Extended Traffic State Determination based on Wireless Detection of Individual Vehicles

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Problem Statement
For traffic control and traffic management, the acquisition of traffic-related parameters is a fundamental precondition. Therefore, infrastructure operators usually use automatic traffic detection systems and analyze the data obtained in traffic management centers. Typically, this is data from local detection systems like inductive loops. Newer systems for the acquisition of traffic data also provide the availability to map the spatial variation of traffic parameters. In particular, the parameter travel time and travel speed are gaining in importance. To determine these characteristics, measurement methods have been established for the re-identification of vehicles (or travelers) at several successive measuring sections. Examples based on wireless detection include Bluetooth and Wi-Fi sensors, which detect the Media-Access-Control (MAC) address of electronic devices via their radio interface.

The focus of this work is on such stationary radio-based sensor networks, which register the presence of Bluetooth or WiFi-enabled devices with activated radio interface carried along by passing travelers (truck-drivers, car-drivers, cyclists or pedestrians). In detail, the aim of this research is the re-identification of vehicles on freeways to allow for the detection of travel times to determine the detailed traffic state along equipped routes.
Methodology

The data which is available from several dozens of Bluetooth detectors in the freeway network of Northern Bavaria in the South of Germany sums up to 500 million single vehicle detections since 2009 in a PostgreSQL database.

The tasks to be answered within this work are:

- Determination of travel times using radio-based detection of individual vehicles.
- Model development for the determination of the remaining capacity in incident situations.
- Localization of the current position of the incident-causing situation by using the forward and backward shockwave propagation speed.
- Recommendations for necessary penetration rates with radio-based devices on board of vehicles.

Fig. 2: Automatic incident detection flow chart.

The presented work also describes the use of the newly introduced “Time Dependent Comparison to Neighbor Values Filter” (TiDeCoNe) to determine the prevailing traffic state on the different segments of the freeway network to dynamically guide the long-range traffic through the fastest routes. Determining the traffic state means in the first step to determine the achieved speeds and in the second step to determine the begin and end in space and in time as well as the severity of incidents and which impact they have on the capacity of the road network.

Fig. 2: Example of a detected incident situation.

References

