Current and future use of Floating Car Data

4th International Transportation Systems Performance Measurement Conference

Alexander Sohr
Institute of Transportation Systems

Since: March 2001
Director: Prof. Dr.-Ing. Karsten Lemmer
Employees: Presently 100 employees from various scientific disciplines
## Fields of Research

<table>
<thead>
<tr>
<th>Automotive Systems</th>
<th>Railway Systems</th>
<th>Traffic Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods / Evaluation</td>
<td>Operation</td>
<td>Traffic data recording</td>
</tr>
<tr>
<td>Understanding the driver</td>
<td>Life cycle management</td>
<td>Traffic data management</td>
</tr>
<tr>
<td>Human factors</td>
<td>Safety and rail human factors</td>
<td>Traffic simulation und prediction</td>
</tr>
<tr>
<td>engineering &amp; design</td>
<td>Technology</td>
<td>Traffic control and management</td>
</tr>
<tr>
<td>Technologies for ADAS</td>
<td></td>
<td>Traffic quality</td>
</tr>
<tr>
<td>Vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulators</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Traffic Data Collection 1 (classic)

- Primarily stationary
  - Induction loops (traffic flow, local speed, time gap, occupancy)
  - Infrared sensors (esp. traffic flows)
- Characteristics:
  + Local mostly precise
  - High Costs, short lifetime
  - Only on main roads and there not everywhere
  - Travel times are not measured directly
Traffic Data Collection 2 (research)

- Recent detection methods
  - Stationary video detection
  - Video detection on mobile platform
  - Mobile Phone movements (GSM handover)
    - Car2X (Car2Car and Car2Infrastructure)
  - „Floating Car Data“ (FCD): GPS-data

- Characteristics FCD:
  + Low costs to the infrastructure
  + Area wide detection (even on minor roads)
  + Direct measurement of travel times
  - Only a part of the total flow is measured
  - Spatial and Temporal noisy and incomplete
FCD – System architecture

Taxi headquarter
Disposition system

FCD-Server
Data processing

Service Provider
Data usage

digital radio
oder GPRS

GPRS, SMS,
RDS-TMC, HTTP...

Taxi

FCD-Server

Service Provider

GPRS, SMS,
RDS-TMC, HTTP...

...
FCD Applications I
Cityrouter

- Traffic Condition Map
- Dynamic Routing
- Location aware Route Monitoring
- Quality value: Coverage

Copyright © 2011 Deutsches Zentrum für Luft- und Raumfahrt (DLR). Alle Rechte vorbehalten.
GPS Density from FCD (Berlin, 1 month)

Density profiles on inflows after matching
FCD Applications II

Density Profile Analyzer

- Correlation between density and queue length
- Needs Calibration (stop line, profile, length, ...)
  → DPACalibrator
FCD applications III
Turn dependent travel times

- Definition of one junction inflow
- Definition of the different turn segments
- Decomposition of the trajectories
- Comparison of the travel times on the inflow
FCD applications III
Turn dependent travel times

- Decomposition of the GPS-Trajectories
- For every trajectory:
  - Calculate distance and travel time for every inflow / outflow pair outside of the jam area

- Increase the accuracy of the delivered travel times

- delay = 19.2 s
- delay = 25.8 s
- delay = 37.0 s
FCD applications III
Turn dependent travel times

crossing 692

0 - 100

COMPLETE INFLOW travel time
STRAIGHT travel time
LEFT-TURN travel time
RIGHT-TURN travel time
L-S travel time
R-S travel time

00 02 04 06 08 10 12 14 16 18 20 22
00

time of day [h]

Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Institute of Transportation Systems > Aerospace technology for road and railway

Current and future use of Floating Vehicle Data > 01 June 2011 > 12
FCD applications IV
Delay time based signal control

Complete delay-time reduction

- Car without delay-time
- Cars with delay-time

Delay Time

measure, transmit, influence

(Floating) Cars

Traffic Signal
FCD applications – delay time based signal control

Results of simulation study

http://sumo.sourceforge.net – Simulation of Urban MObility
FCD applications – delay time based signal control

Results with small FCD-rate

Delay time based vs. opt. Fixed time control

- Green-times Memory
- Jam-length estimator

Same / better

worse
Alternative approach using short-range radio

- Vehicles sending unique signals, like:
  - GSM
  - WIFI
  - Bluetooth

- Bluetooth-inquiry delivers MAC-address
- Recognition on two points allows calculation of travel times
UtraLAB – Urban Road Research Laboratory
Bluetooth / WIFI - Stationary detection

→ Comparison to loop detector data
Bluetooth / WIFI - Dynamic Detection

Principle

- Car with Bluetooth-device
- Sensor equipped fleet
- Reconstructed route of the white car

DLR – Processing-System
- Detection area (fleet-members)
- Communication (e.g. GSM)
- Communication (e.g. Bluetooth)
Bluetooth / WiFi - Dynamic Detection

Advantages

- Short range detection car collects MAC addresses
- Net-wide recognition
  → travel times and more (OD-matrices)
- Small equipment rates yield better results than classic FCD

Challenges:

- Ranges → accuracy of positioning
- Classification (vehicle, bike, …)

Next Steps:

- Equipping a fleet
- Find the critical mass
Thank you for your attention

Alexander Sohr
German Aerospace Center (DLR)
Institute of Transportation Systems

Mail: alexander.sohr@dlr.de
Phone: +49 30 670 55 458