Connect & drive : design and evaluation of cooperative adaptive cruise control for congestion reduction

Connect & Drive: Design and Evaluation of Cooperative Adaptive Cruise Control

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Introduction

An effective method to increase road capacity as well as fuel economy, is to decrease the inter-vehicle following distance d_i. Consequently, a driver assistance system is required to still guarantee safety. To this end, radar sensors could be deployed, measuring the inter-vehicle distance and the relative velocity, as a basis for a collision avoidance system. Another, more effective method, is known as Adaptive Cruise Control (ACC), which continuously regulates the inter-vehicle distance. It has however been shown [1] that ACC amplifies disturbances in upstream direction at small distances, causing so-called ghost traffic jams. The origin of this problem is a lack of information about the preceding vehicle's motion. Using wireless communication in addition solves this problem, allowing for active disturbance attenuation. This is called Cooperative Adaptive Cruise Control (CACC), being the focus of this paper, illustrated in Figure 1 for a one-vehicle look-ahead communication architecture.

CACC system design

The main objective is to keep a set distance to the preceding vehicle according the chosen *spacing policy*, subject to the requirement of *string stability* [2]. The latter refers to the ability to attenuate perturbations introduced by a platooning vehicle along the string in upstream direction.
CACC relies to a large extend on wireless communications,

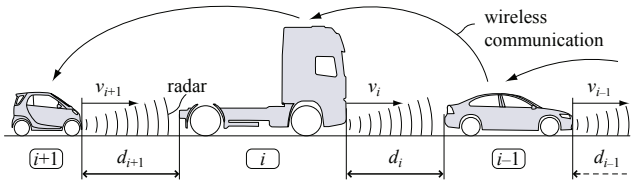

Figure 1: Schematic representation of a CACC platoon.

Figure 2: The Connect & Drive fleet.

allowing for motion information of multiple neighboring vehicles. Consequently, many possibilities exist as to which information is actually to be used, e.g., one-vehicle look-ahead, leader vehicle information, etc.
Dependability aspects, amongst which fail safety and graceful degradation, are of utmost importance since the wireless link will suffer from latency and packet loss, or even might vanish altogether. Therefore, on-board sensors such as radar, lidar, or camera are indispensable.

The Connect & Drive project

This HTAS project aims to investigate the above aspects, including practical implementation in a fleet of 7 passenger vehicles, refer to Figure 2. Recent experimental results will be shown, illustrating the characteristics of CACC.

References

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