

Effects of Authority Transitions between Adaptive Cruise Control and Manual Driving on Traffic Flow Efficiency.



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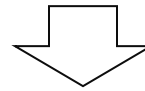
Introduction

Road transport

Congestion

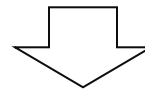
Accidents

Pollution



Adaptive Cruise Control (ACC)

What are the effects of authority transitions?

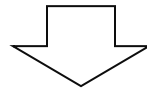


Traffic flow efficiency

1. Overview of work

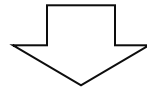
Authority transitions

Driving Behaviour



Microscopic traffic flow simulation

Analysis of empirical driving behaviour



Analysis of traffic flow characteristics

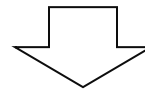
Conclusion and future research

2. Literature review

Data collection methods

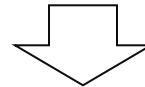
FOT

Driving simulator



Motivations for authority transitions

Behavioural adaptations of drivers



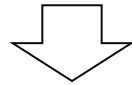
Car following and lane-changing models

Effects on traffic flow efficiency

2.1. Motivations for authority transitions

Authority transitions between ACC and manual driving
(Pauwelussen & Minderhoud 2008; Klunder, et al. 2009)

Discretionary



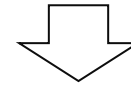
Drivers switches off

Lane change

Create a gap

Left-lane speed
adaptation

Mandatory



System switches off

Sensor failure

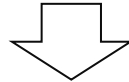
Constraints reached

2.2. Behavioural adaptations of drivers

Behavioural aspects that are influenced by ACC

Higher speeds

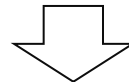
Shorter time headways



Changed role of the driver

Reduction
of vigilance

Reduction of situation
awareness

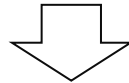


Ability to respond to emergency situations

2.3. Microscopic traffic flow models

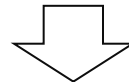
Car following models

Lane-changing models



ACC are a different type of vehicle

Authority transitions are not possible



ACC vehicles have an effect of traffic flow
(Kesting 2008; Klunder, et al. 2009)

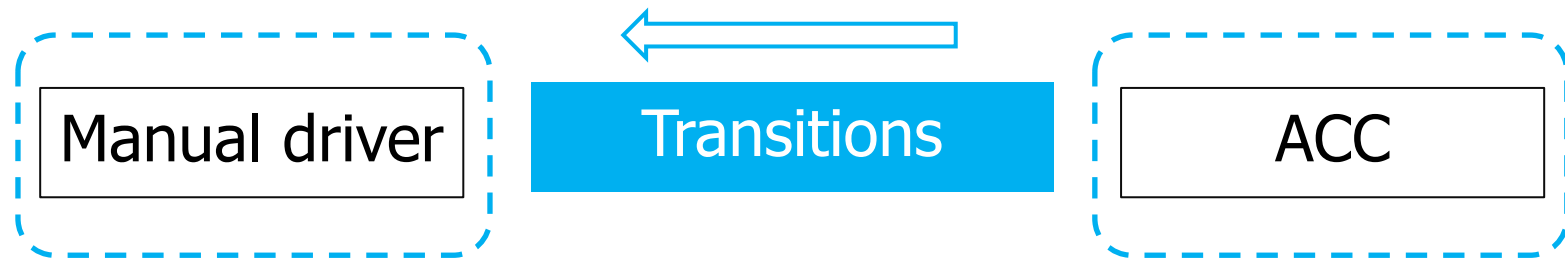
Capacity

Capacity drop

Stability

3. Methodology

Microscopic traffic flow simulation

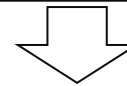


Control condition

No transitions

Experimental condition

Drivers can switch off



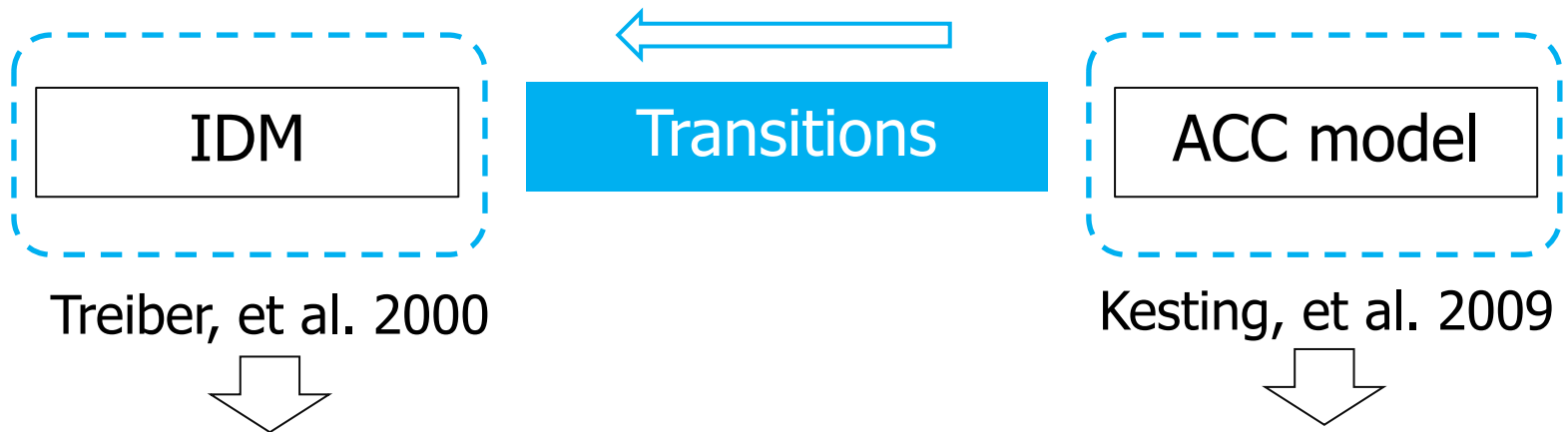
Lane changing manoeuvre

Switch off ACC

Do not switch off ACC

3.1. Model specification

Car following models



Inter-driver heterogeneity

$$a_{max_n} \sim \text{truncN}(1.4, 0.3)$$

$$b_{max_n} \sim \text{truncN}(2, 0.3)$$

$$T_n \sim \text{truncN}(1.5, 0.3)$$

$$T_n \sim \text{truncN}(1.5, 0.3)$$

3.1. Model specification

Lane changing model

Safe gap criterion

$$ds_ego_n > gap_ego_n$$

$$gap_ego_n = s_0 + \theta_n \cdot T_n \cdot v_n$$

$$ds_hp_f_n > gap_hp_f_n$$

$$gap_hp_f_n = s_0 + \theta_n \cdot T_f \cdot v_f$$

$$\theta_n \sim truncN(1, 0.1)$$

$$T_n \sim truncN(1.5, 0.3)$$

Incentive criterion right to left

$$V_{hp_l} > V_l + \varepsilon_n$$

$$\varepsilon_n \sim truncN(1, 0.5)$$

4. Simulation results

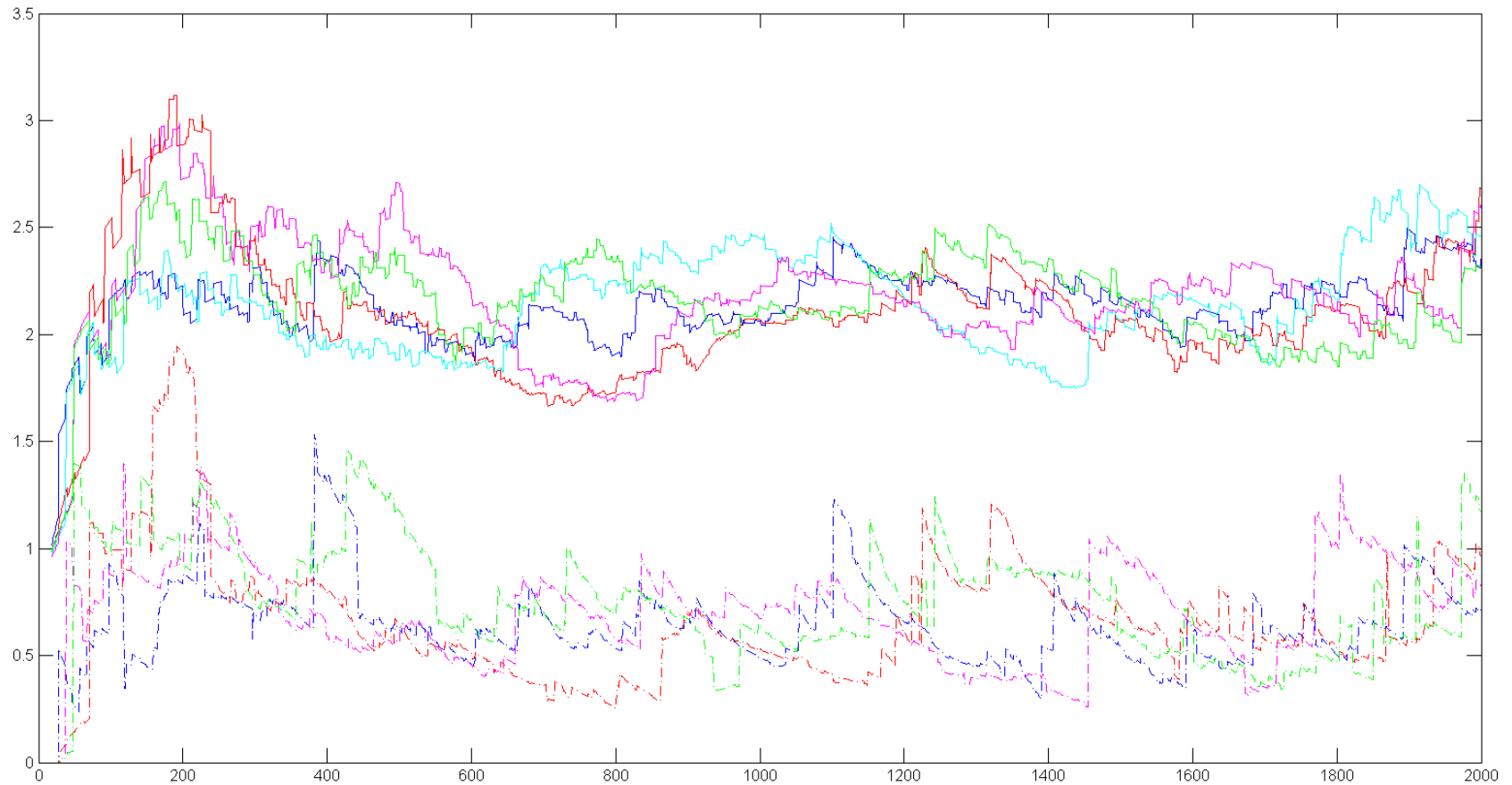
Design	Two lane highway		
Demand levels	1500 - 4000 veh/h		
Mixture	0% ACC	50% ACC	100% ACC

Analysis of traffic flow characteristics

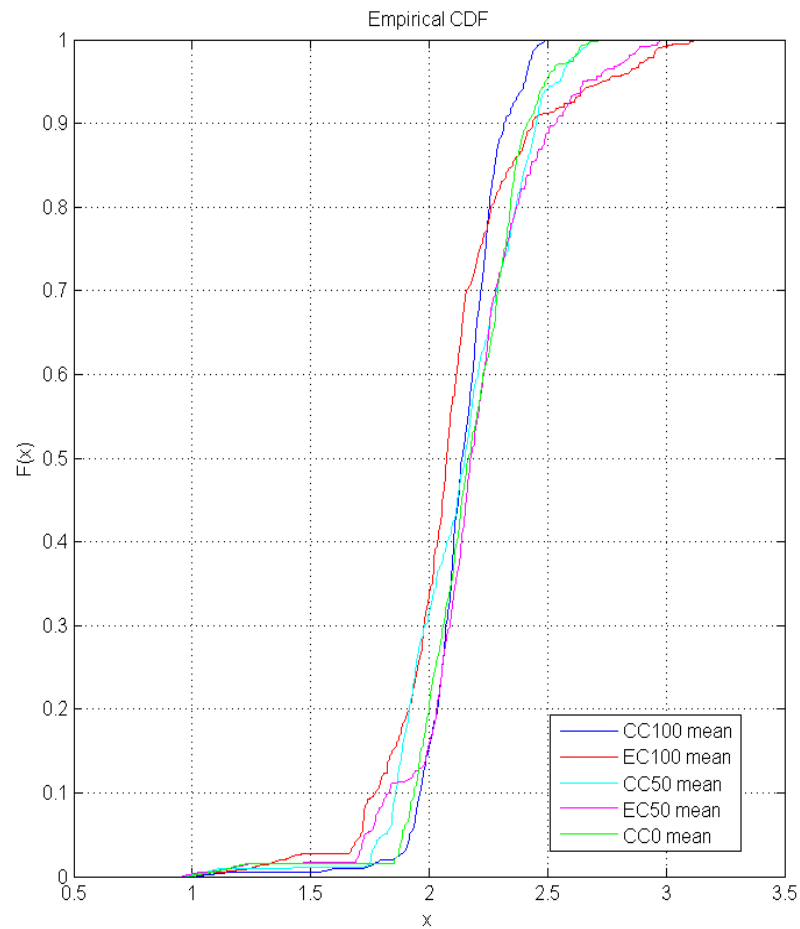
Time & Distance headways	Speed	Acceleration
Density	Traffic flow	

4.1. Time headway

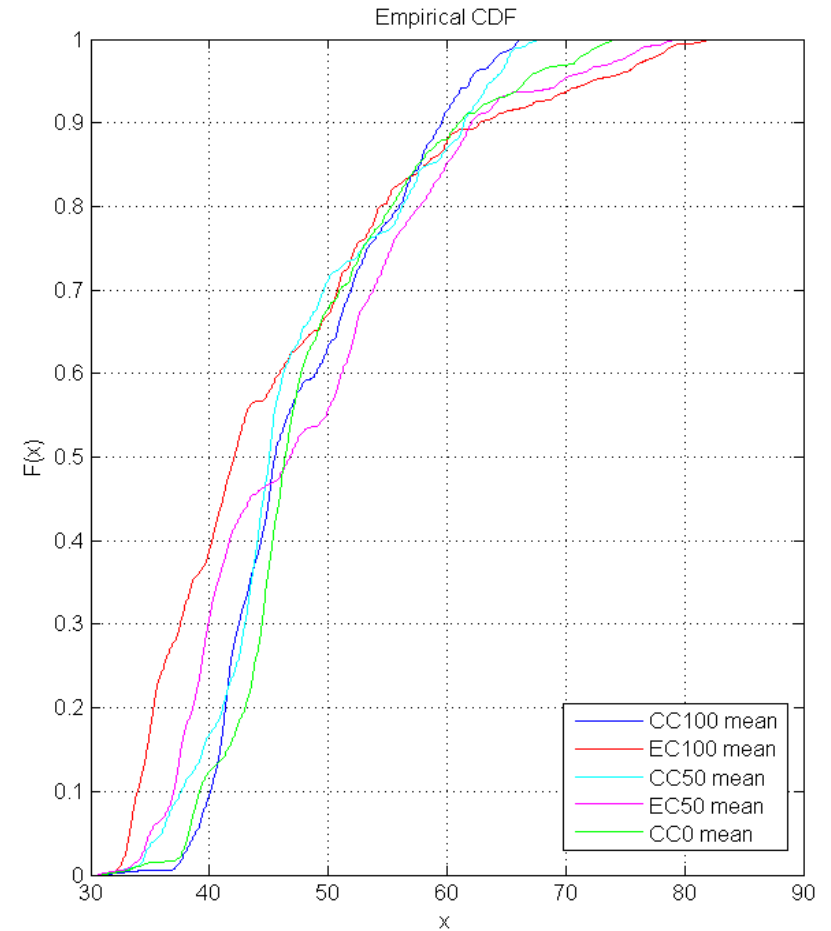
- CC100 mean
- EC100 mean
- CC100 std
- EC100 std
- CC50 mean
- EC50 mean
- CC50 std
- EC50 std
- CC0 mean
- EC0 mean
- CC0 std
- EC0 std



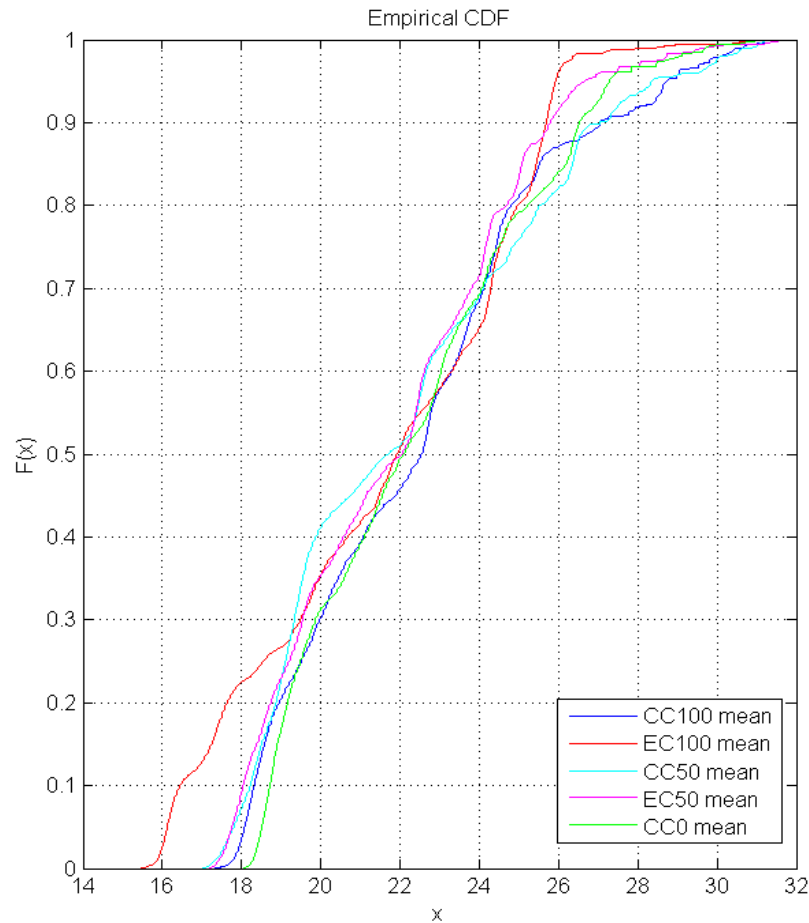
4.1. Time headway



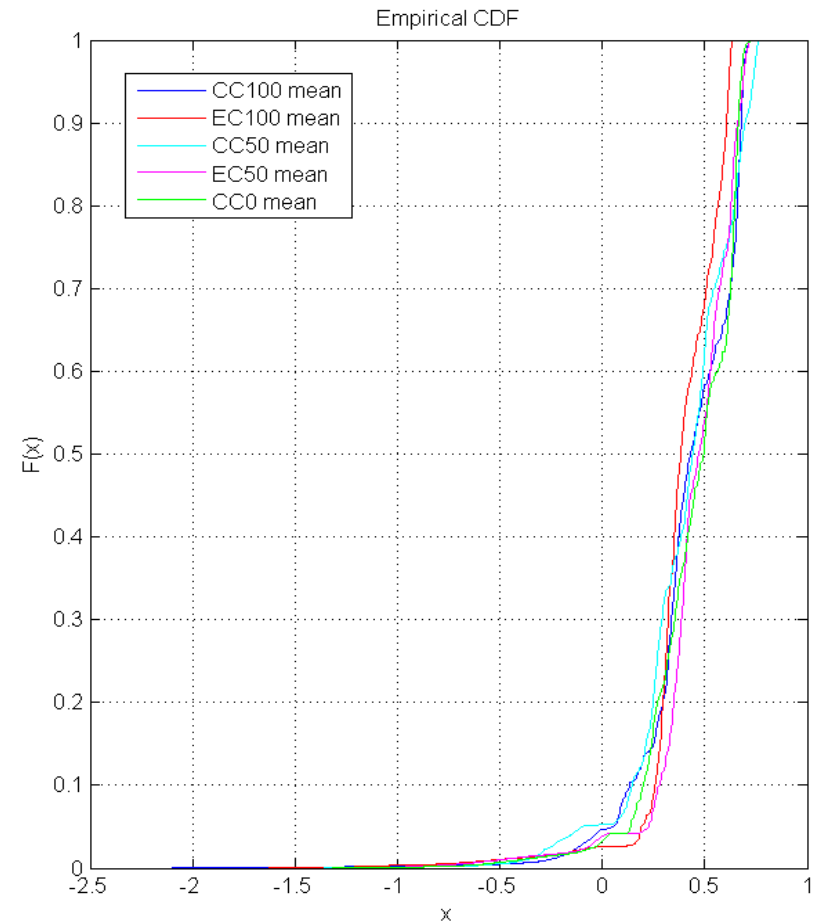
4.2. Distance headway



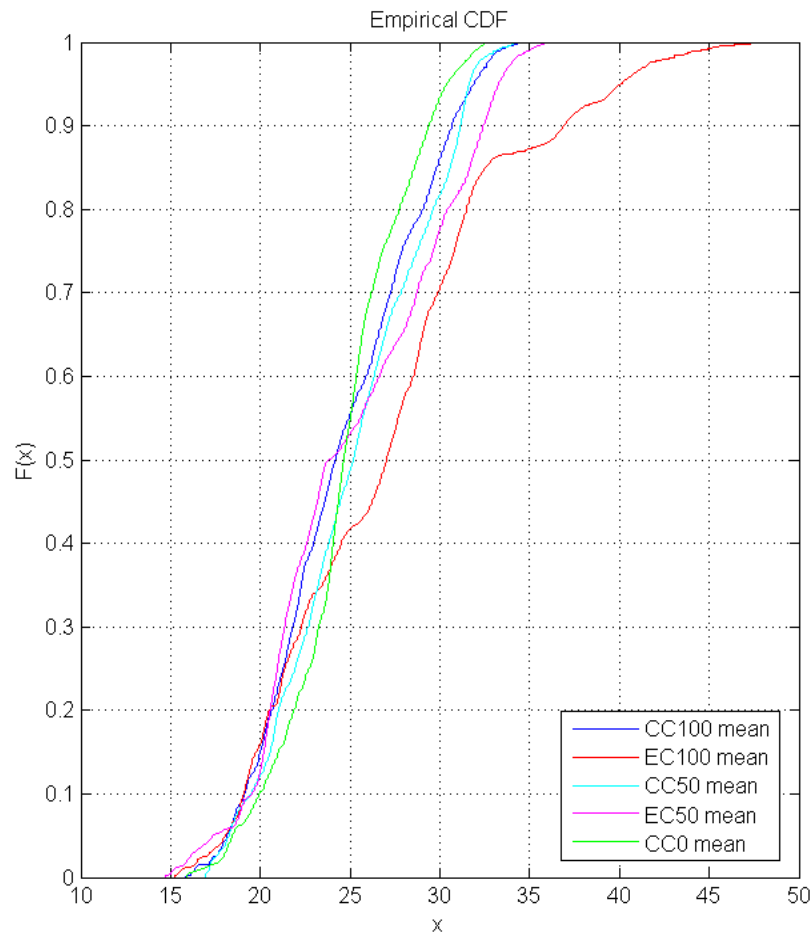
4.3. Speed



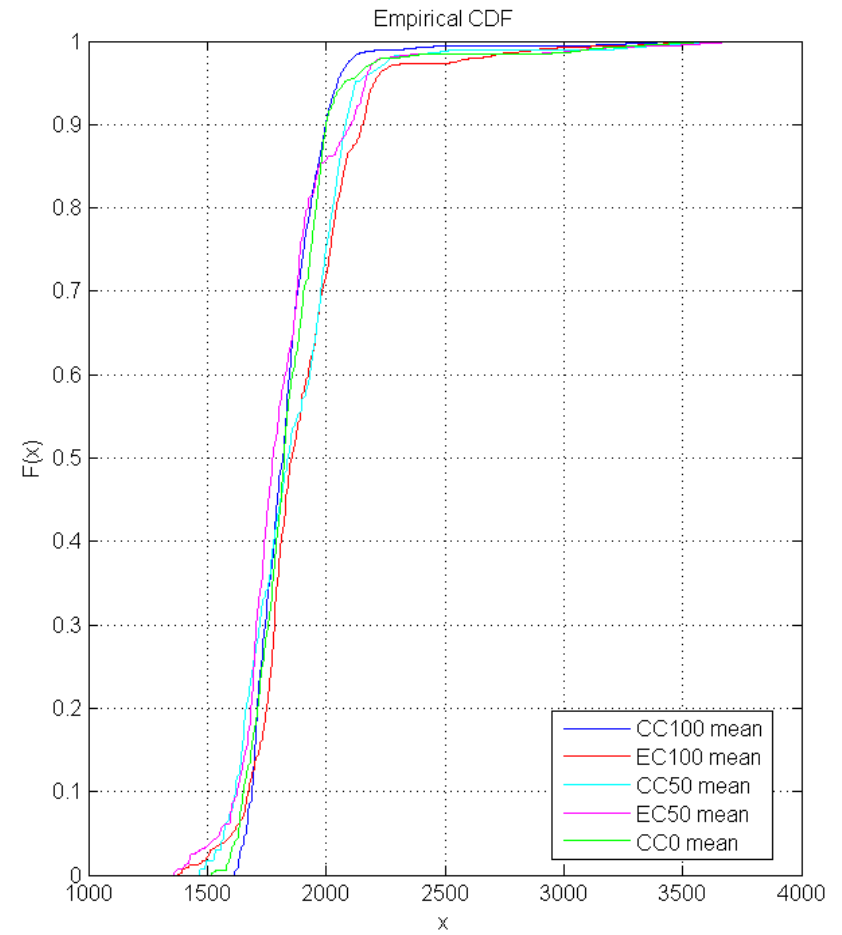
4.4. Acceleration



4.5. Density

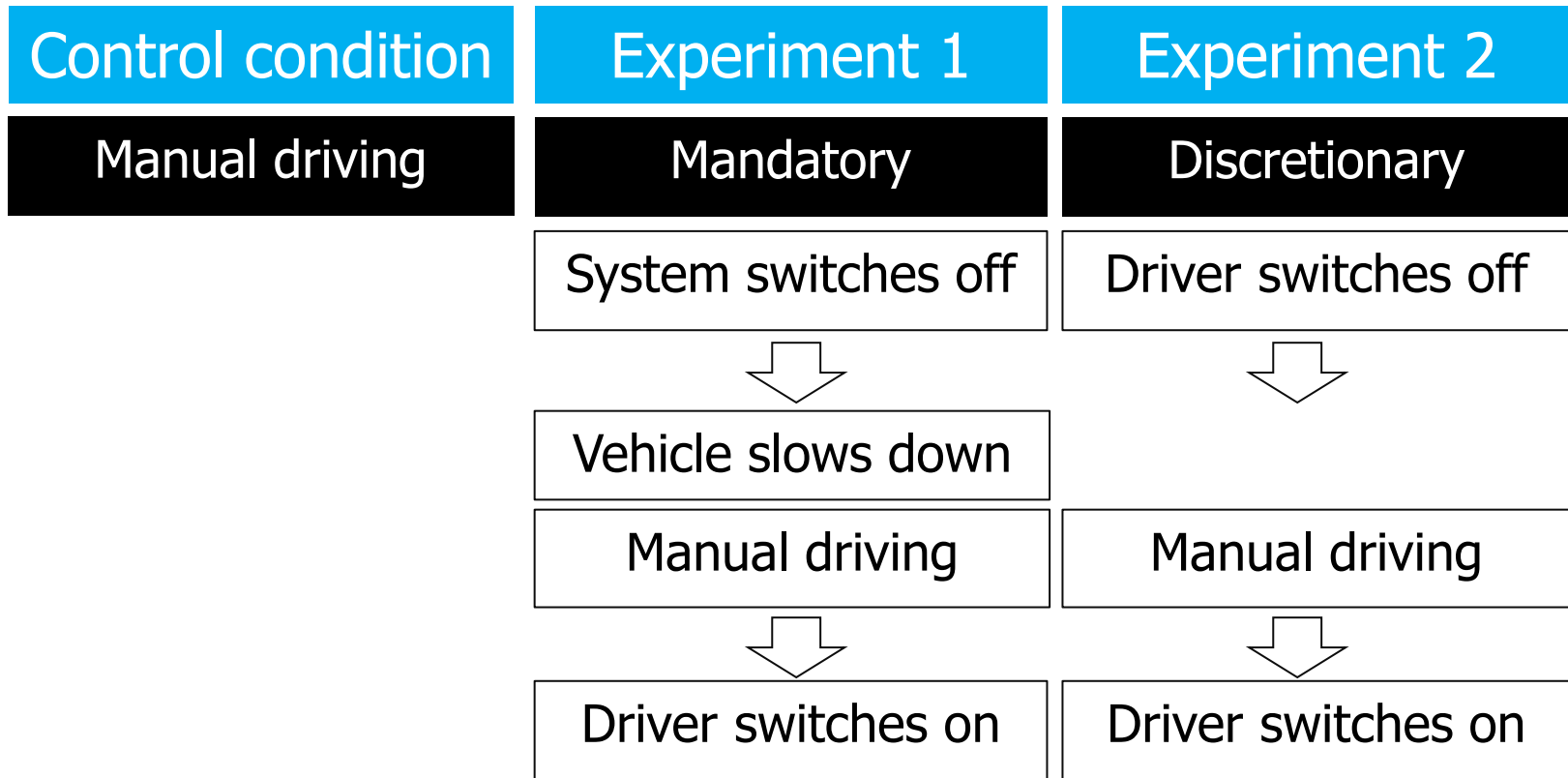


4.6. Flow

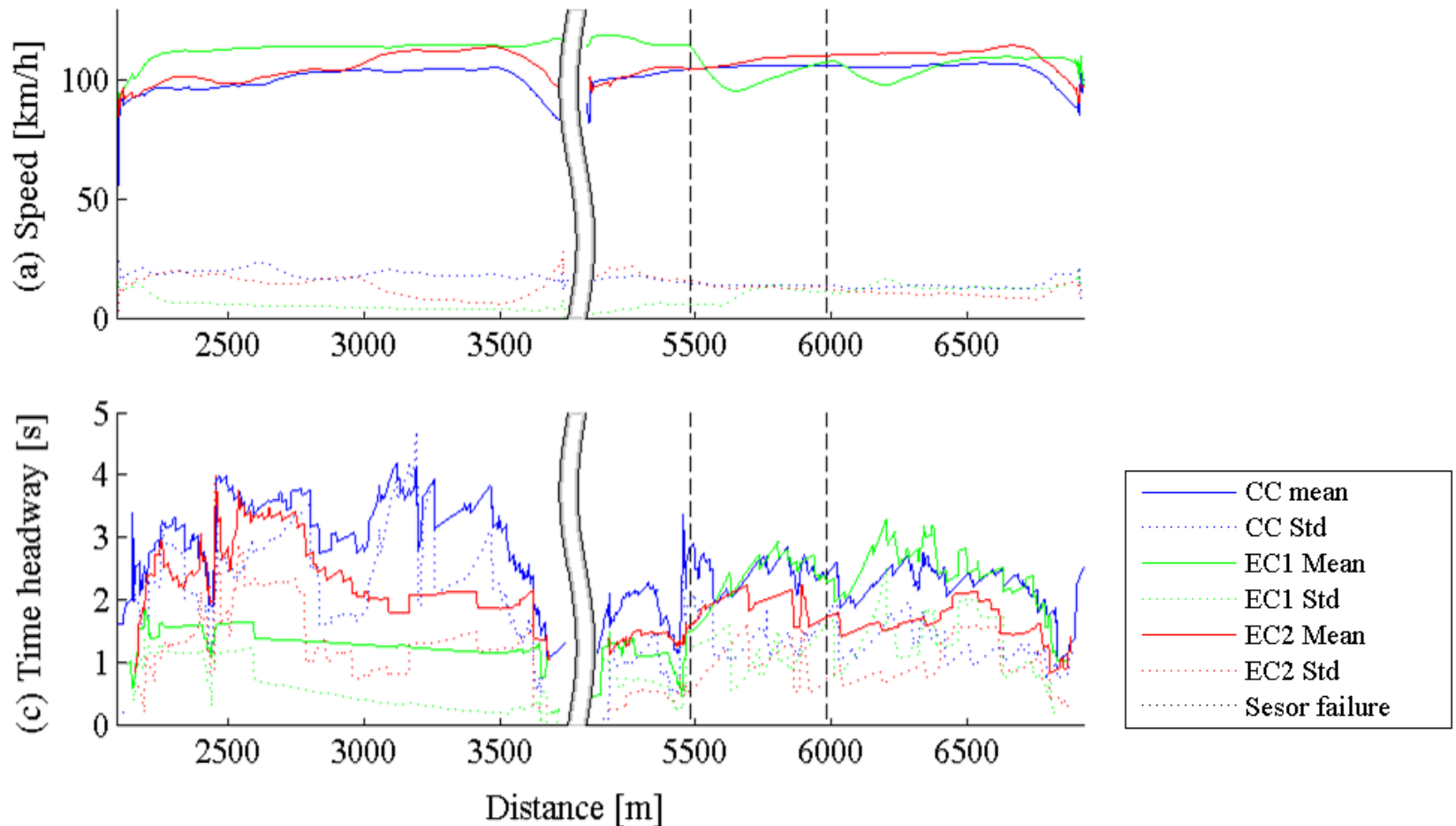


5. Driving simulator experiment

Authority transitions between ACC and manual driving



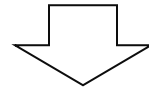
5.1. Experimental results



6. Conclusion and future research

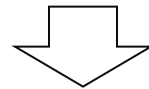
Authority transitions influence traffic flow efficiency

Current models are not adequate



Validity of decision rule introduced

Parameter calibration



When do drivers disengage ACC?

Human factors

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