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Traffic Flow Modelling on Delhi-Gurgaon Expressway

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Objective

- To study the nature of traffic flow on a 8-lane divided urban expressway – The Delhi Gurgaon Expressway
- The objective is achieved through studying the temporal variations in parameters such as Flow, Speeds and Occupancies and studying the fundamental relationships
- The traffic flow at a point on the road has been simulated for further investigations

Background

- Urban Expressways in India have been relatively unexplored in spite of their differences in geometry, driving speeds and traffic composition from other type of roads
- Many of these roads exist: Delhi-Gurgaon and Western Express Highways in Mumbai and more are being built: Yamuna and Kundli-Manesar-Palwal Expressways
- Hence understanding the nature of traffic in these facilities assumes high importance

Delhi Gurgaon Expressway

Deserves a special attention due to

a) The car composition being about 70-75%

b) 2-wheeler composition of the order of 20-25%

c)With higher driving speeds and partial access control

d)With a higher degree of lane-discipline than other type of Indian roads

Study Location on the Expressway

← Towards Gurgaon

Towards Delhi →

Observed Traffic Characteristics

Vehicle Type	Composition (%)	Free-flow speeds, km/h				Vehicle Dimensions, m		Lat. clear. share, m	
		Max.	Min.	Mean	SD	Length	Width	Min.	Max.
Car	70.80	103	78	90	4.00	4.4	1.75	0.40	0.60
Two-wheeler	22.50	87	33	58	8.33	1.8	0.60	0.10	0.30
Three-wheeler	3.30	63	38	50	4.00	2.6	1.4	0.30	0.40
Bus	2.20	93	64	79	5.00	10.3	2.5	0.40	0.60
LCV	0.70	80	63	73	3.33	5.0	1.9	0.40	0.60
Truck	0.50	69	48	60	4.00	7.5	2.5	0.40	0.60

A note on Area Occupancy

- Chunchu and Rao(2006) proposed the concept of Area Occupancy as a surrogate for density suited to Indian Traffic Conditions
- It takes into account the undercounting and over-counting issues caused due to parallel arrivals and lack of lane discipline in Indian traffic conditions respectively
- Does it by applying a non-lane, area-based correction factor to time occupancy

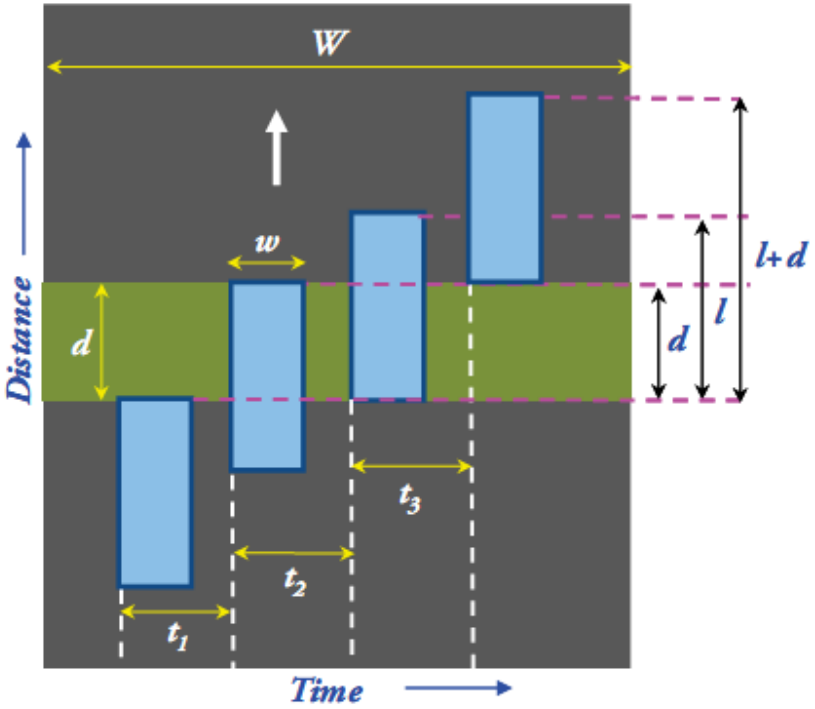
A note on Area Occupancy

- Arasan and Dhivya (2010) formulated

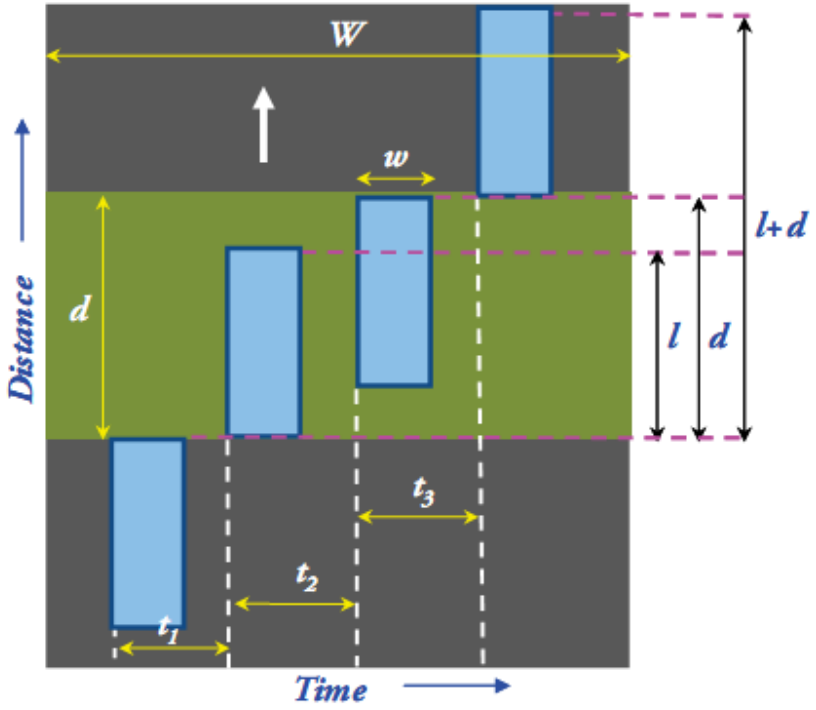
$$Area\ Occupancy = \frac{\sum a_i t_i}{AT} = \frac{\sum t_i}{T} * \frac{\sum a_i}{A}$$

  - They found that Area Occupancy is a surrogate for density for heterogeneous traffic and is not affected by detection zone length
  - Has a great potential for being used in inductive loop detectors in Indian conditions

Area Occupancy(Arasan& Dhivya(2010)



6 (a) - Case 1: Length of Detection Zone less than the length of vehicle



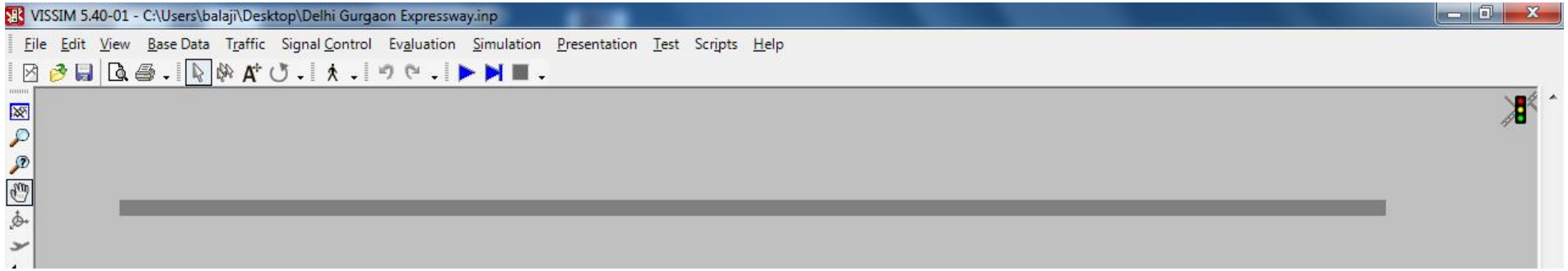
6 (b) - Case 2: Length of Detection Zone more than the length of vehicle

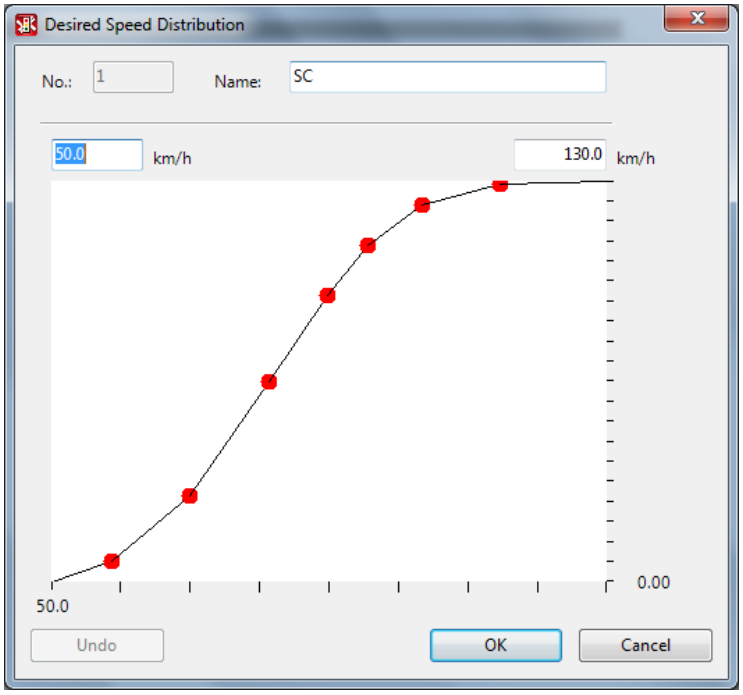
- Detection zone length = 6 m

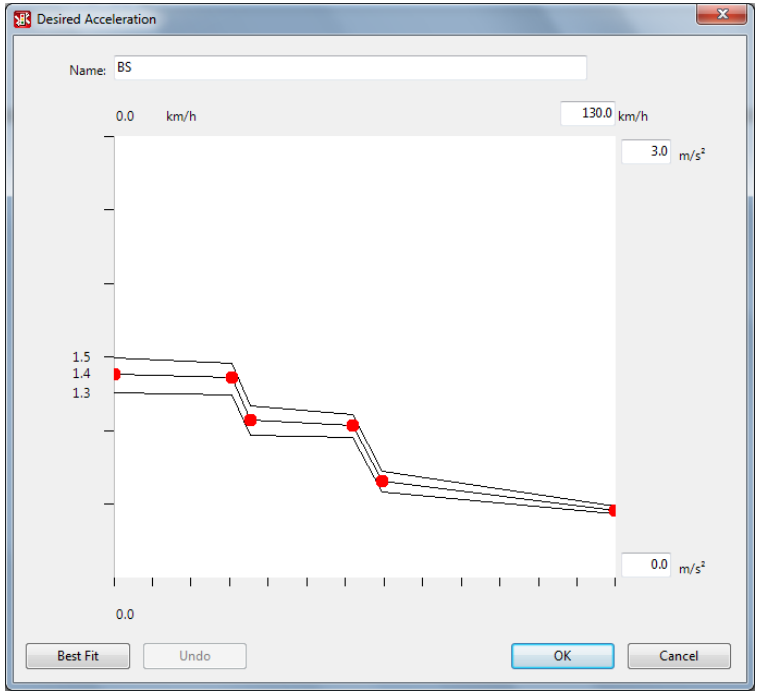
Acceleration Parameters Used (Singh, Ponnu and Arkatkar (2012))

Vehicle Type	0-30 km/hr. (m/s^2)	30-60 km/hr. (m/s^2)	Above 60 km/hr. (m/s^2)
Car	2.15	1.80	1.10
Two-wheeler	1.10	0.70	0.45
Three-wheeler	0.80	0.30	0.25
Bus	1.40	1.00	0.45
LCV	1.30	0.80	0.55
Truck	1.00	0.62	0.46

Simulation Screenshots







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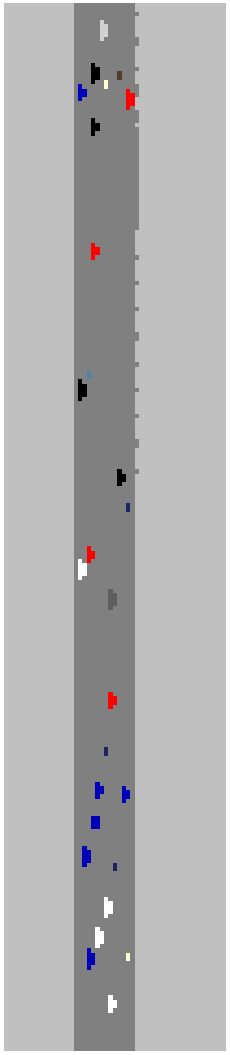
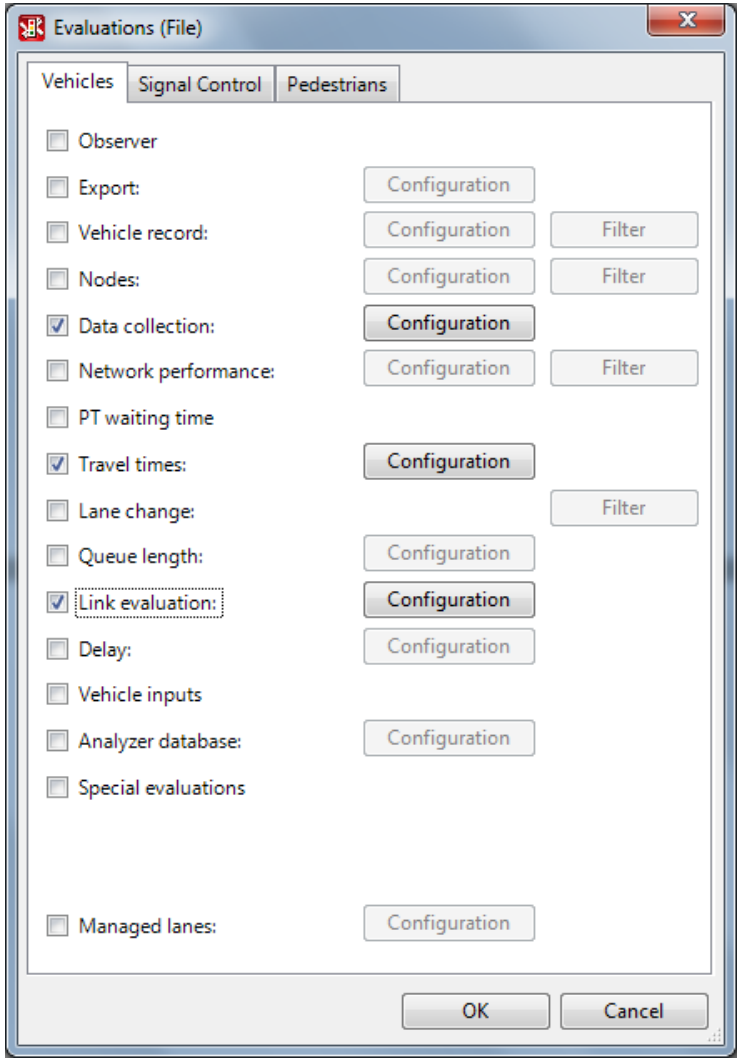
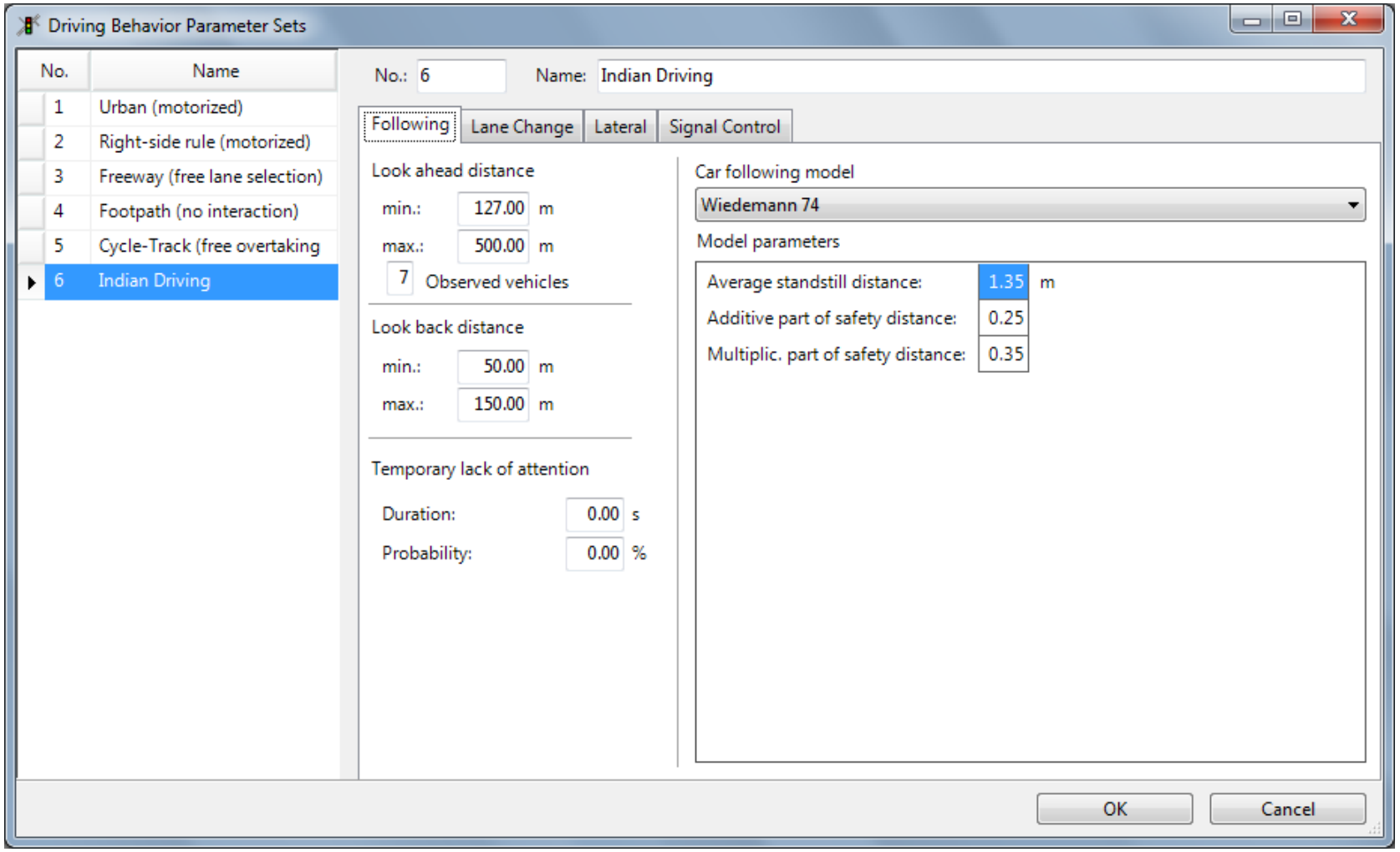




Simulation Screenshots (Anand,Ramadurai and Vanajakshi(2012))



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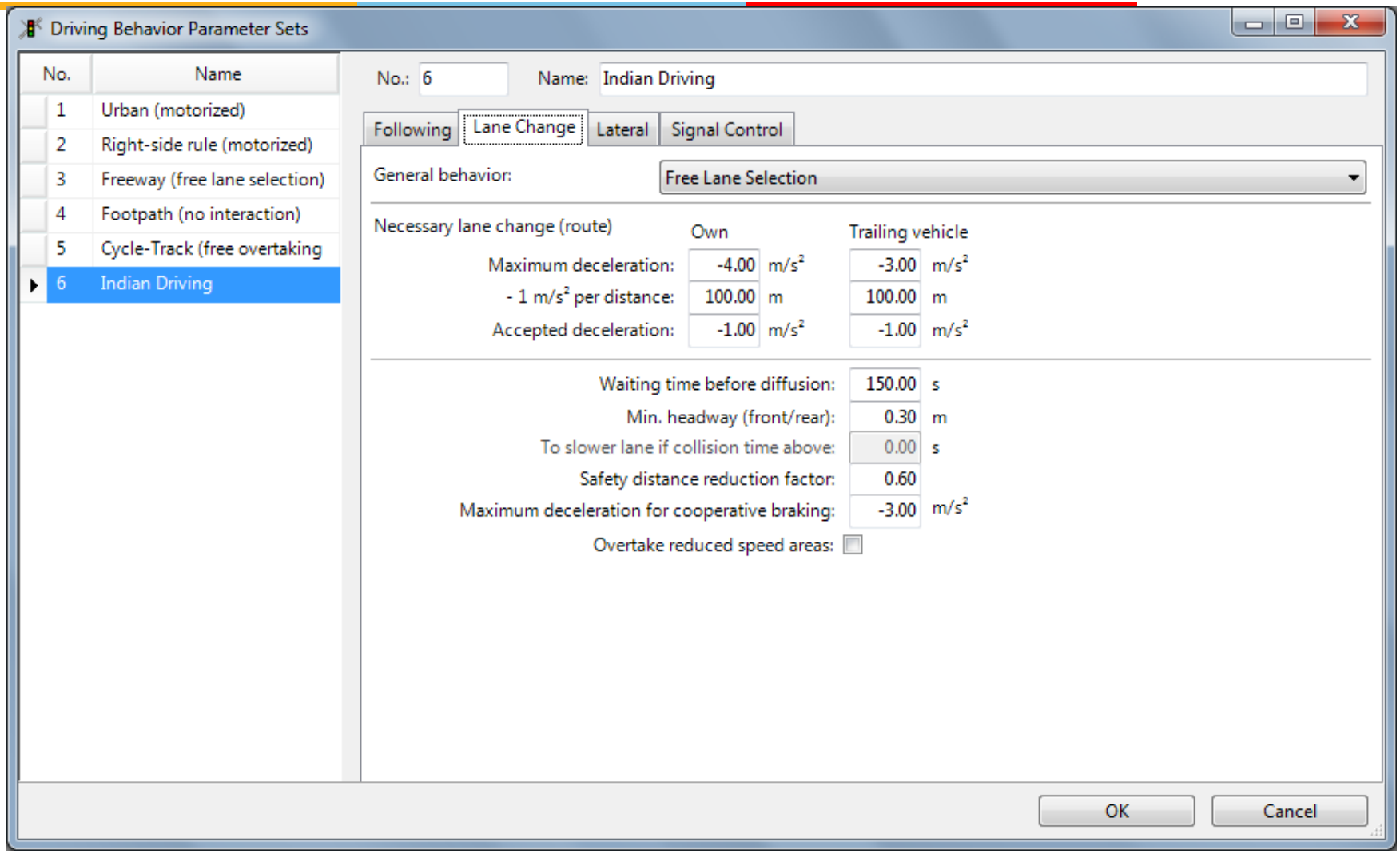

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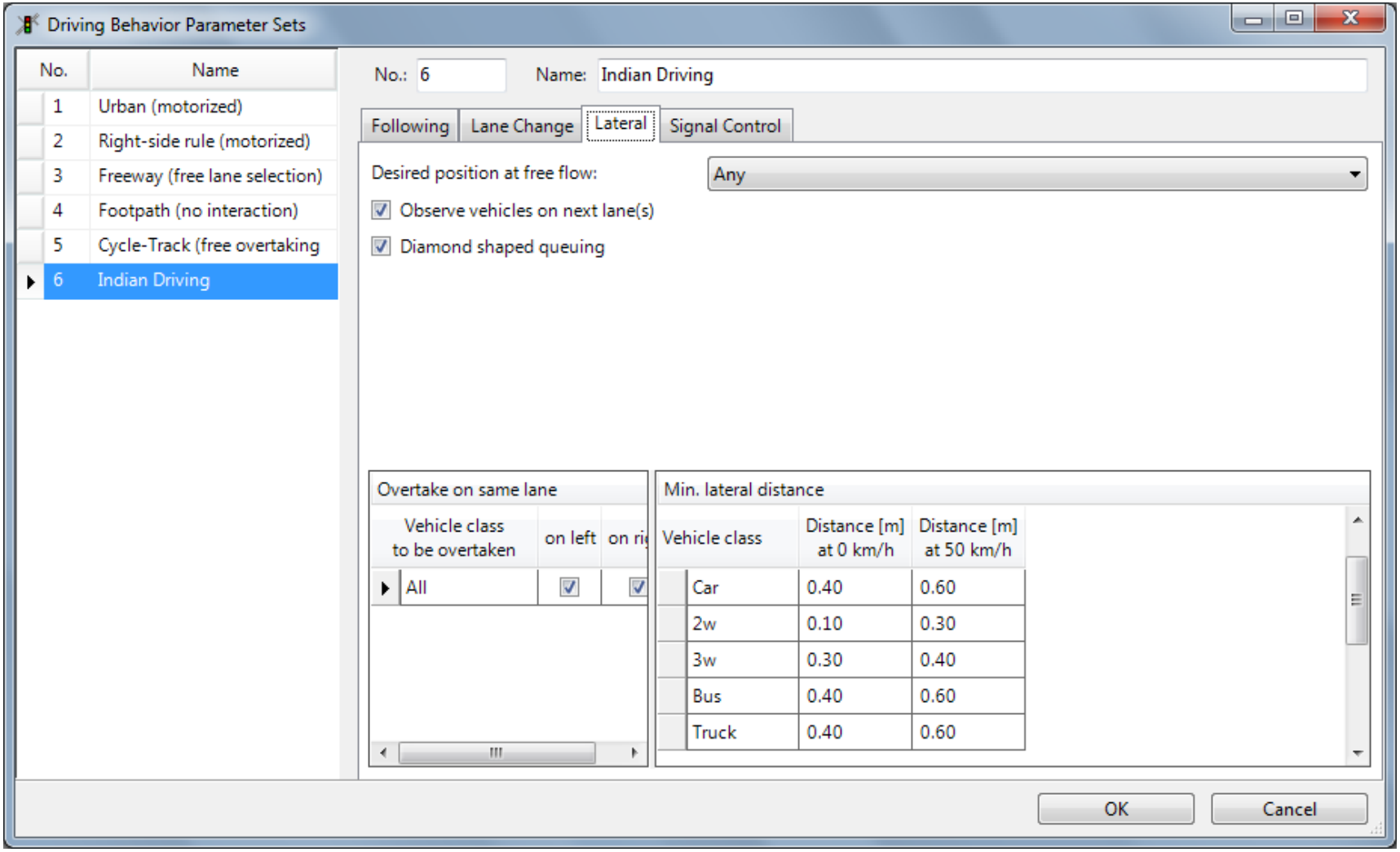
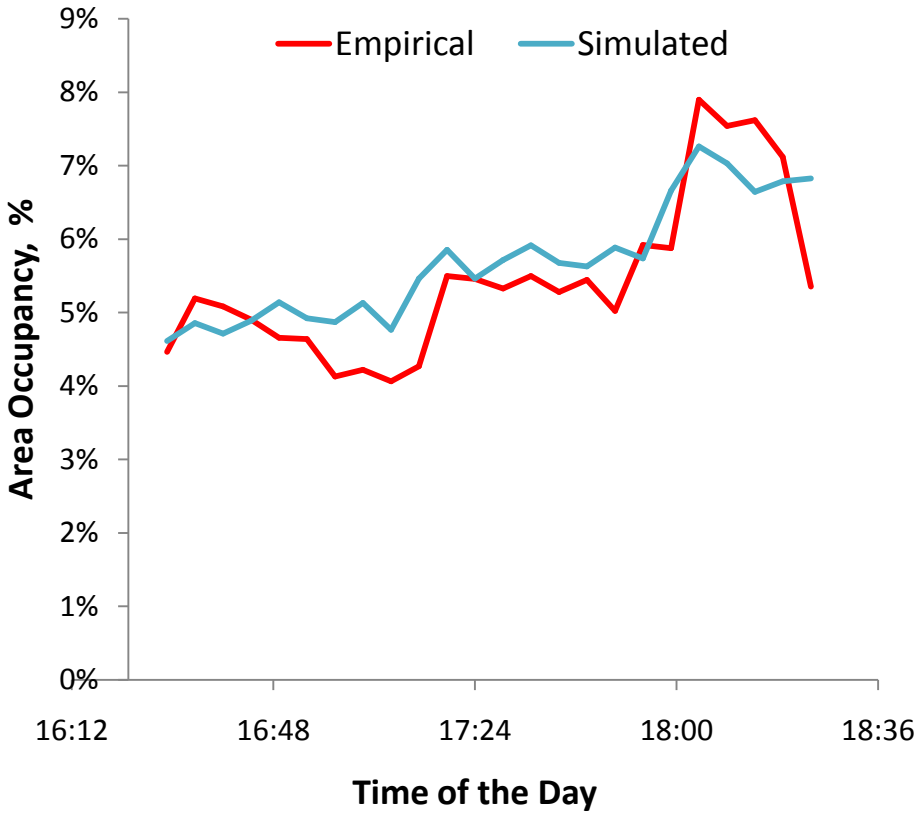
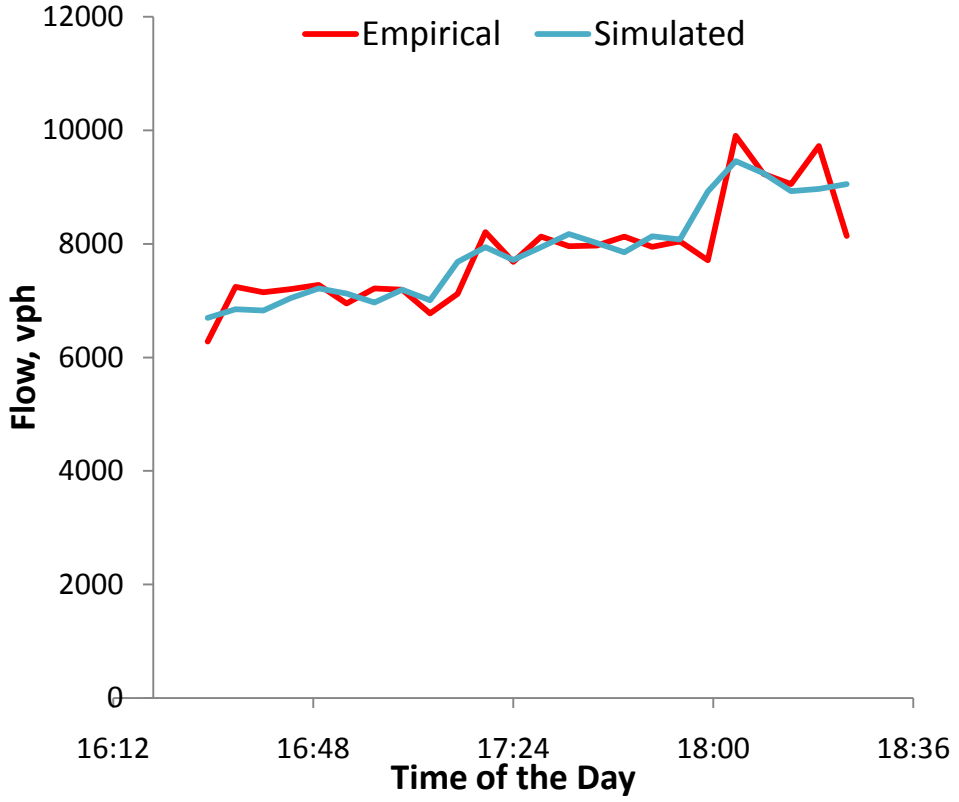
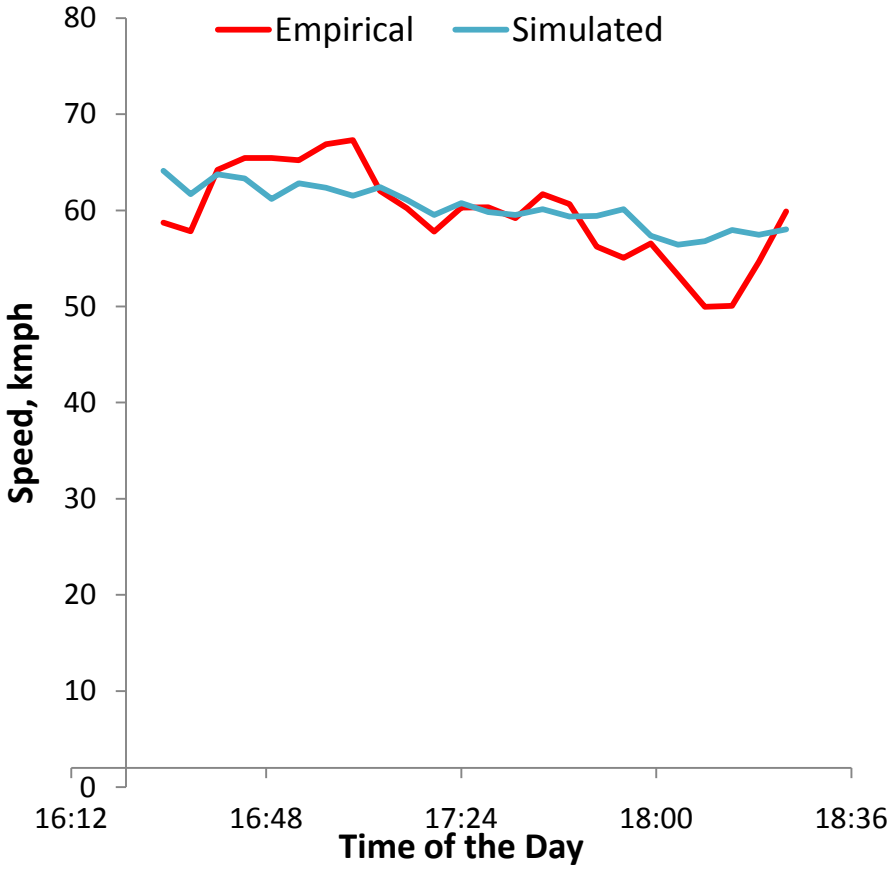


Temporal Validation

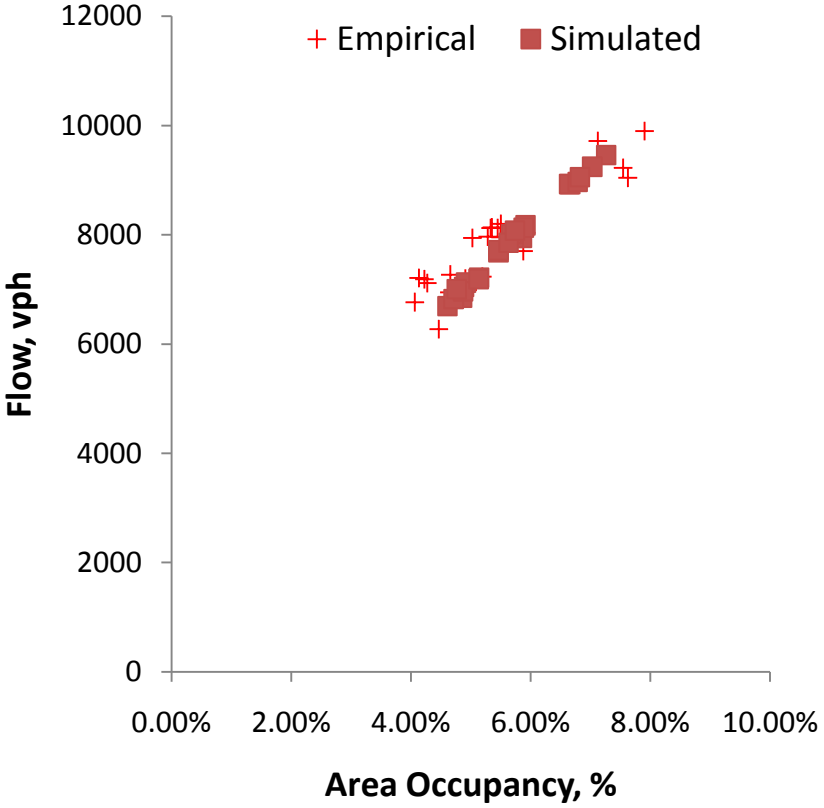


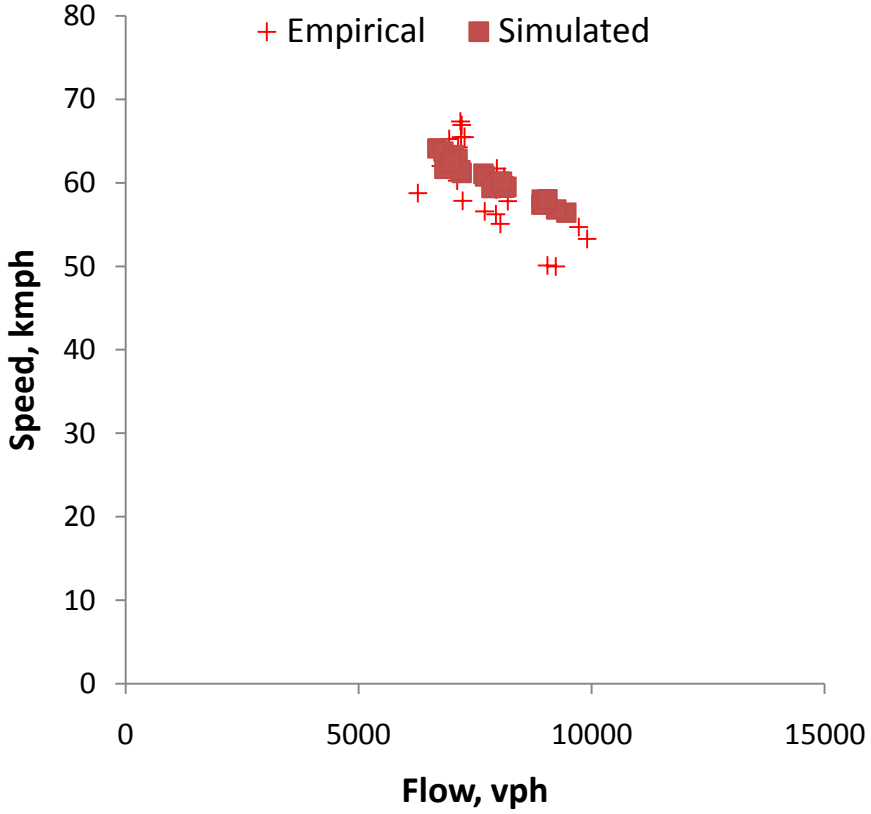


Temporal Validation(contd..)

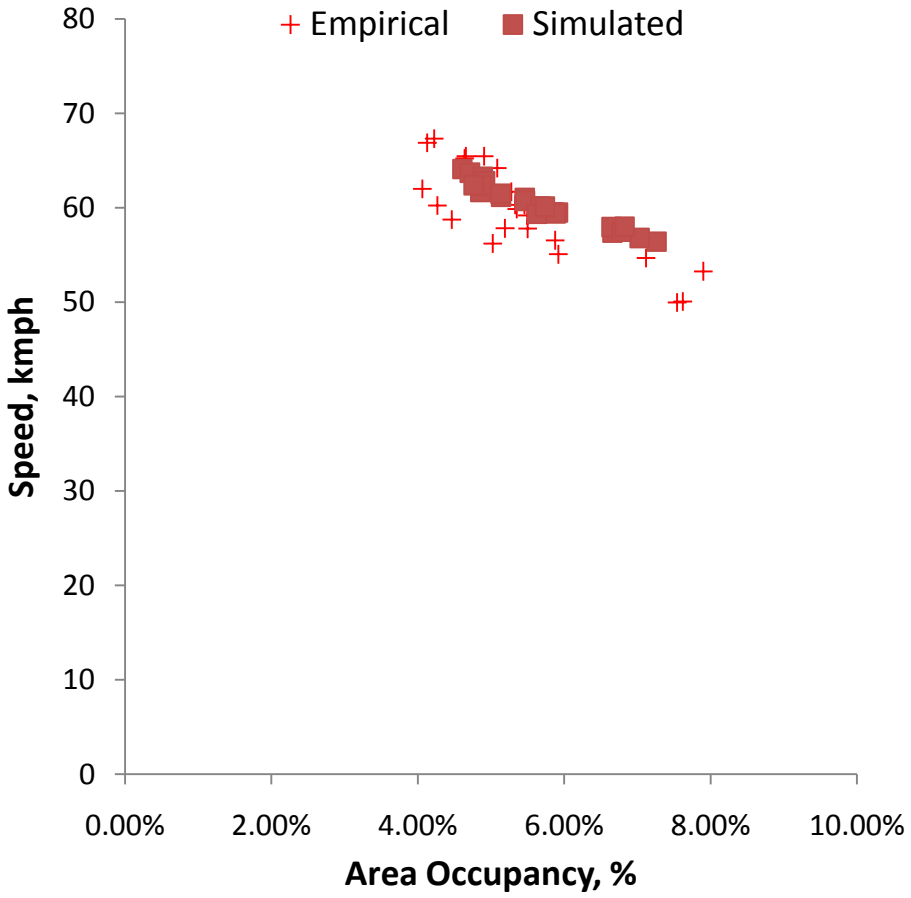


Fundamental Relationship





Fundamental Relationship(contd..)



t-test statistics and MAPE

- H0: The samples are different
- H1: The samples are not different

Parameter	D.O.F	t-statistic	t-critical	MAPE
Flow	23	-2.050	±2.074	3.87%
Speed	23	-0.401	±2.074	4.88%
Area Occupancy	23	-0.975	±2.074	10.18%

- Thus the null hypothesis can be rejected for all the three parameters

Future Scope

- As the field conditions have been simulated with statistical significance, the capacity of the facility can be estimated through simulation
- The driver behaviour parameters can be optimized using techniques such as genetic algorithm
- As the simulation model has been validated with reference to a point, it can be further extended to a segment of the facility

QUESTIONS?

THANK YOU