Bluetooth-based travel times for automatic incident detection – A systematic description of the characteristics for traffic management purposes

Master's Thesis of Maria Karatsoli

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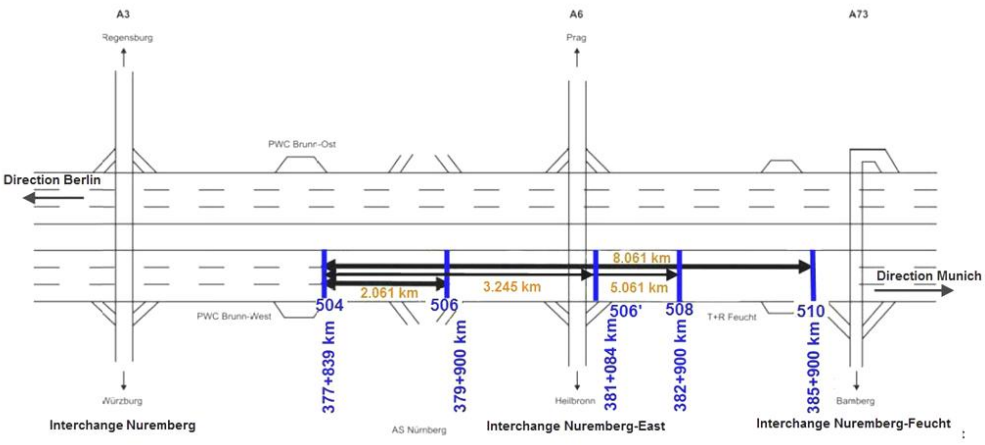
The present thesis analyzes the use of Bluetooth-based travel times, for Automatic Incident Detection (AID) purposes. Automatic incident messages were derived for both actual and simulated data through the use of an AID algorithm. Actual travel times were determined based on Bluetooth data of detectors installed along a 13 kilometre section of A9 motorway in the context of the iRoute project and analyzed towards AID purposes. A Vissim model of the section was set up for further analysis. Different scenarios of traffic situation, incidents and detector layout were introduced in the Vissim model and travel times were generated, processed and then run through the TUM algorithm. The performance measures Detection Rate (DR), False Alarm Rate (FAR) and Mean Time To Detect (MTTD) were used for the analysis of the incident messages' quality of both actual and simulated data. The performance measures were compared and conclusions were reached about the importance of detectors' distance, as well as the incident type and location, to incident detection. Local data were also generated in the Vissim model and used by VK_{Diff} algorithm for incident detection.

Examined Bluetooth Detector Sections	Distance [km]
504506	2,061
504506'	3,245
504508	5,061
504510	8,061



Analysis of field data:
✓Two bluetooth detector sections were analyzed (2,061 km and 8,061 km).
✓ In the first section all the recorded incidents were detected, while in the second one two incidents remained undetected, due to their short duration and long distance from the downstream detector.
✓Incidents were detected earlier at the first section due to their location, at the beginning of the examined road section.

Analysis of simulated data:
✓Four bluetooth detector sections were examined (2,061 km, 3,245 km, 5,061 k m and 8,061 km).
✓The analysis was done under high, normal and low traffic volumes.
✓In total nine actions were implemented at different locations and time in the VISSIM model and led to an incident occurrence.

✓Incidents of short duration and far away from the downstream detector tend not to be detected.
✓Lower MTTD is achieved for incidents located closer to the downstream detectors section, even though detectors were located in longer distance.
✓A higher FAR is demonstrated under high traffic volumes due to the speed variations of vehicles, concerning mainly detectors at close distance. Under low and normal demand the FARs are lower or mostly zero due to the limited speed variations.
✓ The best performance was achieved in the section of 3.245 km. A proposed detectors' distance for better incident detection in this case could be from three to four kilometers.
✓The Automatic Incident Detection based on travel times demonstrated better performance in terms of DR, FAR and MTTD compared to the AID based on local detector data