New platform allows autonomous vehicles to safely drive at small distances

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Ph.D. student Robbin van Hoek has designed a new platform for automated vehicles that integrates the benefits of cooperative and autonomous vehicles. The framework is an important step toward autonomous vehicles that are capable of safely driving at small inter-vehicle distances, while preventing the harmonica effect that is often seen in human driven vehicles at the highway. Van Hoek, who is a researcher at the Dynamics and Control group at the department of Mechanical Engineering, succesfully defended his thesis on Tuesday July 6, 2021.

Vehicle automation has become an important topic in recent years. It is aimed toward mitigating driver-induced traffic accidents, improving the road capacity of the existing infrastructure as well as reducing fuel consumption. Two major classes of automated vehicles can be distinguished.

The first are cooperative vehicles, which use vehicle-to-vehicle communication, or vehicle-to-infrastructure (V2I) communication in order to exchange motion data, making it possible to follow the vehicle in front of you at very small distances, while preventing the harmonica effect that often results in traffic jams. However, this type of vehicle is typically only capable of performing a single task, making its application limited to for example following a preceding vehicle on the highway.

The second class are autonomous vehicles. This type of vehicle uses on-board sensors such as radar, LIDAR and computer vision systems in order to identify the road, other traffic participants, and other relevant features or obstacles. The control algorithms on board these vehicles make use of explicit planning of a vehicle trajectory. By planning various trajectories, the vehicle can select the most suitable type of trajectory for the current situation. This enables it to handle a much wider class of traffic scenarios, compared to cooperative vehicles.

In his Ph.D. research (part of the NWO-funded i-CAVE project), Robbin van Hoek aimed to integrate these two classes of automated vehicles into one single platform. This new vehicle benefits from the communicated motion data from other vehicles by following them at very close distances while preventing traffic jams, but maintains the versatility of the autonomous vehicle. For example, instead of simple following the preceding vehicle, it can also autonomously decide to overtake it, in case it is driving too slow compared to the host vehicle.

Aside from the development of the mathematical methods, the framework was implemented in two Twizys, which have been modified at TU/e to be able to drive autonomously. With the developed cooperative trajectory planning method, Van Hoek was capable of safely following a preceding vehicle at 0.3 seconds.

This research is an important step toward autonomous vehicles that are capable of safely driving at small inter-vehicle distances, while preventing the harmonica effect that is often seen in human driven vehicles at the highway. This research will lead to increased mobility and safety

in transportation.

More information: Robbin van Hoek, Cooperative Trajectory Planning forAutomated Vehicles, supervisors: H. Nijmeijer, J. Ploeg.

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