Estimating Volume and Average Travel Time in an Intersection Using Probe Data

プローブデータを用いた信号交差点における交通量・旅行時間推定

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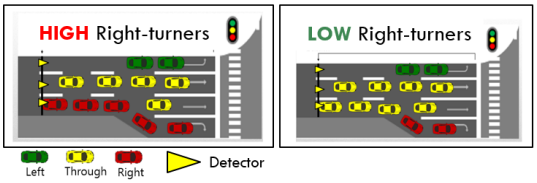
Have you experienced waiting so long at a Right-turn lane?

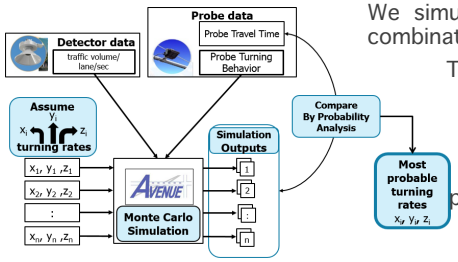
At an intersection, how many cars want to turn left? Turn right? Go through? Detectors cannot recognize this.



Current detectors installed on several roads cannot tell the directional proportion of cars. As a result, the traffic signal timings are not adjusted appropriately.
The common effect is that right-turning cars have to wait a longer time at the queue even if the other directions have low traffic demand.
In this study, we want to estimate the volume (turning rates) and average travel time (per direction) so that we can adjust traffic signals correctly.

Volume (Turning Rate) Estimation

A simulation-based methodology is used to estimate directional volume or turning rates. Detector data, probe data, and traffic signal information are inputted to a traffic simulator.

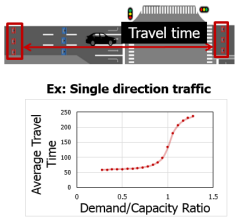


We simulated many possible combinations of turning rates.

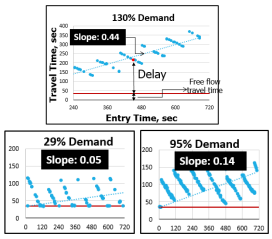
The simulation output are compared to travel times from probe data to determine the most probable combination of turning rates.

We used 2 criteria to determine the most probable turning rate. These criteria are chosen because they are good indicators of changes in traffic demand.

Parameter 1
Average Probe Travel Time

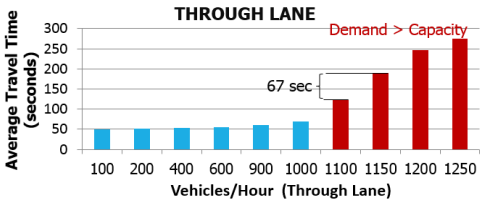


Parameter 2
Slope of delay trend line



Why don't we just use turning proportion of probe cars?

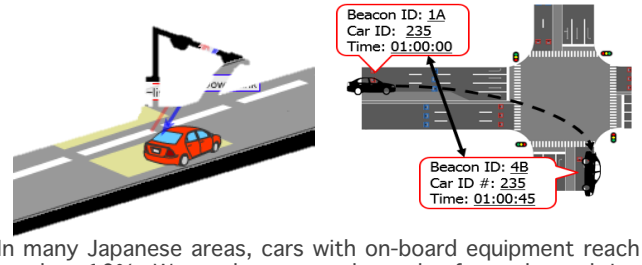
Previous studies assume that the turning rate of probe cars are similar to the turning rate of the entire population of cars.



When demand > capacity of road (congested condition), the average travel times significantly increase for small increase in demand.
Thus, if we simply use probe car turning rates, even small errors in turning rate estimates will greatly affect average travel time estimates.

Probe data

Probe data is data sent by cars with on-board equipment to the infrared beacon. From this data, turning behavior and travel time between beacon points of probe cars can be obtained.



In many Japanese areas, cars with on-board equipment reach as much as 10%. We can have a good sample of actual travel times!

Average Travel Time Estimation Results

The final turning rate estimates are inputted to a simulator. The average travel times of all cars for each direction are extracted.

These are the estimated average travel times. The estimation methodologies were tested using virtual data generated using *AVENUE* simulator.

Virtual Data Characteristics

Three scenarios were considered, each corresponding to a different traffic condition. Only the Through and Right-turn directions were considered.

Time duration : 15 minutes
Total demand : 400 cars
Probe % : 10% (40 cars)

Scenario #	Demand / Capacity	
	Right	Through
1	0.71	0.80
2	1.07	0.68
3	1.33	0.59

Oversaturated traffic demand condition

The travel time estimation results show that the method works better than PTR Method even for high traffic demand and even at 5% probe cars. For low traffic demand, it is alright to use PTR method.

a. **Developed Method**
b. "**PTR Method**": Turning Rates = Probe Car Turning Rates