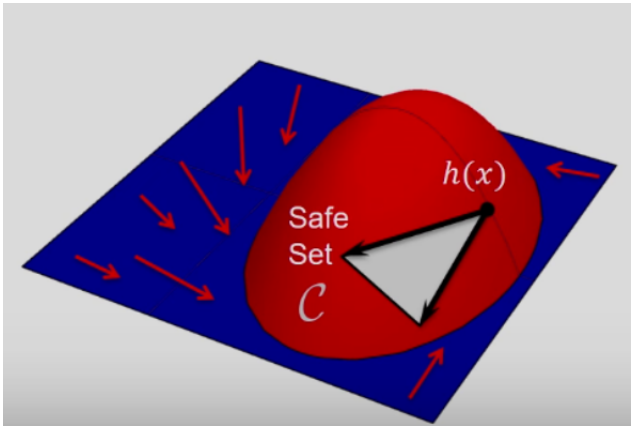
Trajectory Repairing with Control Barrier Functions for Signal Temporal Logic Tasks

Background

The increasing necessity for planning methods that are computationally efficient for autonomous vehicles, operating under temporal logic tasks, has recently become more evident [1]. To formalize the traffic rules in a precise and machine-readable manner, temporal logic languages are often used, such as Linear temporal logic (LTL), metric temporal logic (MTL) [2], and signal temporal logic (STL) [3]. To encode spatial-temporal constraints into the planning problem, the authors in [4, 5] formulate STL specifications as mixed integer constraints that apply to the system variables. However, current techniques are resource-intensive in terms of computation, making them often impractical for real-world application. Particularly in multi-robot systems, these methods fail to scale effectively in computational terms. To solve these issues, in [6, 7], time-varying control barrier functions (CBF) are considered where the temporal properties are used to satisfy STL tasks. Therefore, in this thesis, we would like to explore using the CBF for solving STL tasks in our existing trajectory repairing framework [8].



Control Barrier Function to certify safety[1].

Tasks

- Literature review of works related to CBF, STL, and their combinations; Familiarization with the current trajectory repairing framework
- Implementing trajectory planning and repairing for collision avoidance with CBF
- Implementation trajectory planning and repairing for reach-avoidance task formulated in STL with CBF
- Comparison with existing approaches
- Documentation of codes and other related materials

References

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Research project:
-

Type:
BA

Research area:
Motion Planning, Control Theory, Autonomous Vehicles

Programming language:
Python

Required skills:
Advanced programming skill, able to work independently, familiar with motion planning algorithms

Language:
English

Date of submission:
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