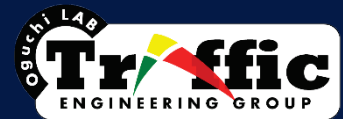


# Driving Behaviour Analysis at Sag Sections on Expressway

高速道路単路部ボトルネックにおける追従挙動分析

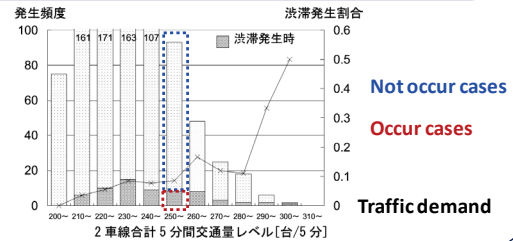


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## Background

- Sag sections are the main traffic bottleneck of Japanese expressways.
- The congestion occurs at sag section probabilistically.
- Only when the congestion occurs, the bottleneck capacity can be observed. Thus the observable case for high traffic demand is limited.
- Behavior variations cause propagation of unrecognized speed reduction leading to severe capacity decrease at sag sections.



## Objective

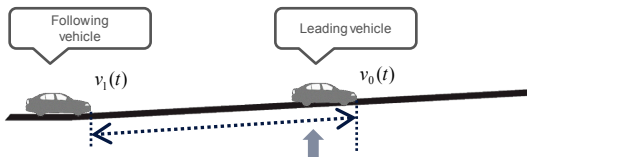
- Quantify the probability of congestion occurrence



- A simple and adequate car-following model
- A simulation which can reproduce the flow condition before and in congestion.

## Car-following model

Car Following Model



$$a_1(t + \tau) = \begin{cases} \alpha_1(v_0(t) - v_1(t)) + \alpha_2(x_0(t) - x_1(t) - s_1^*) & t < t_0 \\ \alpha_1(v_0(t) - v_1(t)) + \alpha_2(x_0(t) - x_1(t) - s_1^*) - \beta g[\sin \theta(t) - \sin \theta_0] & t > t_0 \end{cases}$$

Reaction time  $\tau$

Acceleration (red), Deceleration (blue)

$s_1^* = \delta + \tau v_1(t)$  Desired Spacing

Effect of vertical slope

Parameters:  $\alpha_1, \alpha_2, \beta, \delta, \tau$

## Methodology

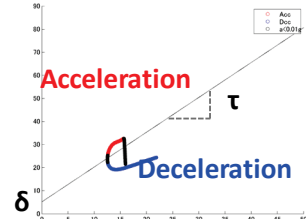
Desired spacing with regression

Reaction time with correlation analysis

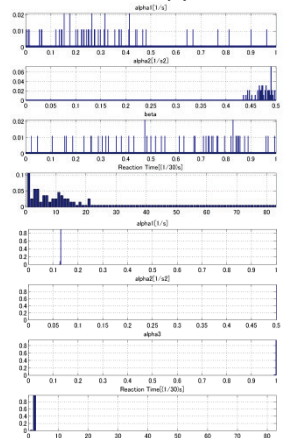
Other parameters with cross-entropy

Observable      Observable      Unobservable

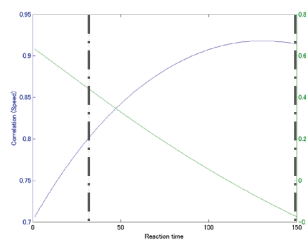
- Desired spacing estimation



- Cross-entropy



- Reaction time range

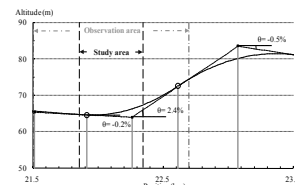


## Data

A trajectory data was obtained from 1.2km section of roadway including a sag section in Tomei Expressway Japan during congestion formation.

- Acceleration, speed, distance were observed every 1/30 s.
- 550 m section including sag section was used to prevent
- 393 observed samples, 328 following vehicles (efficient samples)

Observation date	Time period	Congestion duration	Number of cars observed
Jul. 15, 2006	4:30-7:30	6:15-18:50	104
Jul. 22, 2006	4:30-7:30	6:45-11:10	92
Jul. 29, 2006	4:30-7:30	5:55-13:40	78
Aug. 4, 2006	6:00-9:00	7:25-12:55	119
Total			393



## Results

Probability of congestion occurrence grows with overall flow rate

