

Optimization with Expensive Cost Functions for Safe Maneuver Automata

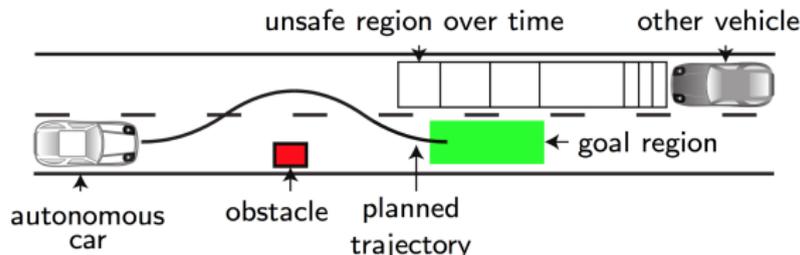
Bastian Schürmann

Technische Universität München

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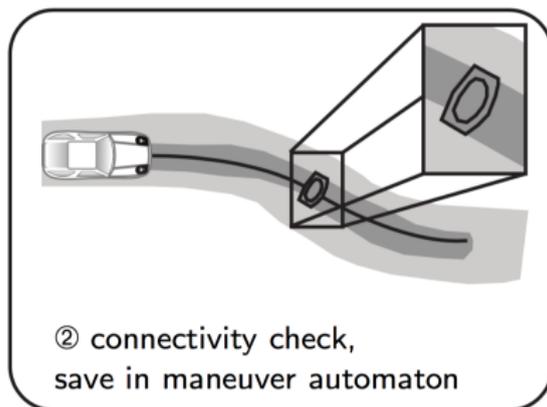
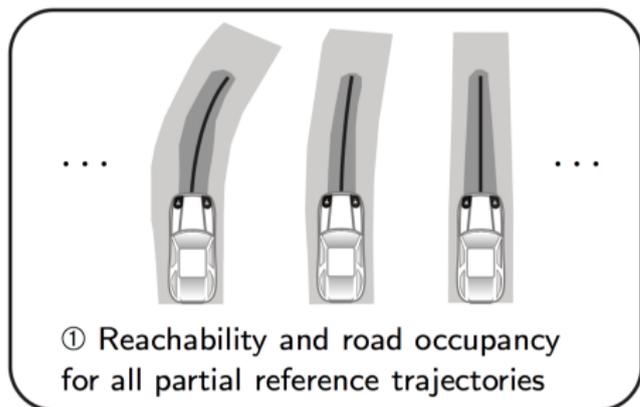
Maneuver Automata

Autonomous Driving



- Safe trajectory planning is a hard task ...
- ...but it can be simplified using maneuver automaton (see previous presentation)

Maneuver Automata: Offline Part



- Optimal controllers and reachable set are computed for short trajectories, so-called motion primitives, e.g., drive straight for a short time, turn left, turn right, etc.
- All motion primitives are stored as states in a maneuver automaton
- If the final reachable set of one motion primitive is **completely inside** the initial set of another motion primitive, they can safely be concatenated

Maneuver Automata: Offline Part

- Motion primitives can be combined if the final reachable set of one motion primitive is **completely inside** the initial set of another motion primitive
- For best planning, we want to be able to connect as many motion primitives with each other as possible
 - ⇒ The reachable sets of the motion primitives should be as small as possible
 - This can be done by using a novel optimal control algorithm

Optimization

- The optimal control algorithm for computing the motion primitives requires solving an optimization problem with an expensive cost function
- In classical optimization, the evaluation of the cost function is cheap and can be performed many thousand time in a short amount of time
- In our case, each evaluation of the cost function requires computing the reachable set of a system, which takes some time
⇒ Optimization algorithms are needed which choose the cost function evaluations in a smart way

Topic: Optimization with Expensive Cost Functions for Safe Maneuver Automata

- Several optimization algorithms for expensive cost function have been developed
- **Goal:** Find the best optimization algorithm for the computation of motion primitives and use it to compute a maneuver automaton
- **Tasks:**
 - Review literature for existing optimization algorithms for expensive cost function
 - Implement the optimization algorithms in Matlab
 - Apply them for our problem and compare their performance and computation times

Questions?

Contact:

Bastian Schürmann

MI 03.07.039

bastian.schuermann@in.tum.de