Abstract

Wireless communication between road vehicles enables a range of cooperative traffic applications including safety, efficiency and comfort functions. A common characteristic of the envisioned applications is that they act on environmental information to intepret traffic situations in order to provide the driver with warnings or recommendations. In this thesis we explore both the detection of hazardous traffic situations in order to provide driver warnings but also the detection of situations in which the cooperative system itself may fail.

The first theme of this thesis investigates how traffic safety functions that incorporate cooperatively exchanged information can be constructed so that they become resilient to failures in wireless communication. Inspired by how human drivers coordinate with limited information exchange, the use of pre-defined models of normative driver behavior is investigated by successfully predicting driver turning intent at an intersection using mobility traces extracted from video recordings. Furthermore a hazardous driving warning criterion based on model switching behavior is proposed and evaluated through test drives. Maneuvers classified as hazardous in the tests, such as swerving between lanes and not braking for traffic lights, are shown to be correctly detected using the criterion. Whereas robust coordination mechanisms may mask communication faults to some degree, severe degradations in communication are still expected to occur in non-line-of-sight conditions when using wireless communication at 5.9 GHz.

The second theme of the thesis explores how communication performance can be efficiently logged, gathered and aggregated into maps of communication quality. Both in-network aggregation as well as centralized aggregation is investigated using vehicles in the network as measurement probes and the feasibility of the approach in terms of bandwidth and storage requirements is shown analytically. In conjunction with a proposed communication quality requirements format, tailored specifically for vehicle-to-vehicle applications, such maps can be used to enable application-level adaptation in response to situations where quality requirements likely cannot be met.