Prof. Dr.-Ing. habil. Falko Dressler
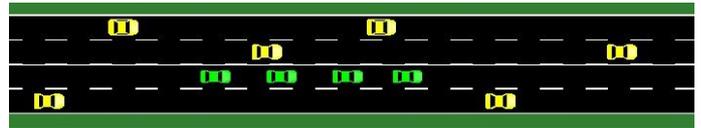## Data Communication and Networking – TKN

Technische
Universität
Berlin

Bachelor/Master's Thesis

Cooperative Re-Ordering Maneuver for Platoons

To cope with the ongoing growth in road traffic and pollution, researchers and car manufacturers are working on *platooning* that groups multiple vehicles in tightly coupled convoys.

Platooning promises improved traffic flow, reduced fuel consumption, and improving safety. It has been shown that an optimized order of the platoon members can have a high impact on the advantages of platooning [1]. However, the order of the members may not always be optimal when vehicles join and leave the platoon and the order considered optimal can change over time. Therefore, it can be beneficial to re-order platoon members of an existing platoon.

Performing changes to an existing platoon requires cooperative maneuvers. For re-ordering vehicles in a platoon, there is only little work available so far [2].

■ Goals of the Thesis

The goal of the thesis is to design an algorithm for cooperative re-ordering maneuver for a platoon of cars on freeways in Finite State Machines (FSMs). The algorithm should only rely on local sensor data of the individual platoon members that is exchanged among the members via Vehicle-To-Vehicle (V2V) messages. The focus of the algorithm is the proper execution of the re-ordering of the vehicles to a given (optimal) sequence. During the maneuver, the algorithm needs to continuously asses the safety of the platoon and other road users by monitoring the current traffic situation.

After modeling, the algorithm should be implemented into our simulation framework Plexe [1] and its correct behavior (and safety) needs to be validated. Finally, its performance should be assessed within a simulation study.

To successfully complete this thesis, you need to do the following:
- Model an algorithm for cooperative re-ordering a platoon to a given sequence.
- Implement the algorithm within Plexe and validate its correct behavior.
- Evaluate the performance using well-stabled metrics, e.g., for safety and platoon benefits.

■ Required Knowledge

You will need a basic understanding of *FSMs*, *Vehicular Networking*, *Network Simulation*, and *Python*.

[1]   R. Hall and C. Chin, "Vehicle sorting for platoon formation: Impacts on highway entry and throughput," *Elsevier Transportation Research Part C: Emerging Technologies*, vol. 13, no. 5, pp. 405–420, Dec. 2005. DOI: 10.1016/j.trc.2004.09.001.

[2]   T.-W. Huang, Y.-Y. Tsai, C.-W. Lin, and T.-Y. Ho, "Vehicle Sequence Reordering with Cooperative Adaptive Cruise Control," in *23rd Design, Automation And Test in Europe Conference & Exhibition (DATE 2019)*, Florence, Italy: IEEE, Mar. 2019, pp. 610–613. DOI: 10.23919/date.2019.8714722.

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[1]http://plexe.car2x.org