ENPM 661: Planning for Autonomous Robots

Project 5 - Practical Implementation

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Introduction

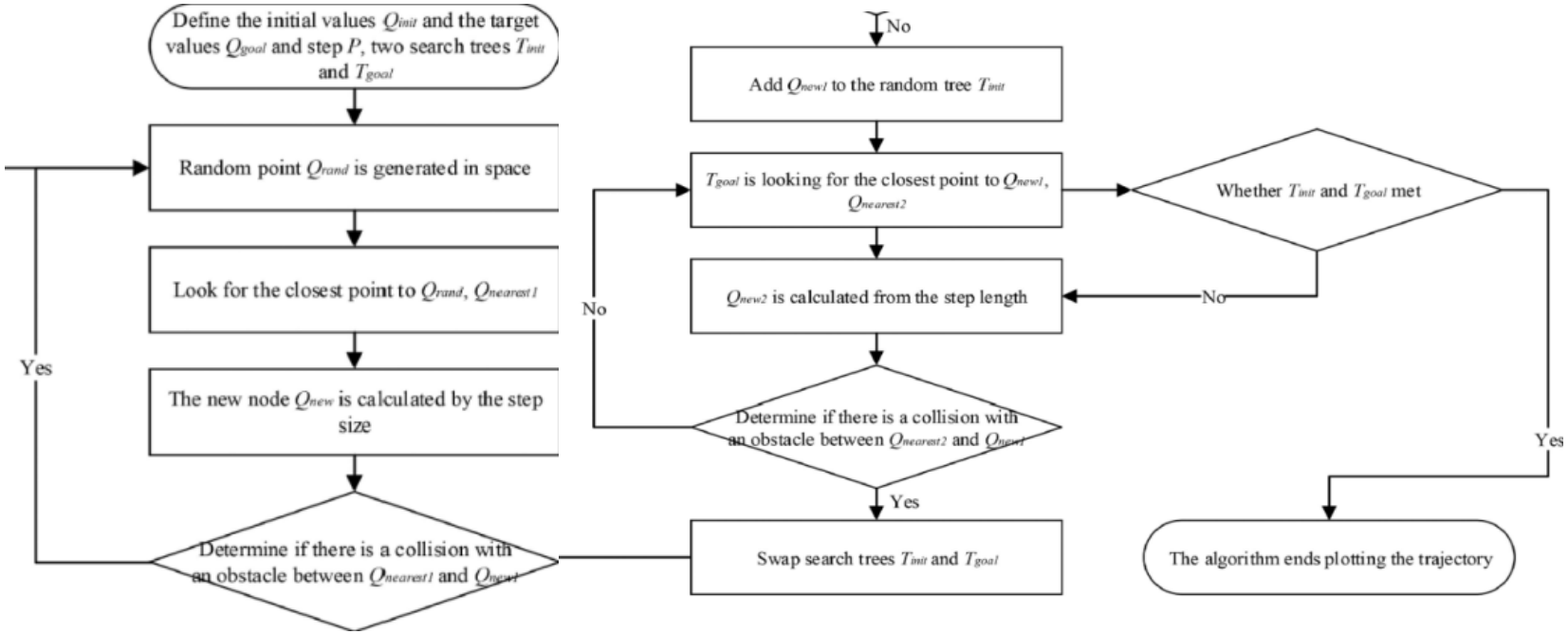
- Path planning is crucial for guiding autonomous systems and robots efficiently from a starting point to a destination while avoiding obstacles.
- It ensures safety, optimizes resource usage, adapts to dynamic environments, and plays a vital role in various fields such as transportation, robotics, and disaster response.

About the Paper

- The paper implemented proposes, Improved RRT Connect computes an efficient path, when compared with RRT and RRT connect.
- The algorithm introduces a goal biased strategy on the original RRT-Connect algorithm and the efficiency is calculated based on the path length.

RRT Connect

Flowchart



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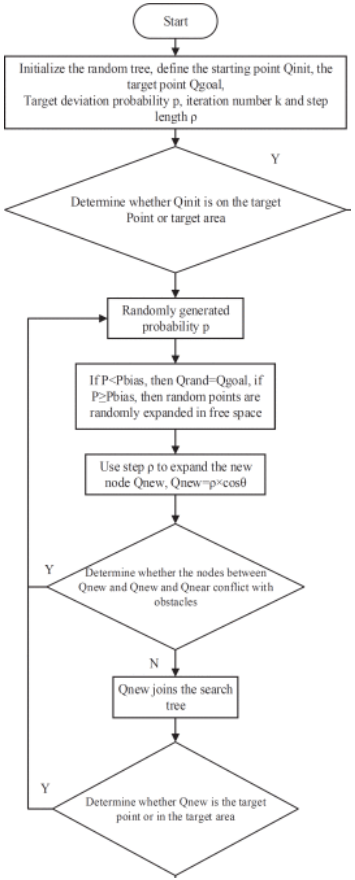
Simulation

Link :
https://drive.google.com/file/d/1AIWhru4JNyvubYm33OQYQLNmX_Bh4qNo/view?usp=drive_link

Improved RRT-Connect

Algorithm:



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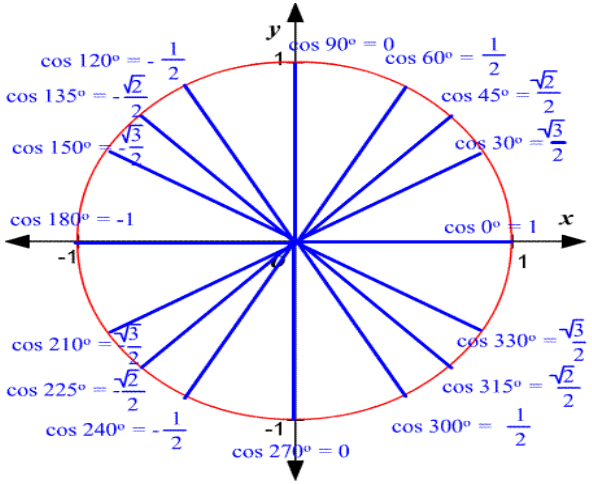
Contd.

Exploitation

- If P<=Pbias, then Qrand = Qgoal

Exploration

- If P>Pbias, then Qrand = Qsamp



Adaptive step adjustment(Qnew):

$$\overrightarrow{p}_1 = Q_{near} - Q_{rand}$$

$$\overrightarrow{p}_2 = Q_{near} - Q_{goal}$$

$$\cos\theta = \frac{\left(\overrightarrow{p_1} \cdot \overrightarrow{p_2}\right)}{\left|\overrightarrow{p_1}\right| \left|\overrightarrow{p_2}\right|}$$

$$Q_{new} = Q_{near} + \rho \square \cos\theta$$

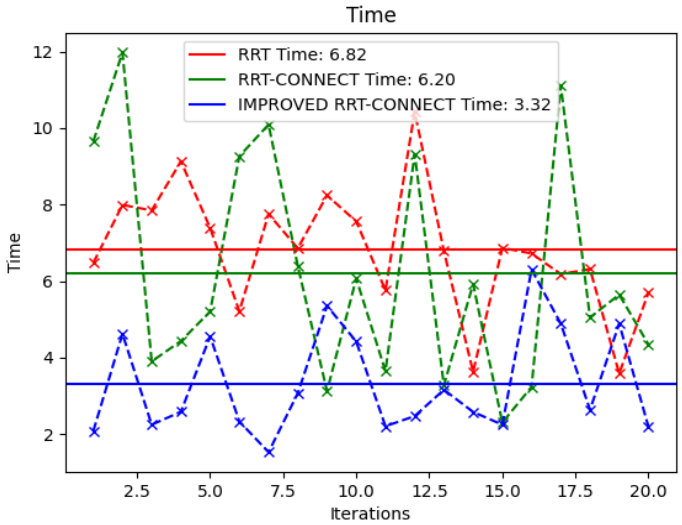
Demo:

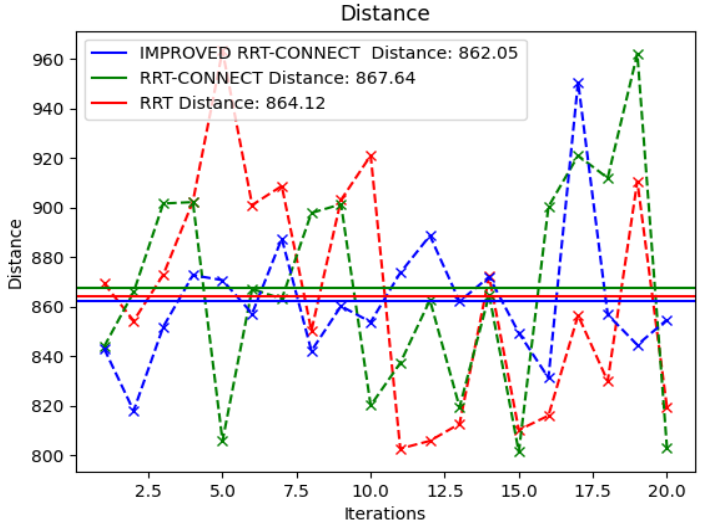
LINK: https://drive.google.com/file/d/1CUI_M3-1sVeWMz0YgvEY4T5AiCV-0X39/view?usp=sharing

Results

Comparison:

- The graph shows a **46.45%** reduction in time when using the Improved RRT-Connect algorithm compared to the RRT-Connect.
- Improved RRT-Connect exhibits optimal path convergence in comparison to RRT-Connect.





Future Work:

- Implementing the RRT-connect and Improved RRT-connect in Turtlebot simulation and Real world.
- Compare the results of how pbias value affects the algorithm time and path efficiency,
- Assess the performance of the algorithms in challenging scenarios, including environments with narrow passages and obstacles. This will help determine the robustness and adaptability of the algorithms in more intricate navigation tasks.

Problems Faced:

- As the nodes are sampled randomly, each of the algorithms cannot be compared in a single run, so ran multiple runs to get the mean time and path distances respectively.

Thank you

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