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MASTER'S THESIS

Exploring the Role of Human-Driven Vehicles in Lane-free Traffic

Problem description:

Connected and Automated Vehicles (CAVs) are expected to eventually completely replace Human-Driven Vehicles (HDVs). To fully exploit new capacities from CAVs, traffic rules may be reconsidered and some features introduced to facilitate the driving task to a human driver can be relaxed. For example, recent work [1] showed that a considerable increase in the road throughput can be obtained by giving up fixed "discrete" lanes and allowing vehicles to occupy any lateral position. The approach was further explored in [2]. Although very promising, the above-mentioned approach is still far from practical application, since HDVs will continue to be part of the traffic for a significant amount of time.

The goal of this work is to model and simulate the possible behavior of HDVs in lane-free traffic. HDVs can be simulated using standard motion planning algorithms, in which other traffic participants are regarded as dynamic obstacles and without taking advantage of communicated information. Uncertainty is added to model unpredictability of the human decisions. Extensive literature review must be conducted, highlighting the challenges and possible models representing HDVs' behavior in lane-free traffic. In a simulation study, it will be explored how HDVs can be included in lane-free traffic. One essential question is for example which instructions human drivers have to receive to orient in lane-free traffic. Further the impact of possibly inferior performance of a human driver on road throughput and safety will be investigated.

Tasks:

- Literature review
- Modelling of human driving in lane-free traffic
- Simulation and discussion of several mixed (CAVs and HDVs) lane-free scenarios

Bibliography:

- [1] M. Papageorgiou, K.-S. Mountakis, I. Karafyllis, I. Papamichail, and Y. Wang, "Lane-free artificial-fluid concept for vehicular traffic," *Proceedings of the IEEE*, 2021.
- [2] V. K. Yanumula, P. Typaldos, D. Troullinos, M. Malekzadeh, I. Papamichail, and M. Papageorgiou, "Optimal path planning for connected and automated vehicles in lane-free traffic," in *IEEE International Intelligent Transportation Systems Conference (ITSC)*, 2021.

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