Graduate Student Research Seminar

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Interactive Motion Planning for Autonomous Vehicles via Adaptive Interactive MPC

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3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Interaction with other road users is one of the core aspects of driving which humans execute naturally. For the foreseeable future, autonomous vehicles will drive alongside human-driven vehicles and therefore, making the onboard computer capable of interaction becomes vital. Imparting such a sense into the decision making and motion planning algorithms has been explored in some of the recent autonomous vehicle planning research. It may be inferred that motion plans which are generated without considering the mutual influence in driving, result in overly conservative behavior of the ego vehicle. In interaction intensive scenarios like mandatory lane change and merging, this may result in inability to execute the required maneuver.

This work presents a new optimal control-based interactive motion planning algorithm for an autonomous vehicle interacting with a human-driven vehicle. The ego vehicle solves a joint optimization problem for its motion planning involving costs and coupled constraints of both vehicles and applies its own actions. The non-convex feasible region and lane discipline are handled by introducing integer decision variables and the resulting optimization problem is a mixed-integer quadratic program (MIQP) which is implemented via model predictive control (MPC). Furthermore, the ego vehicle imputes the cost of human-driven neighboring vehicle (NV) using an inverse optimal control method based on Karush-Kuhn-Tucker (KKT) conditions and adapts the joint optimization cost accordingly. We call the algorithm adaptive interactive mixed-integer MPC (aiMPC). Its interaction with human subjects driving the NV in a mandatory lane change scenario is tested in a developed software-and-human-in-the-loop simulator. Results show the effectiveness of the presented algorithm in terms of enhanced mobility of both the vehicles compared to baseline methods.

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