

A decorative network graph pattern in the top-left corner, featuring a complex web of interconnected nodes and edges. Some nodes are highlighted with blue circles, and others with blue dots.

Motion Planning Under Spatio-Temporal Constraints

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A decorative network graph pattern in the bottom-right corner, featuring a complex web of interconnected nodes and edges. Some nodes are highlighted with blue circles, and others with blue dots.

Motivation

- ◎ **Traditional Approach** :- Most motion planning algorithms compute a path that connects a start configuration S and a goal configuration G , while avoiding collision with known obstacles.
- ◎ **Challenges** :-
 - Real World applications require solving more complex tasks.
E.g. go to location A first then go to location B, after that go back to start location.
 - Multi-query Problem (Multiple goals and constraints).
 - Heterogeneous robots (ground, aerial, etc)

Proposed Approach

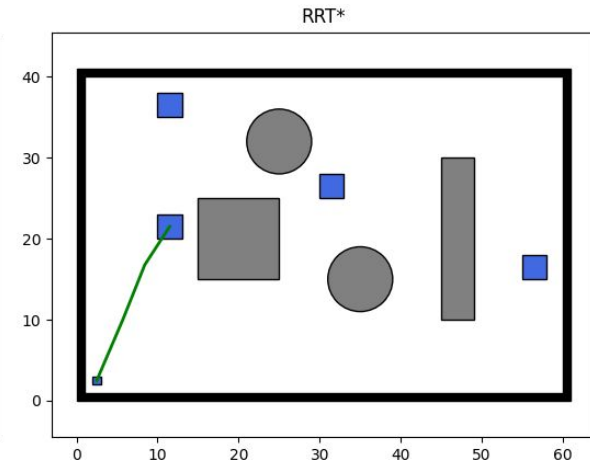
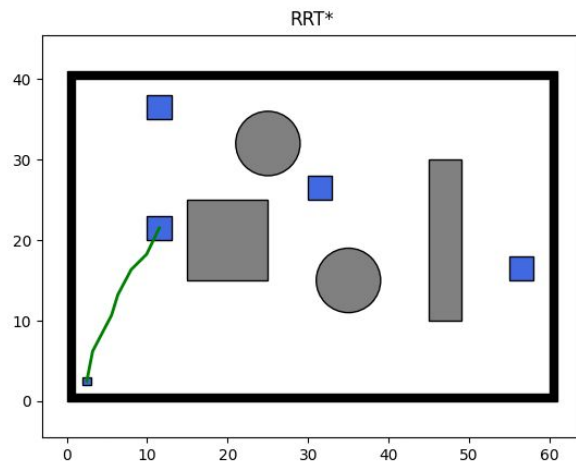
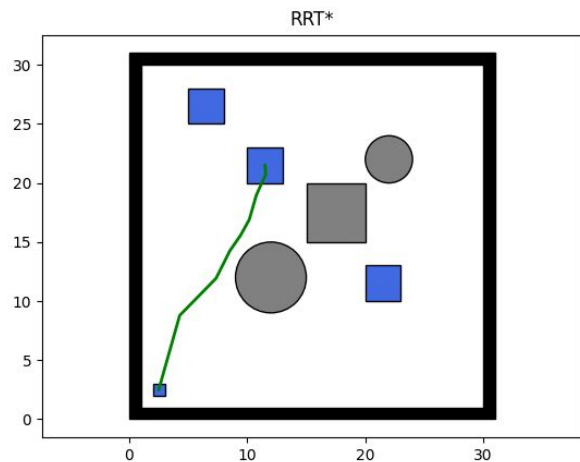
- ◎ **Goal** :- To Design a motion planning algorithm that can handle spatial and temporal constraints for a given robot.
- ◎ **Solution** :-
 - Use Temporal Logic Specifications to formally define task we want to plan for.
 - Embed Temporal Logic formulation into a existing state-of-the-art motion planning algorithm.

Current Progress

- ◎ Understand and Implement the Signal Temporal Logic specifications in Python.
- ◎ We Started with Implementing a Multi-goal RRT* which can be expressed as STL specification without time specifications.

Results so far

- ⊙ We modify RRT* to achieve multi-goal task specifications.



Next Steps

- ◎ Next we will investigate how to combine STL with a motion planning algorithm.
- ◎ Design a algorithm to include time formulation for a single goal task specification.
- ◎ Possible Solution is using STL Robustness value, which gives us information regarding how well we are satisfying the task at hand.

References

- ◎ There are several works addressing this problem using Different temporal logic formulations (LTL, MITL, STL, scLTL, etc.)
- ◎ We look in some these work:
 - a. J Karlsson et al,. Sampling-based Motion Planning with Temporal Logic Missions and Spatial Preference.
 - b. Vasile et al,. Sampling-bases synthesis of maximally-satisfying controllers for temporal logic specifications.



Thanks!

Any questions?