TURN SPECIFIC VS. LINK BASED TRAVEL TIMES CALCULATED FROM FLOATING CAR DATA (FCD)

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FCD – System architecture

- Taxi headquarter
  - Disposition system
  - digital radio oder GPRS

- FCD-Server
  - Data processing

- Service Provider
  - Data usage
  - GPRS, SMS, RDS-TMC, HTTP

- Service
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- GPS

- Taxi car
Problem description

- FCD/PVD is excellent traffic data source for provision of travel times
- Travel times are provided for each street segment (or TMC segment)
- Handling of turns in navigation and route planning: additional travel times
  - Right-turns: 5 seconds (example)
    - Waiting for pedestrians, cyclists
  - Left-turns: 10 seconds (example)
    - Waiting for pedestrians, cyclists
    - Waiting for oncoming traffic
  - Sometimes dependent on intersection type / street types
- Is this really a good solution?
- Are these assumptions always approximately valid?
- What if a jam on a segment is only for vehicles driving straight on?
- ...

- Suggestion: Hold turn dependent travel times on street segments
Approach – Turn Dependent Decomposition of FCD

- Definition of an inflow to an intersection
- Definition of the turn sections
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- Decomposition of all data related to the street segments
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- Definition of the turn sections
- Decomposition of all data related to the street segments
- Comparison of travel times for the inflow section
Data set

- About 4300 Taxi-Floating Cars in Berlin
- Delivering Positions with time stamp every 30 seconds
- Data of about four months (08.01.2010 – 30.04.2010)
- Analysis of 42 crossings and 162 inflow sections

Data from taxis every
green: < 10 min
yellow: < 20 min
blue: >= 20 min
Calculation of travel times for inflow segments

- Calculate travel time $t_t$ on inflow segment for each vehicle
- Group in daytime intervals $i$ of 15 Min
- Median value over period of 4 months
- Data smoothing by averaging median values with interval before and after:

$$t_t_{i \text{ (smoothed)}} = \frac{(t_t_{i-1} + t_t_i + t_t_{i+1})}{3}$$
Results - crossing 69
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![Graph showing travel time variations over time of day for different traffic conditions.]
Results - crossing 69

The graph shows the travel time for different crossing directions over the course of a day. The x-axis represents the time of day in hours, while the y-axis shows the travel time in seconds. The graph includes data for COMPLETE INFLOW, STRAIGHT, LEFT-TURN, RIGHT-TURN, L-S, and R-S travel times, each represented by a different line color.
Results - crossing 35
Results - crossing 35

The diagram shows the travel time for different types of crossing at crossing 35. The travel times are grouped into:

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

The x-axis represents the time of day in hours, ranging from 00 to 00, while the y-axis represents the travel time in seconds, ranging from -40 to 140.

The data shows variations in travel times throughout the day, with some peaks and troughs indicating different traffic conditions or possibly unusual events.
Results - crossing 35

The graph shows the travel time for different directions at crossing 352. The x-axis represents the time of day in hours, ranging from 00 to 24. The y-axis represents the travel time in seconds, ranging from -20 to 120. The graph includes lines for COMPLETE INFLOW, STRAIGHT, LEFT-TURN, RIGHT-TURN, L-S, and R-S travel times.
Results - crossing 35

crossing 353

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

traveltime [seconds]

time of day [h]
Results - crossing 35

The graph shows the travel times for different types of vehicles at crossing 354. The travel times are grouped into COMPLETE INFLOW, STRAIGHT, LEFT TURN, RIGHT TURN, L-S, and R-S categories. The x-axis represents the time of day in hours, while the y-axis shows the travel time in seconds. The graph indicates variations in travel times throughout the day, with certain times showing higher travel times compared to others.
Results - crossing 12
Results - crossing 12

The graph shows the travel time at crossing 121 for different types of traffic. The x-axis represents the time of day in hours (00 to 24), and the y-axis represents the travel time in seconds (0 to 40). The graph includes lines for:

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

The travel times vary throughout the day, with some peaks and troughs indicating periods of higher or lower traffic volumes.
Results - crossing 12

The chart shows the travel time in seconds for different types of traffic at crossing 12. The travel times are categorized into:
- COMPLETE INFLOW travel time
- STRAIGHT travel time
- LEFT-TURN travel time
- RIGHT-TURN travel time
- L-S travel time
- R-S travel time

The x-axis represents the time of day in hours, and the y-axis shows the travel time in seconds.
Results - crossing 12

crossing 123

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

travel time [seconds]

time of day [h]
Results - crossing 55

**Travel Time**
- Complete Inflow
- Straight
- Left-Turn
- Right-Turn
- L-S
- R-S

**Time of Day**

**Location**
- Institute of Transportation Systems > Aerospace technology for road and railway, Berlin
Results - crossing 55

The graph shows the travel time for different types of travel across crossing 551, categorized by time of day. The travel times are measured in seconds and range from 0 to 120 seconds. The types of travel include COMPLETE INFLOW, STRAIGHT, LEFT-TURN, RIGHT-TURN, L-S, and R-S travel times. The graph indicates variations in travel time throughout the day, with peaks and troughs at different hours.
Results - crossing 55

![Graph showing travel times for different directions at crossing 55]
Summary & Conclusion

- Simple additional travel time for left-/right-turns not appropriate for accurate routing
- Dependence on time of day and traffic volumes
- Reasons for distinction of different turning directions may be manifold
  - Pedestrians+bicycles (for turners)
  - Oncoming traffic (left turners)
  - Length of turning lanes
  - Downstream congestions
  - Traffic signal plans
  - Separate signalisation for turning vehicles
- Future research: structural categorisation of effects
- Analyses may also be conducted for optimization of traffic signal plans.
THANK YOU FOR YOUR ATTENTION !!!

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