)
    - Map 3 from (5, 5) to (495, 495), from (311, 388) to (366, 346), and from (106, 399) to (298, 59)
    - Map 4 from (441, 22) to (142, 462)
    - Map 5 ffrom (5, 5) to (495, 495), from (135, 256) to (206, 173), and from (94, 481) to (233, 68)

The problem that the Potential Field method suffer from is the local minima. Since the Potential Field method method relies on the attracting potential and repulsing potential, the robot can get trapped in positions where the potentials cancel each other out and the robot does not know where to move anymore.

6. Compared to the Roadmap Method, the algorithm does not find the shortest path in any of the simulations. This is due to the fact that the Potential Field method is a local planner and is prioritized on avoiding the obstacles and not in finding the optimal path.

7. The algorithm is not suitable for all types of maps. The alogirthm does not work well in maps where

    - there are concave obstacles with pocket in which the robots can get trapped inaccuracies
    - there are very long obstacles where the robot cannot find a path around if the goal is behind the obstacle
    - there are a lot of obstacles with their overlapping repulsive potentials preventing the robot from finding the path

8. The Potential Field Method is a local planner and will face problems with reliability when used as a global planner. It cannot realiably find the path to the goal everytime. The solution to it would be to use it in combination with a global planner, to avoid dynamic obstacles on the path. The planner is also prone to getting trapped in the local minima which can be avoided by employing the random walk method.

3 Investigation of Distance Transform Method

3.1 Simulations

Evidence screenshots will be provided in Appendix C.

	Start	**Goal**	**Path found?**	**Path optimal?**
Map 1	5, 5	495, 495	Yes	No
	252, 127	275, 267	Yes	No
	90, 458	275, 113	Yes	No
Map 2	5, 5	495, 495	Yes	No
	84, 310	201, 294	Yes	No
	70, 110	437, 31	Yes	No
Map 3	5, 5	495, 495	Yes	No
	311, 388	366, 346	Yes	No
	106, 399	298, 59	Yes	No
Map 4	5, 5	495, 495	Yes	No
	369, 109	49, 321	Yes	No
	441, 22	142, 462	Yes	Yes
Map 5	5, 5	495, 495	Yes	No
	135, 256	206, 173	Yes	No
	94, 481	233, 68	Yes	No

Table 3.2: Distance Transform Method Simulations