Interaction-Aware Trajectory Repairing for Autonomous Vehicles

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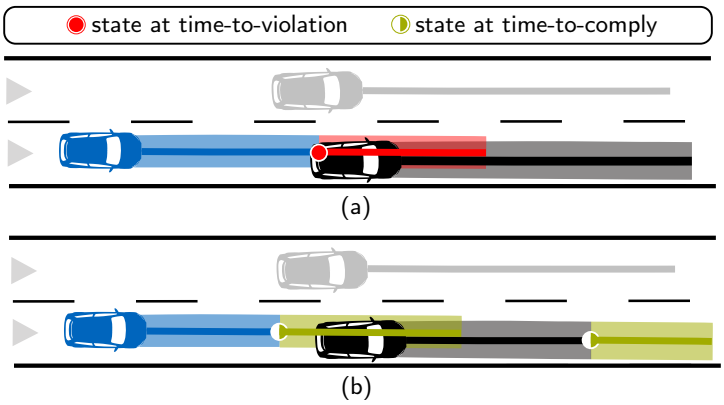
Background

Autonomous vehicles need to comply with traffic rules so that they cannot be held liable for traffic accidents. To formalize the traffic rules in a precise and machine-readable manner, temporal logic languages are often used, such as Linear temporal logic (LTL) [1, 2], metric temporal logic (MTL) [3], and signal temporal logic (STL) [4]. However, it is computationally nontrivial to ensure the compliance of real-time motion planning with all traffic rule constraints, especially in complex situations. Obviously, if planned trajectories are not rule-compliant or physically infeasible, one can replan them for consecutive planning cycles. Nonetheless, replanning a complete trajectory is often unnecessary and time-consuming. To solve this issue, we proposed the trajectory repairing framework in our previous works [5, 6].



(a): the initially-planned trajectories. (b): the interaction-aware repaired trajectories.

Description

Until now, the trajectory repairing framework only considers the planning problem of the ego vehicle, which would be extended to multiple interacting agents in this thesis. The influence the ego vehicle's actions might have on other agents can not be considered during planning which can result in suboptimal solutions [7] or irreparability of the trajectories [6]. To account for dynamic interactions between rational agents, multi-agent planning [8], forward simulation methods [9], and game theory [10, 11] are often used. In this context, we are looking for a thesis student to support us in the further development of our trajectory repairing framework with multiple agents using the above mentioned interaction-aware approaches. The results should be demonstrated in CommonRoad[1] [12], which is a collection of composable benchmarks for motion planning on roads.

Tasks

- Literature review of works related to traffic rule formalization, interaction-aware motion planning algorithms
- Familiarizing with the current trajectory repairing framework and the existing traffic rule monitor in CommonRoad platform
- Evaluation of different interaction-aware planning algorithms and deciding which ones fit the repairing framework the best
- Using the chosen approaches for interaction-aware trajectory repairing
- Evaluation of the developed approach on CommonRoad scenarios
- Documentation of codes and other related materials

[1] https://commonroad.in.tum.de/

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Advisor:
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Research project:
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Type:
Master's Thesis/ Guided Research/ Semester Thesis

Research area:
Motion Planning, Traffic Rules, Game Theory

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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