SMART CRUISE CONTROL FIGHTS PHANTOM TRAFFIC JAMS

WOUTER KLEIN WOLTERINK & MARTIJN VAN EENENNAAM

In heavy traffic, one unexpected foot on the brake can be enough to cause a serious traffic jam. Such "phantom traffic jams" can be prevented by making automobiles communicate better. Wouter Klein Wolterink and Martijn van Eenennaam are developing the technology for the new Cooperative Adaptive Cruise Control.

An estimated thirty percent of all traffic jams in the Netherlands are not caused by accidents or construction work, but by delayed, forceful braking. One driver suddenly reduces speed, the driver behind reacts by applying the brakes, forcing the third driver to brake even harder to avoid a collision. The first driver can keep going, simply because there is no problem, but a traffic jam forms in the wake. "It is a sort of shockwave against the flow of traffic. It sets off a harmonica effect: the first vehicles can keep moving, while other vehicles are added at the end of the phantom traffic jam," explains CTIT researcher Wouter Klein Wolterink.

Klein Wolterink is not a traffic expert. His Master's degree is in telematics. As a PhD-student, he is involved in research aimed at finding a solution for the problem of phantom traffic jams, in collaboration with fellow telematician Martijn van Eenennaam. The potential solution already has a name: Cooperative Adaptive Cruise Control (CACC). The technology is expected to do something that people are not always capable of doing: anticipating the actions of several vehicles ahead. "Most drivers don't usually look farther ahead than one or two vehicles, particularly in heavier traffic. They don't realize that they should brake until it's too late. A signal indicating that a traffic jam is forming ahead can allow drivers the opportunity to reduce their speed gradually, thereby avoiding being caught in traffic. It's all about anticipation", observes Van Eenennaam.

In this sense, CACC goes beyond the existing Adaptive Cruise Control (ACC) system, with which a limited number of the more expensive vehicles are equipped. As soon as the distance between vehicles becomes too short, the system reduces the acceleration of the second vehicle. "The basic Adaptive Cruise Control is largely a convenience application, and it doesn't offer a solution for phantom traffic jams", observes Klein Wolterink. "CACC goes further by communicating with more vehicles in the immediate area. It helps traffic flow more efficiently, thereby increasing safety and reducing CO_2 emissions."

The project in which the two CTIT researchers are involved is known as "Connect & Drive". As the name suggests, communication with other vehicles is essential. Van Eenennaam is responsible for ensuring that the units to be installed in vehicles, currently being developed, will be able to communicate as much data as possible. "Each vehicle needs to transmit and receive information about speed, acceleration and position several times per second. This information can be used to regulate the speed of the vehicle. This is no small task. In addition, the ideal system should use the same platform that is used for road pricing and similar systems. Conceivably, it could even be used to communicate information about the technical state of the vehicle directly to the garage." All of this will require considerable airtime, which could become problematic, as messages could start to collide with each other, according to Van Eenennaam. "It's like a crowded living room where everyone is talking at the same time and no one can understand each other. I'm going to orchestrate the flow of information in such a way that all of the messages are transmitted intact and on time within the platform. How? One option would be to make each transmitter wait its turn. Another option would be to limit the number of messages per second."

Klein Wolterink is working with the communications protocol that will bring vehicles in contact with each other. In other words, he is developing a way to steer all of the information through the network quickly and efficiently. "Take a vehicle trying to merge onto the motorway. To keep traffic moving, the other vehicles on the motorway need to know well ahead of time that they need to allow the space needed to merge. This information can be transmitted by roadside equipment that continuously informs motorway users about the merger's speed and position. The vehicles then decide amongst themselves who is going to yield."
In order to solve the problem of phantom traffic jams, it will be necessary for enough vehicles to be equipped with the new generation of cruise control. A built-in CACC is still some time away, but Van Eenennaam is optimistic. "The global scale of the automobile industry and the interests of governments - safety, mobility - are advantageous factors."
Klein Wolterink notes that Connective Cruise Control, a forerunner of CACC, can offer an interim solution. "It can be used in any vehicle, just like a TomTom. The system advises the driver when to take such actions as letting up on the accelerator. Even this type of system can improve traffic flow considerably."

CONNECT & DRIVE

In their research on the new generation of cruise control, Wouter Klein Wolterink and Martijn van Eenennaam are collaborating on the project "Connect & Drive: Vehicle-to-vehicle Communications". They are working within the Design and Analysis of Communication Systems (DACS) research group at the University of Twente.

In addition to the UT, the following parties are involved in the research: TNO, TU Eindhoven, TU Delft, Centric Tsolve, Fourtress and Twente Institute for Wireless Mobile Communications (WMC). TNO is contacting frequent practical tests of the technology, as in February 2010 on the A270 between Helmond and Eindhoven. The completion date for the study on Cooperative Adaptive Cruise Control is in 2011.