PADERBORN UNIVERSITY
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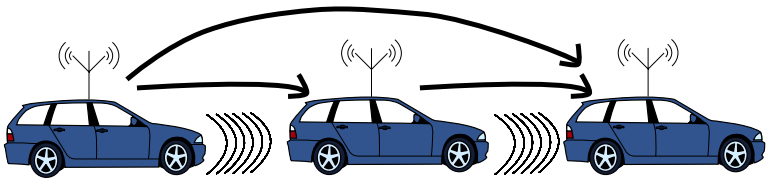
Cooperative Mobile Systems – CCS Labs
CCS

Bachelor Thesis

Analysis of different Cooperative Adaptive Cruise Controllers



Vehicle-to-everything communication can serve as the basis for novel applications enabling cooperation among mobile systems of the future. An example application for this is *vehicle platooning* on different kind of streets. Vehicle platooning means a convoy or a platoon of vehicles travelling in close co-ordination under fully automated longitudinal and lateral control. In general, a platoon has a leader which is responsible for setting the trajectory and speed for all vehicles in the platoon. All other vehicles in the platoon are following one another with a very small headway spacing, and they are linked to each other through control mechanisms. Such a control mechanism is an advanced Adaptive Cruise Control (ACC), called Cooperative ACC (CACC), which drastically reduces inter-vehicle gaps. This mechanism describes how the following vehicles have to react to steady-state operations or to disturbances. The fundamental idea is to share information such as speed, position or acceleration with other platoon members. The small headway leads to an increased capacity of the road and reduced fuel consumption by using the reduced air drag.

Literature about platooning introduces several CACC controllers. The CACC design mainly differ in terms of control topology, meaning the data that is considered. One of the most famous one is the CACC PATH controller, which has been developed in the scope of the California PATH project. Compared to the controller published by Ploeg et al., the PATH controller exploits data from the leader and not only from the vehicle in front. However, the FLATBED controller by Ali et al. claims to be stable even in the case of total loss of communication. Beside that the FLATBED controller additionally reduces the inter vehicle gap and claims to be more secure and efficient in terms of communication overhead. Nevertheless, all controllers are especially designed for longitudinal and lateral control on highways and they have, to the best of our knowledge, never been compared to each other in more detail.

Goals of the thesis

In the scope of this thesis we want to analyze and compare different CACC controllers in extreme scenarios and use cases. As all controllers are designed for platooning on highways, we want to investigate those controllers especially for urban scenarios. The thesis should show differences of at least two controllers and shall be able to give justified recommendations for platooning in cities. We already have some platoon controllers implemented, which will be used for this thesis. The results of this thesis will help make platoons more secure and more dynamic in realistic scenarios.

Keywords

C++, Platooning, Network Simulation, Vehicular Networking

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