

CAPACITY DROP: A COMPARISON BETWEEN STOP-AND-GO WAVE AND QUEUE CONGESTION AT LANE-DROP BOTTLENECK

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Introduction

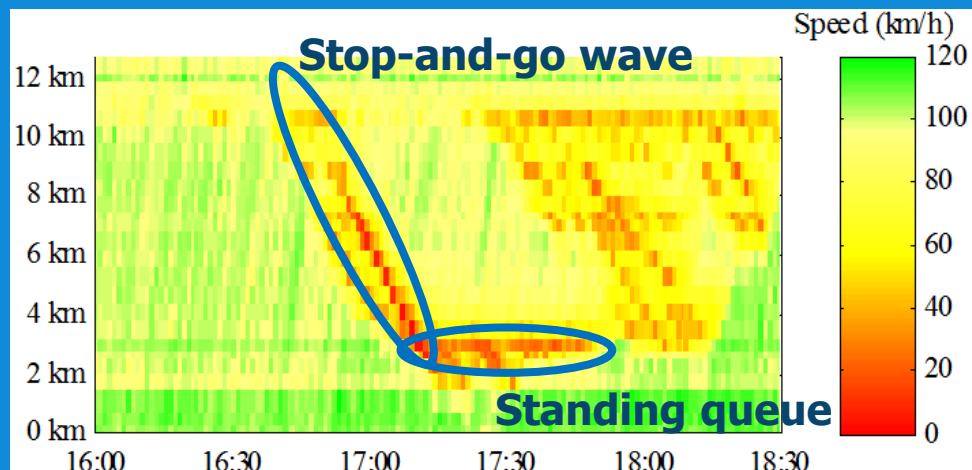
- For decades, many efforts have been devoted to the research on capacity drop;

However,

- The macroscopic features of capacity drop are still not completely clear;
 - To what extent the capacity can reduce
 - Flow distribution over lanes downstream congestion

Research question:

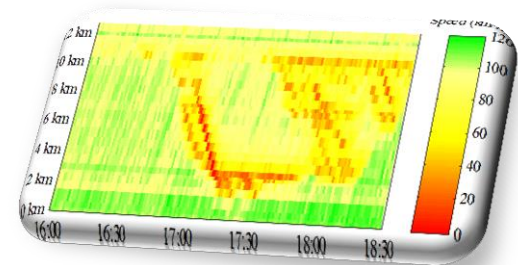
What are differences between the downstream state of a stop-and-go wave and that of a standing queue?



Research questions

What are differences between the downstream state of a stop-and-go wave and that of a standing queue?

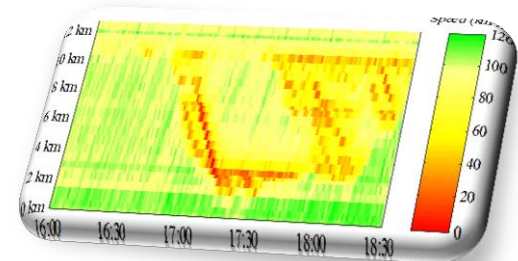
1/4 To what extent can the capacity reduce in the downstream of a stop-and-go wave?



Research questions

What are differences between the downstream state of a stop-and-go wave and that of a standing queue?

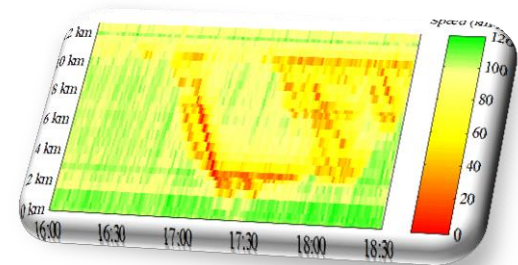
2/4 To what extent does the congestion discharge rate vary at the same road section without the other disturbances, such as weather?



Research questions

What are differences between the downstream state of a stop-and-go wave and that of a standing queue?

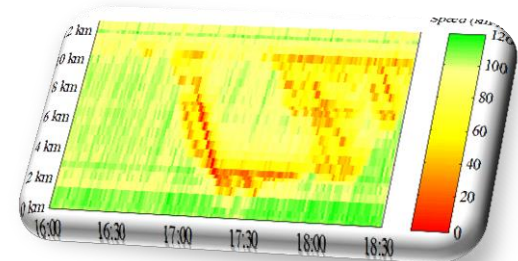
3/4 What is the downstream flow in each lane in the queue discharge conditions?



Research questions

What are differences between the downstream state of a stop-and-go wave and that of a standing queue?

4/4 What is the flow distribution over lanes in the downstream of a bottleneck with compulsory merging behaviours?

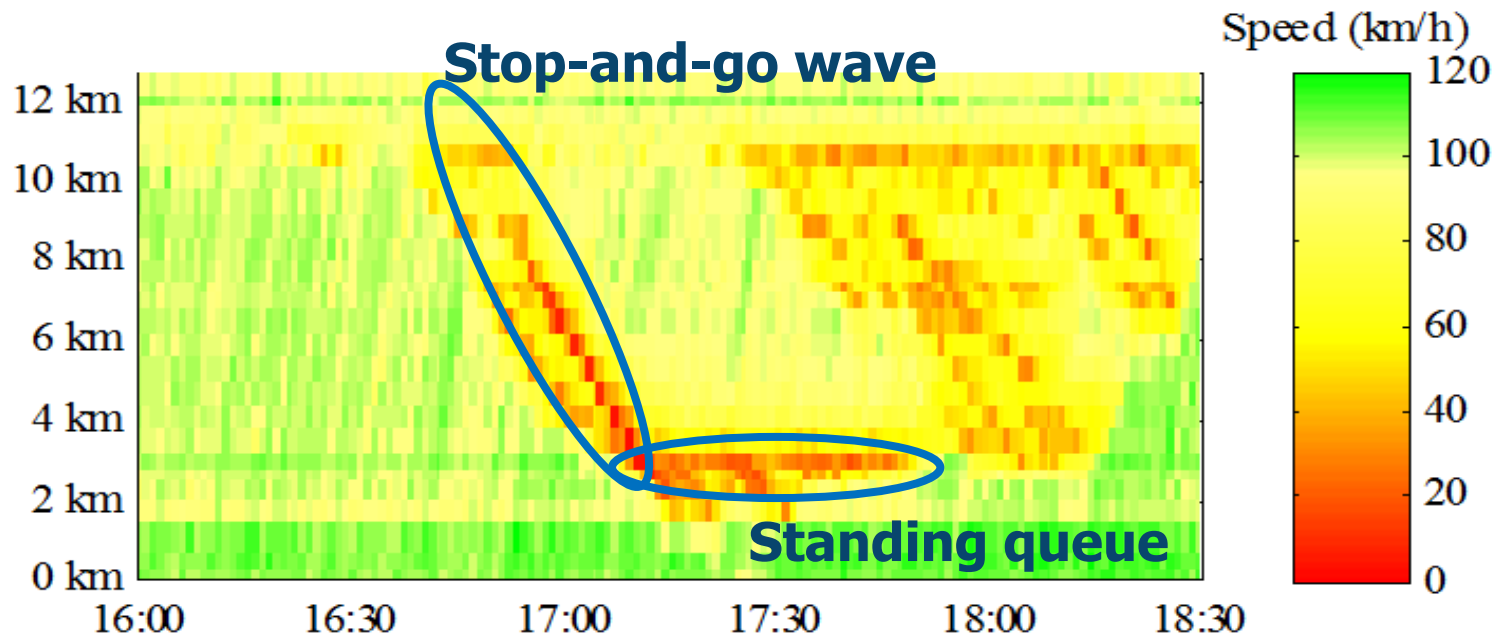


Outline

- ✓ Introduction
- Methodology
- Data and study site
- Results
- Conclusions

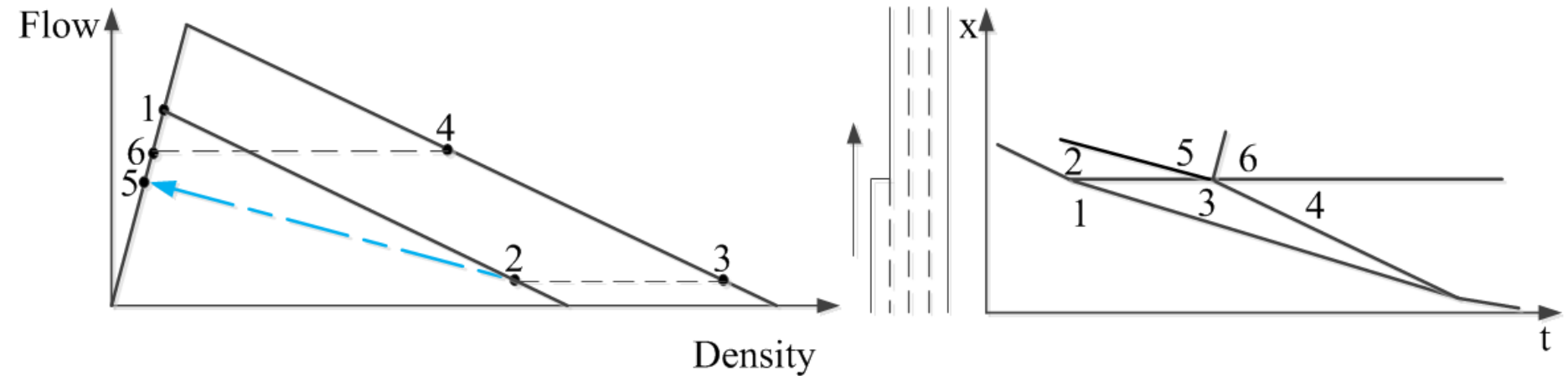
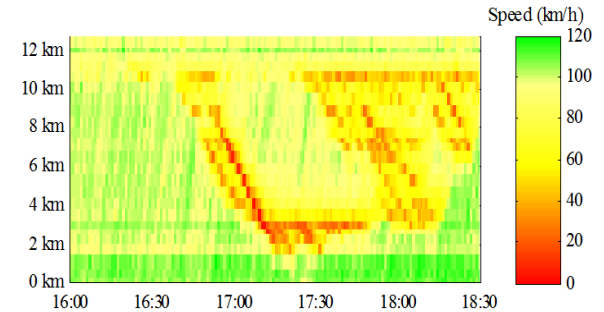
Methodology

- Traffic scenario at a lane-drop bottleneck



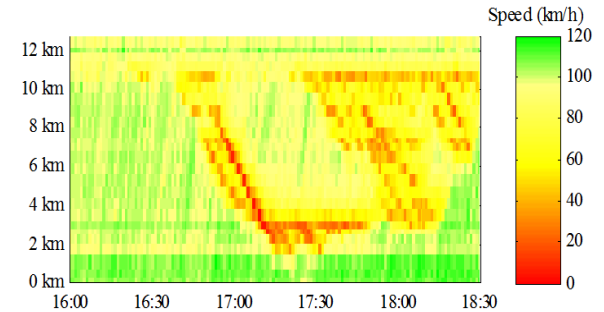
Methodology

- Traffic scenario
- Analytical solution – Shock wave analysis



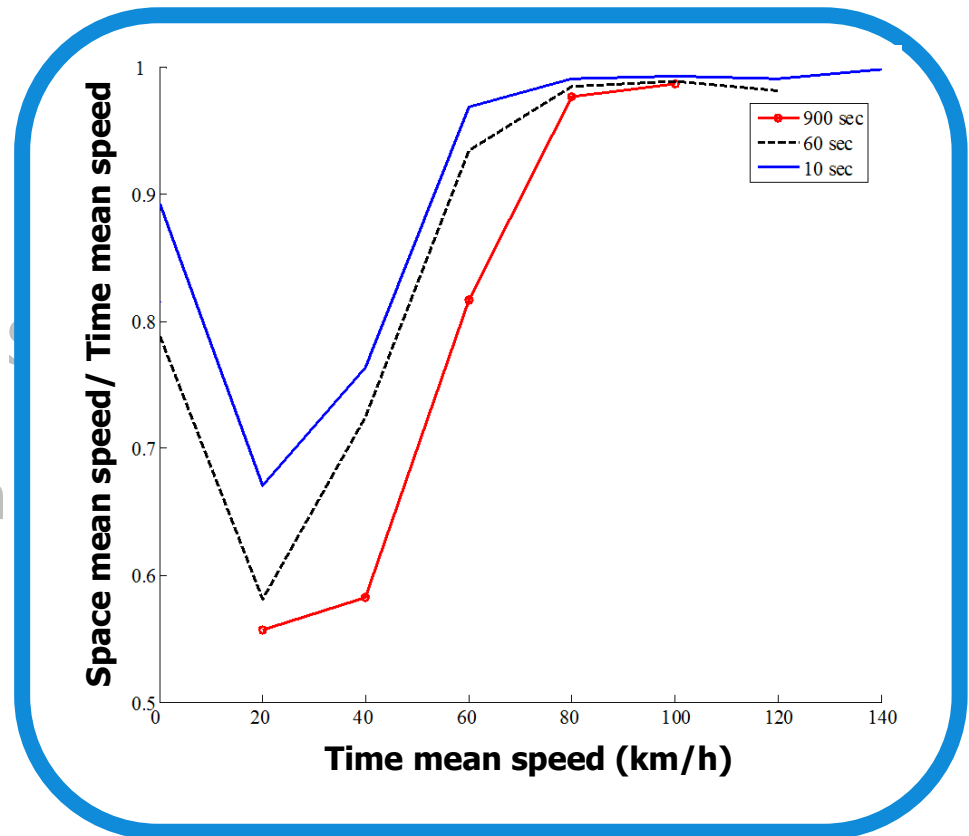
Methodology

- Traffic scenario
- Analytical solution – Shock wave analysis
- Quantitative solution – Slanted cumulative counts
- Data handling



Methodology

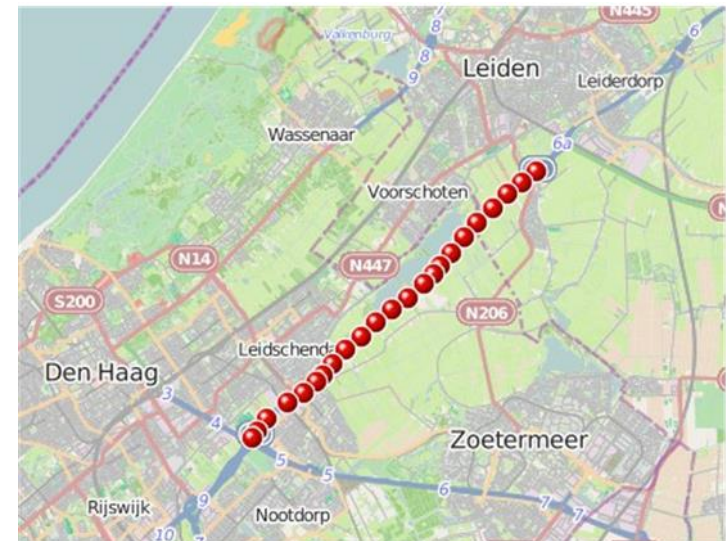
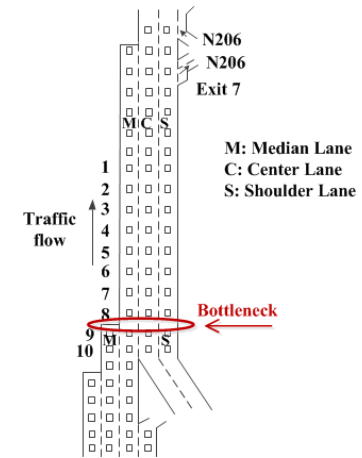
- Traffic scenario
- Analytical solution – S
- Quantitative solution
- Data handling



* From Knoop et al. (10)

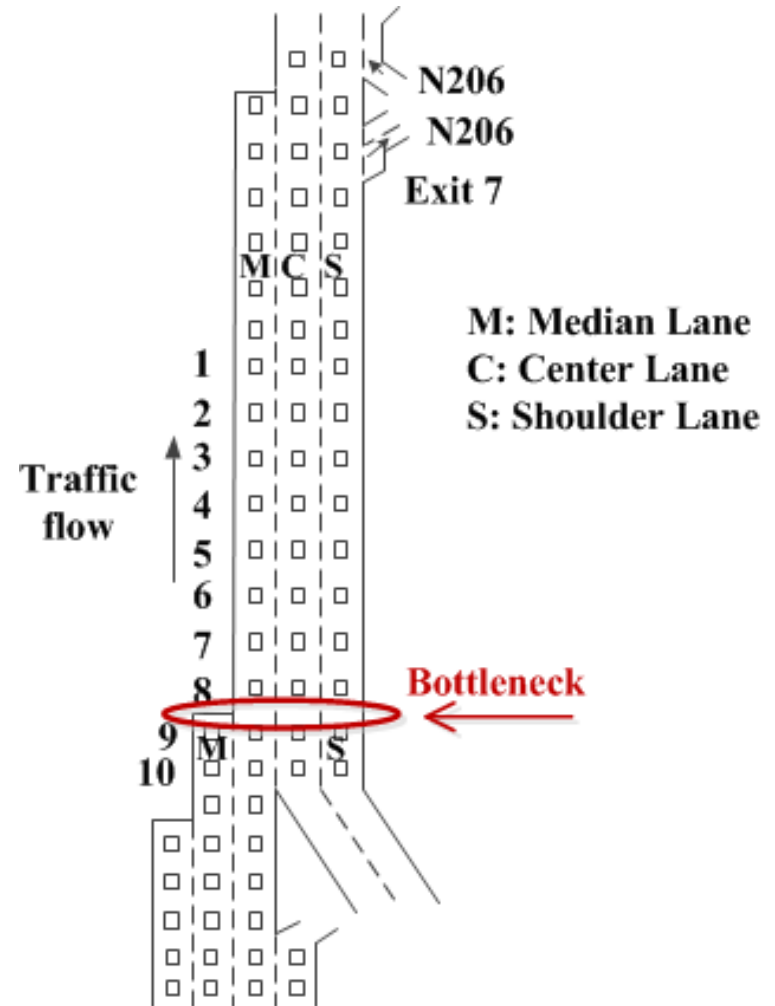
Data & study site

1. Freeway A4 in the Netherlands
2. 1-min aggregated
3. Time mean speed and flow in each lane
4. Keep Right Unless Overtaking



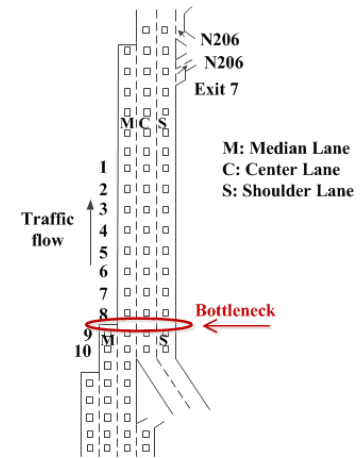
Data & study site

8 locations, 4 km
10 locations, 5 km



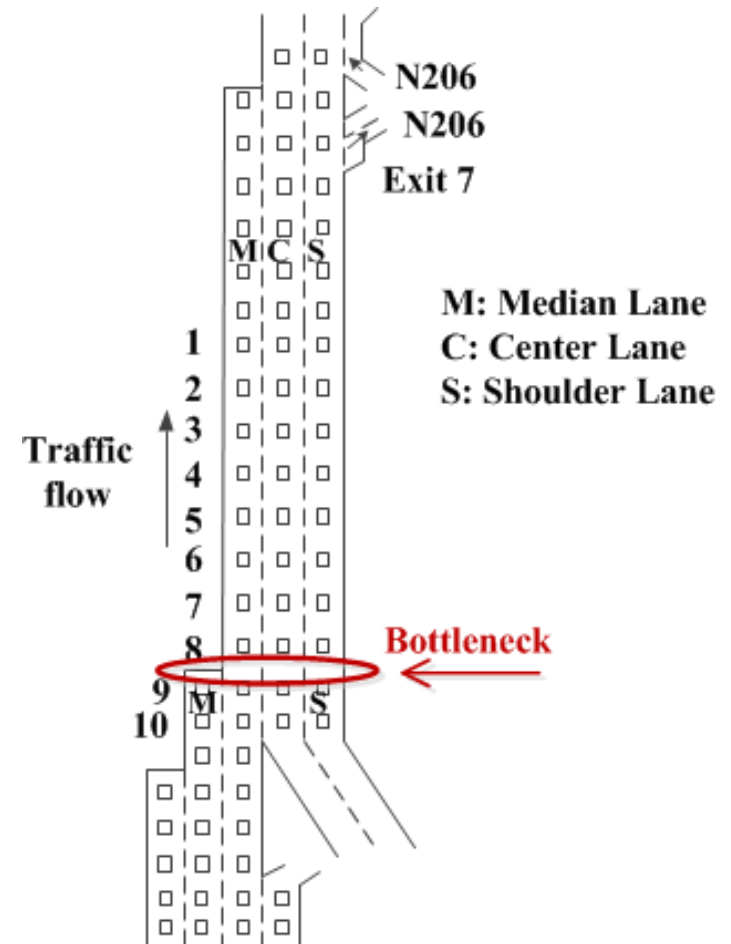
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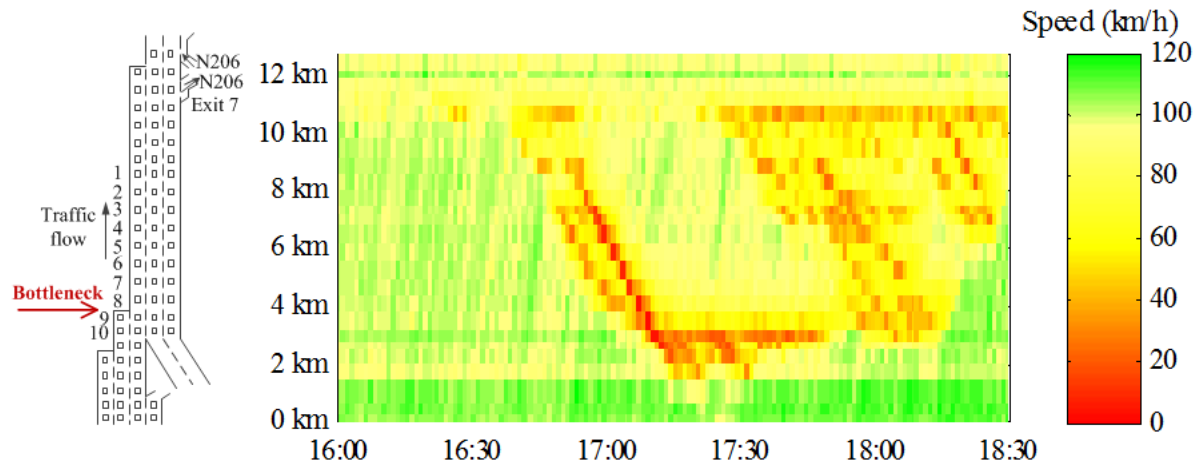
Data & study site

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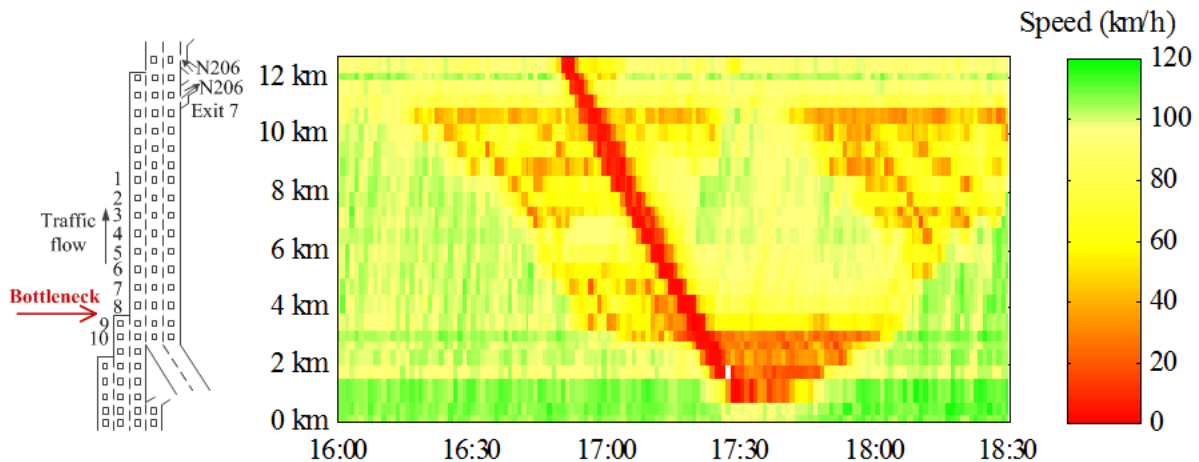


Data & study site

18 May 2009

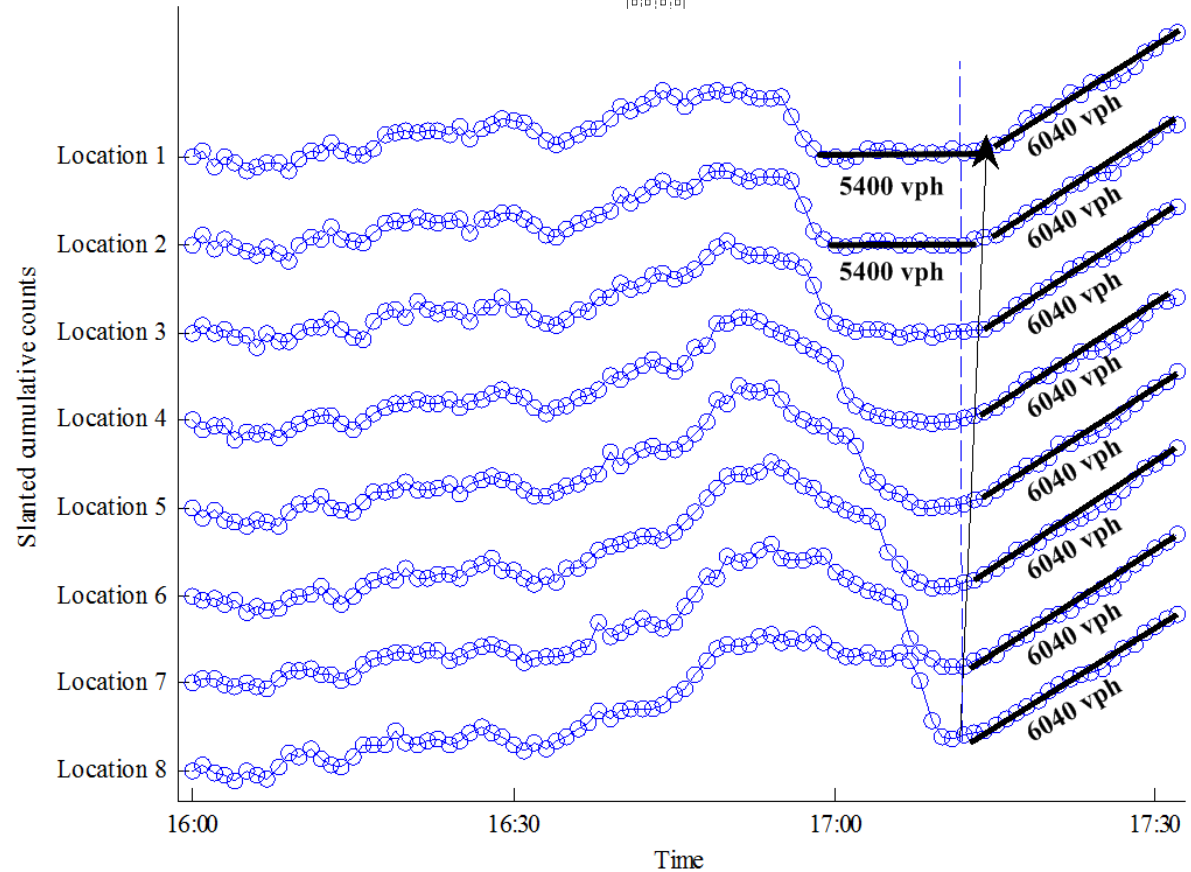
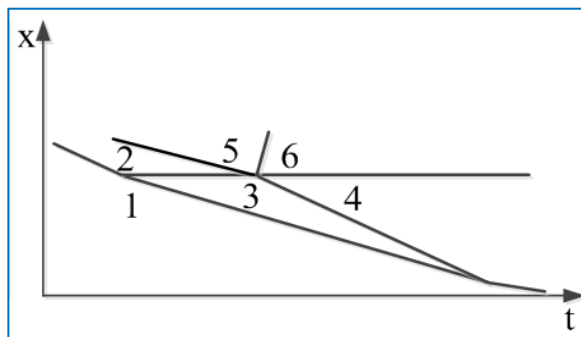
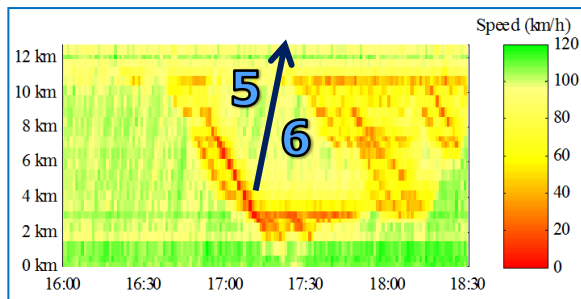
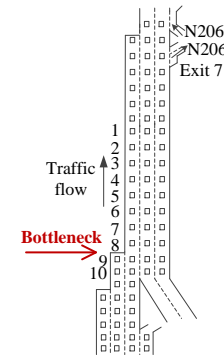


28 May 2009



Results

– State Identification



Results

– Discharge rates

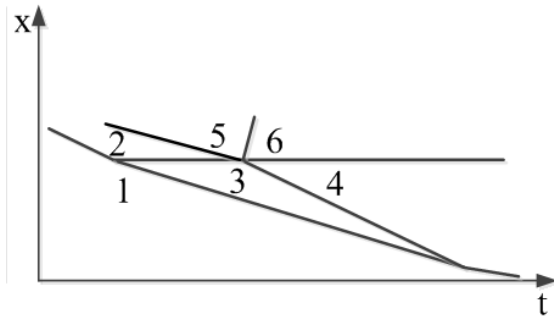
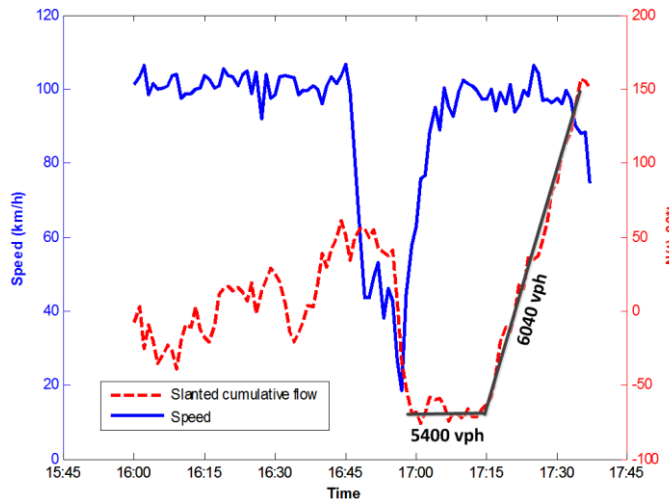
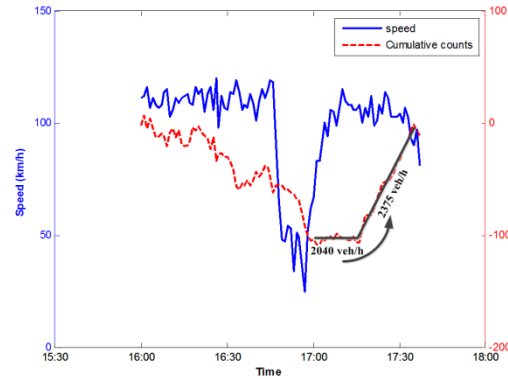
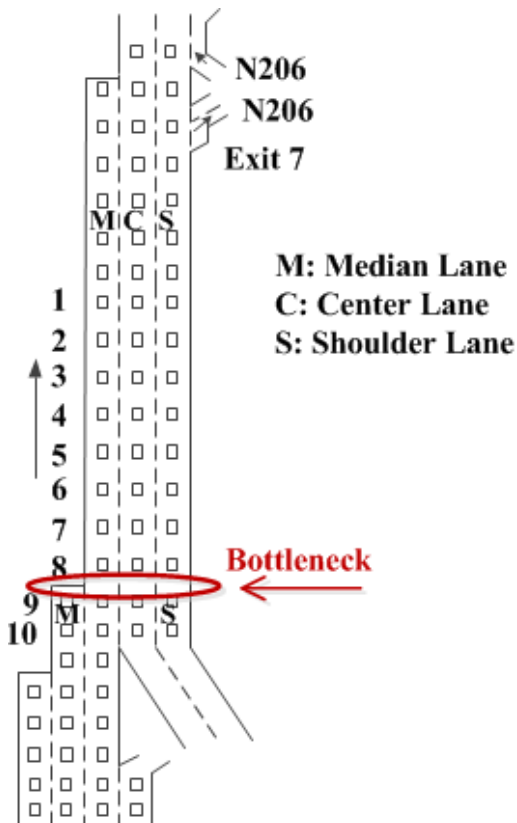


TABLE 1 Speed and Flow in Different Traffic State Points

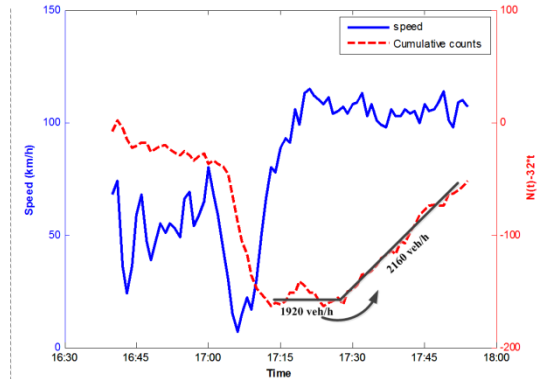
	18 May 2009		28 May 2009	
	(km/h)	(veh/h)	(km/h)	(veh/h)
State 5	98.73	5400.00	98.52	5220.00
State 6	98.32	6040.00	98.24	5700.00



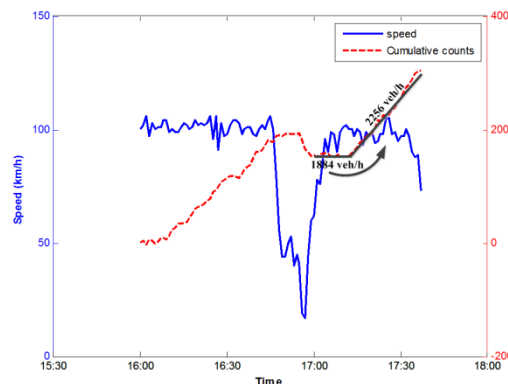
– Discharge rate in each lane



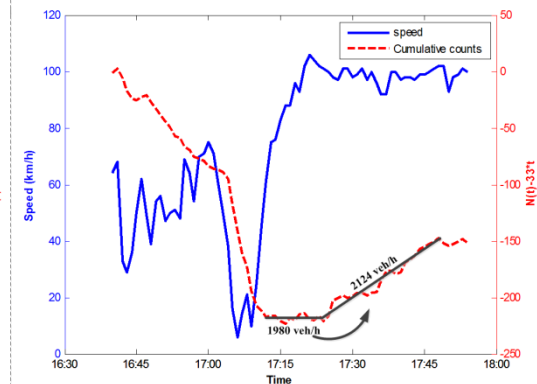
a) Median lane, location 1, 18 May 2009



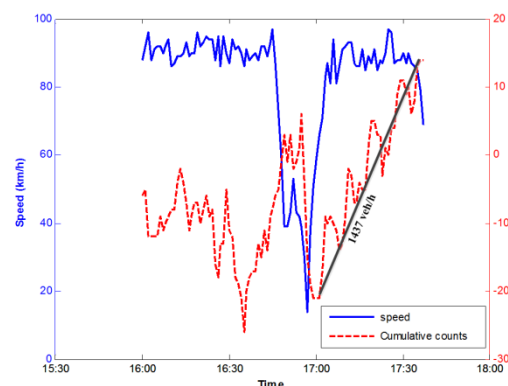
b) Median lane, location 1, 28 May 2009



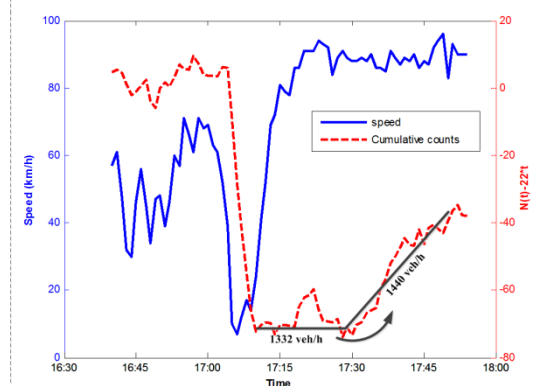
c) Center lane, location 1, 18 May 2009



d) Center lane, location 1, 28 May 2009



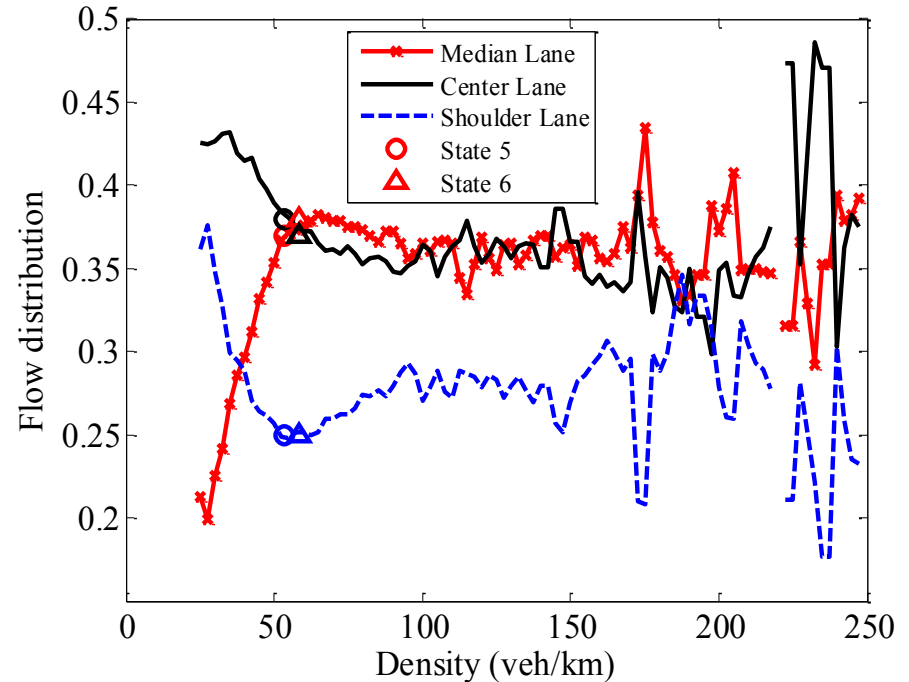
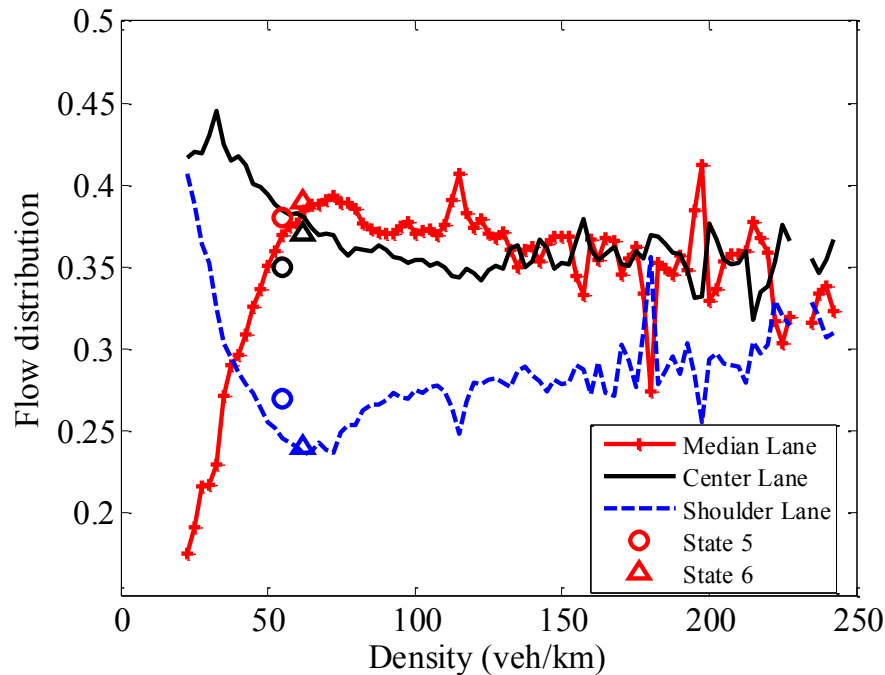
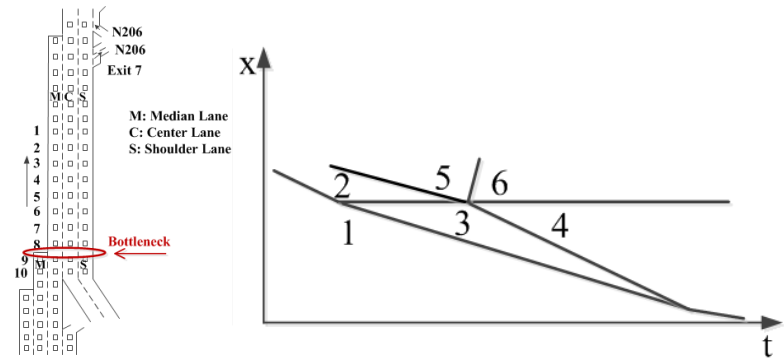
e) Shoulder lane, location 1, 18 May 2009



f) Shoulder lane, location 1, 28 May 2009

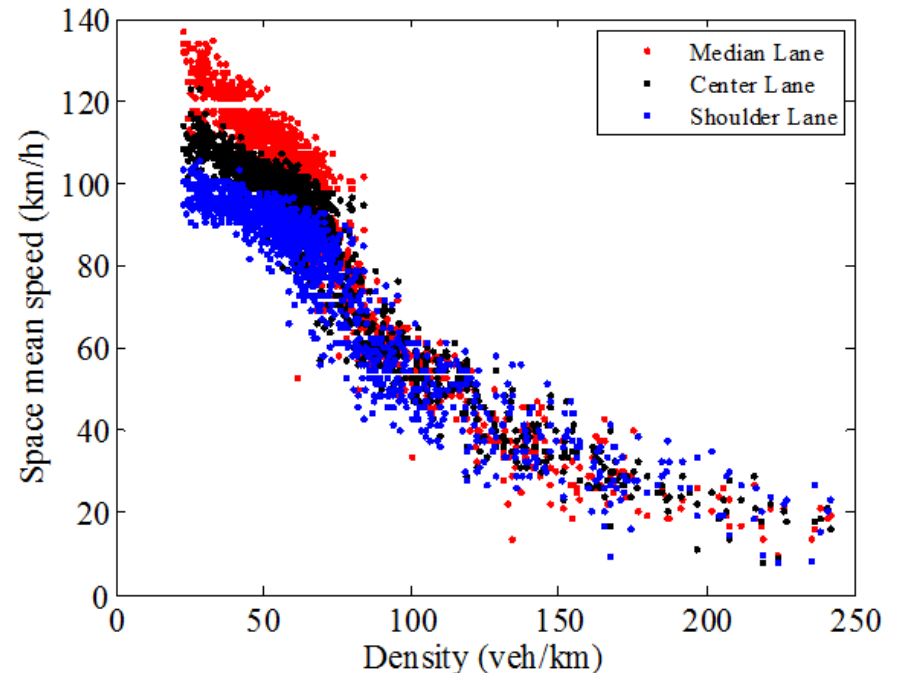
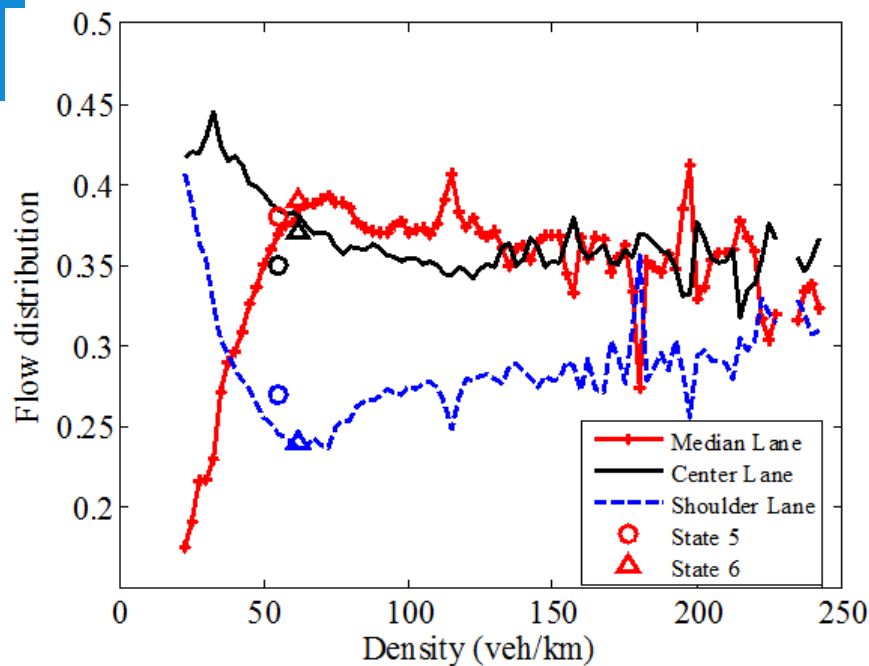
Results

– Flow distribution



Results

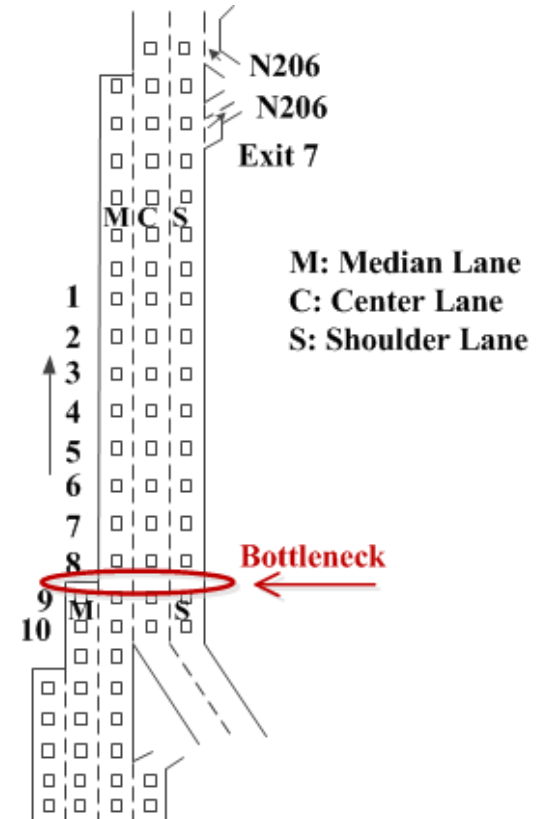
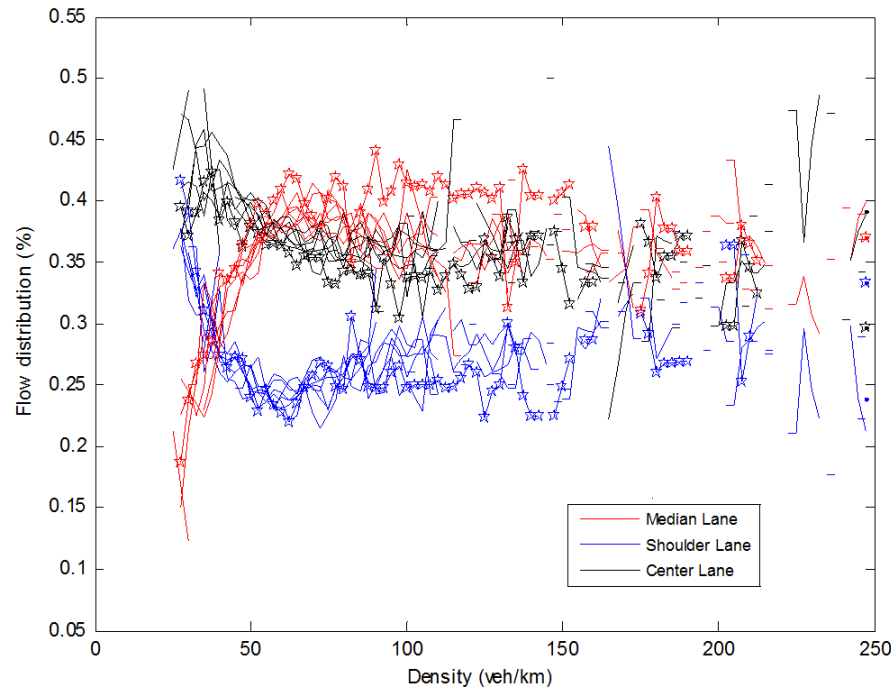
– Flow distribution



In congestion states, flow difference among lanes is due to the density

Results

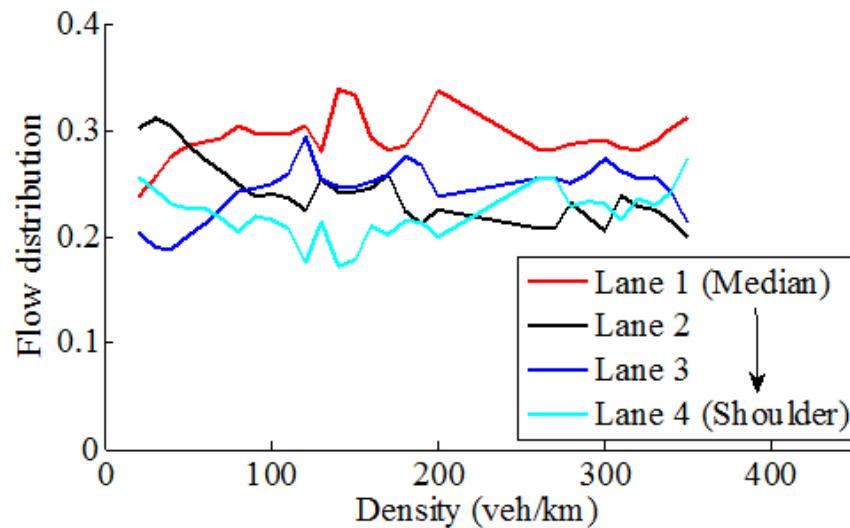
– Flow distribution



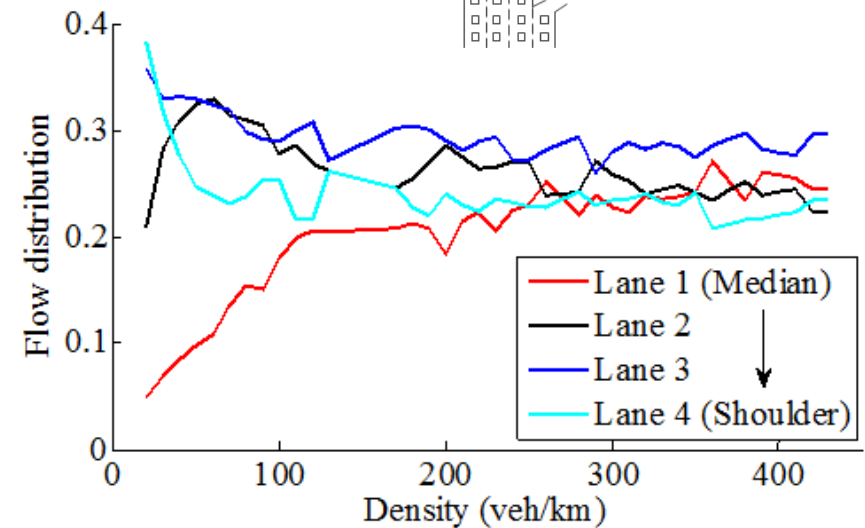
Downstream capacity of median lane which is close to the lane-drop bottleneck is temporarily increased due to merging behaviours

Results

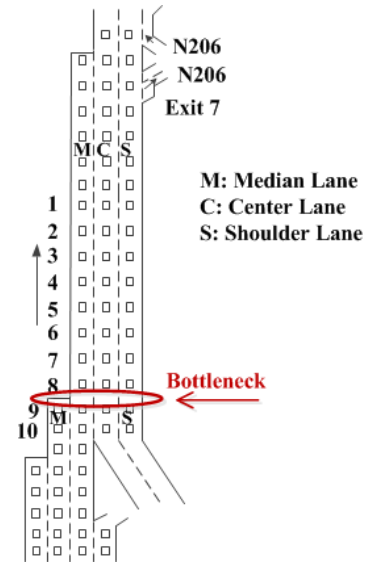
– Flow distribution (4-lane)



a) Location 10, 18 May



b) Location 9, 18 May



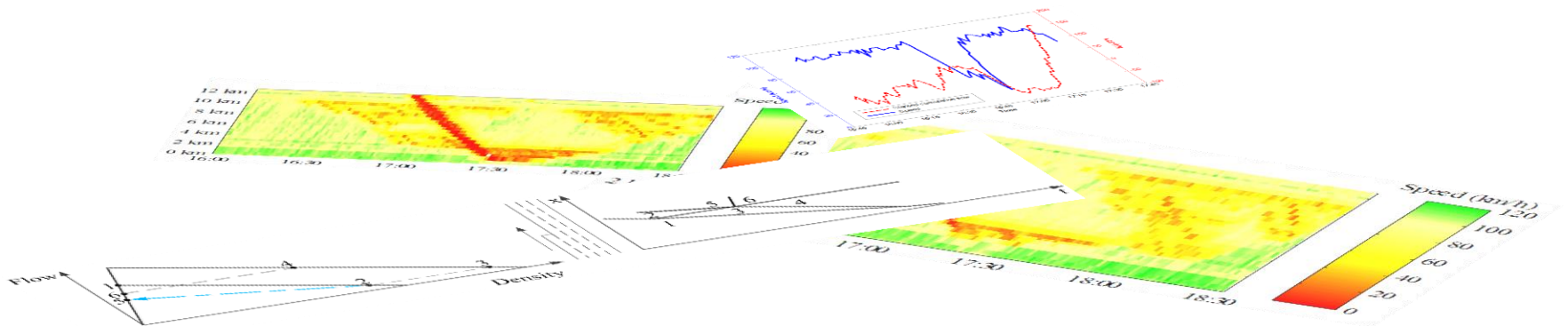
Conclusion

- The discharge rate at the same location varies in a wide range, from 5220 veh/h to 6040 veh/h;
- The stop-and-go wave discharge rate is much higher than the standing queue discharge rate;
- The various discharge rate could be strongly related to the congestion states;

Conclusion

- Features of queue discharge rate in each lane differ from each other;
- Flow distributions shows in congestion states the capacity in the shoulder lane is largely wasted, due to the large spacing;
- Merging behaviours temporarily increase the capacity of the median lane;

Thank you !



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