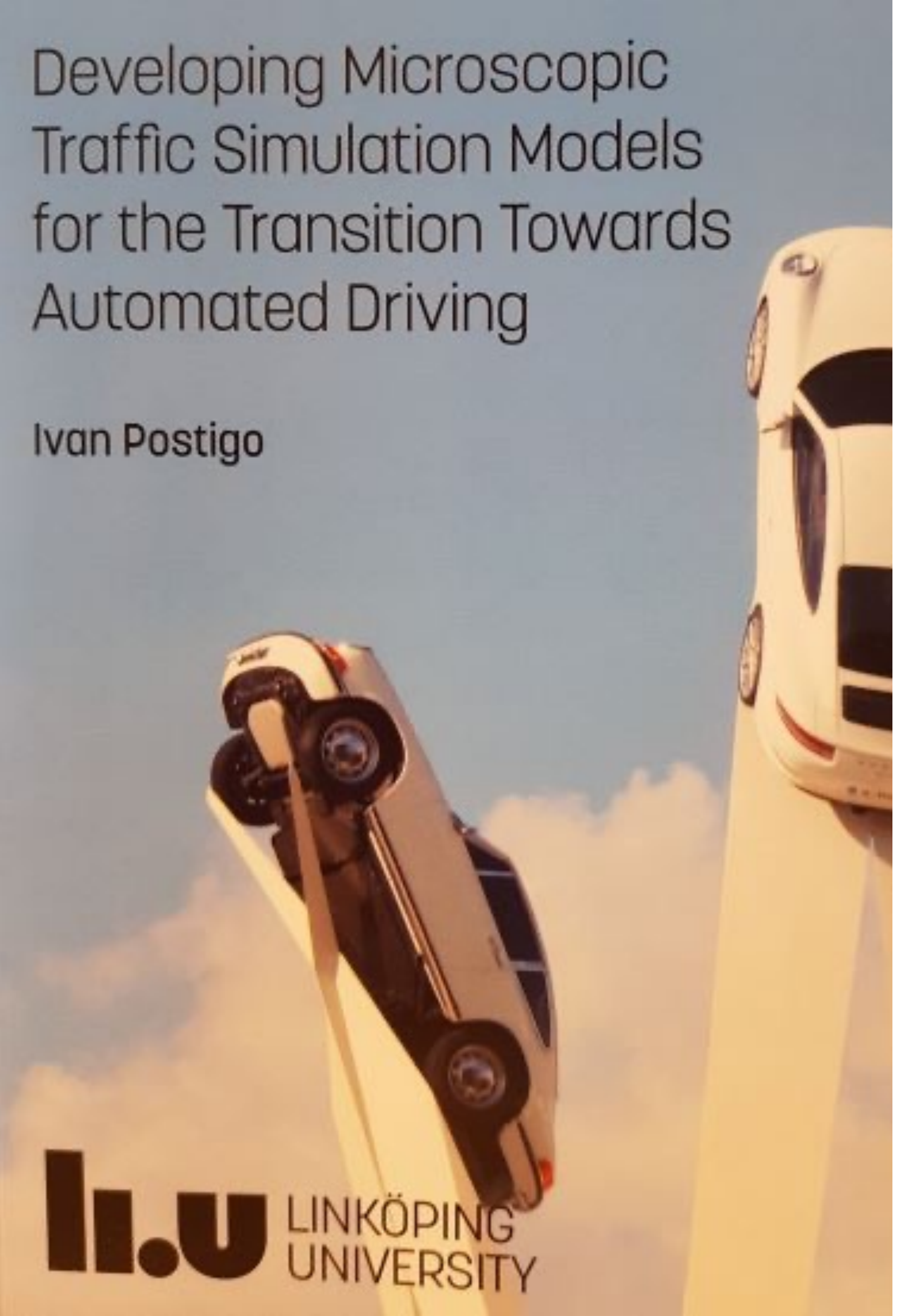

SMART III : Simulation and Modeling of Automated Road Transport

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CTR Day - 2022

CTR

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The purpose of the SMART project

- Identify the limitations of current traffic models to include automated vehicles.
- Further develop current traffic models to enable analysis of traffic systems including automated vehicles.
- Evaluate the effects on traffic systems due to driving automation for two application cases.
- Contribute to long-term knowledge building.

Background

- Traffic simulation is an important tool used for traffic analysis.

- Microscopic traffic simulation models describe the movements and interactions of all individual vehicles or travelers.

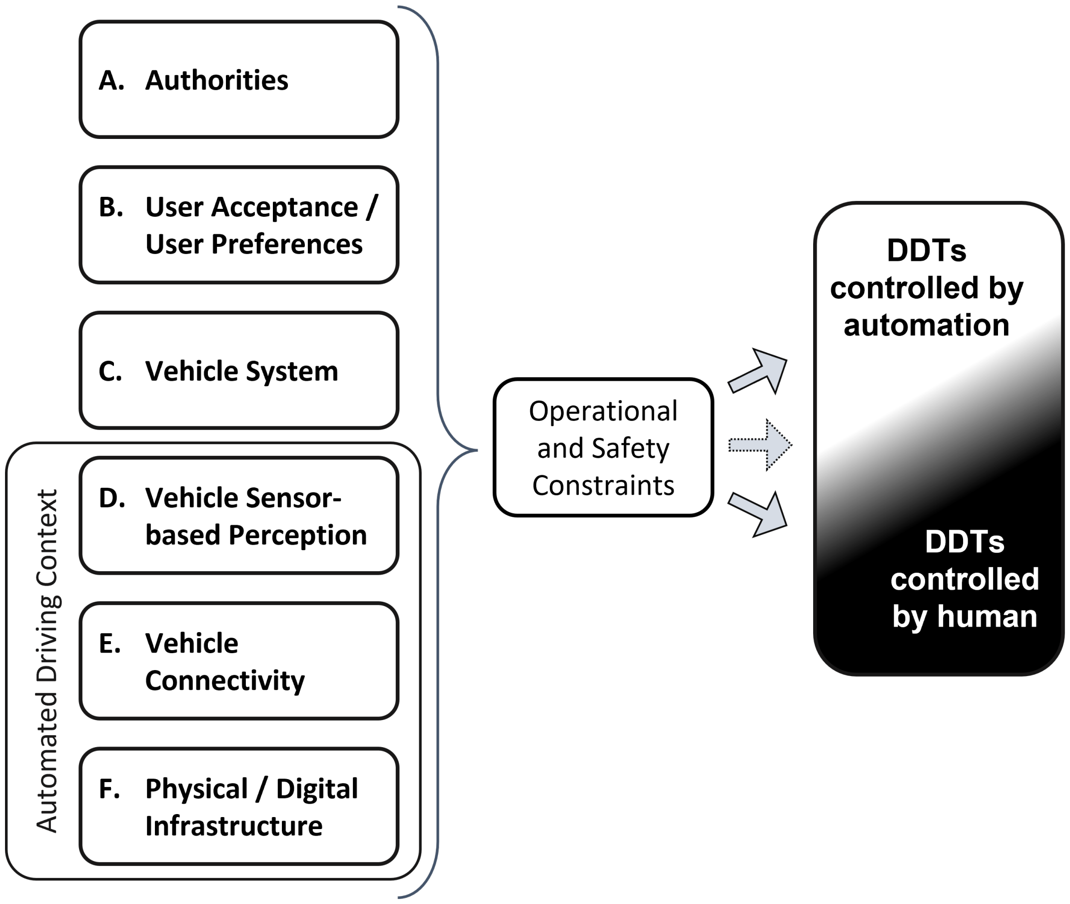
- Several studies have used microscopic traffic simulation to investigate the impact caused by automated vehicles.

Microscopic modeling of automated driving

Research questions:

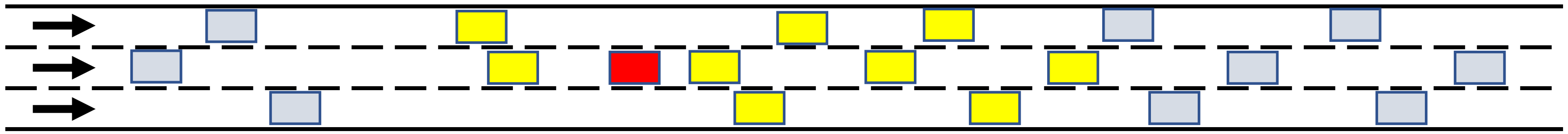
- How to model automated driving?
- How will the interaction between conventional and automated vehicles affect traffic systems?

Aspects to consider for modeling automated driving

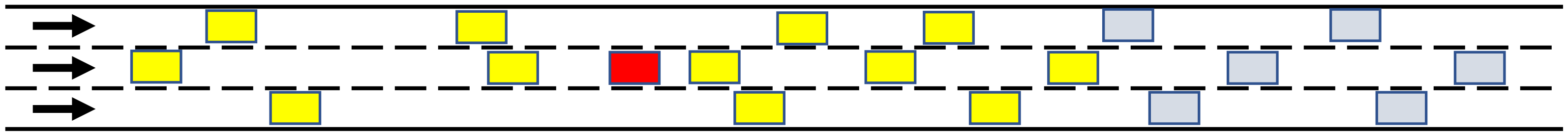


Modes of perception

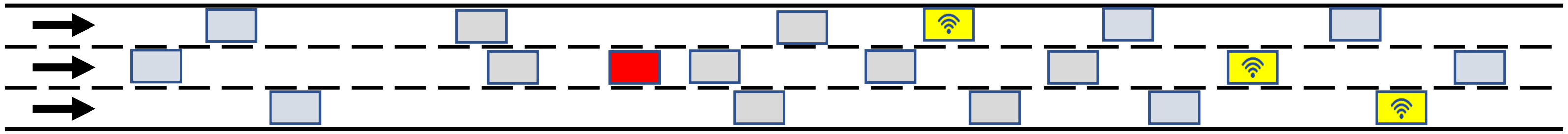
Human



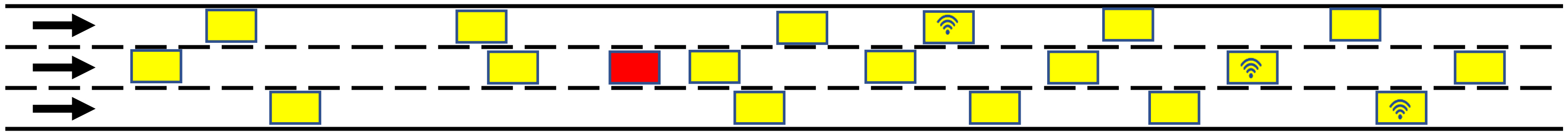
Sensor-based



Connectivity (i)



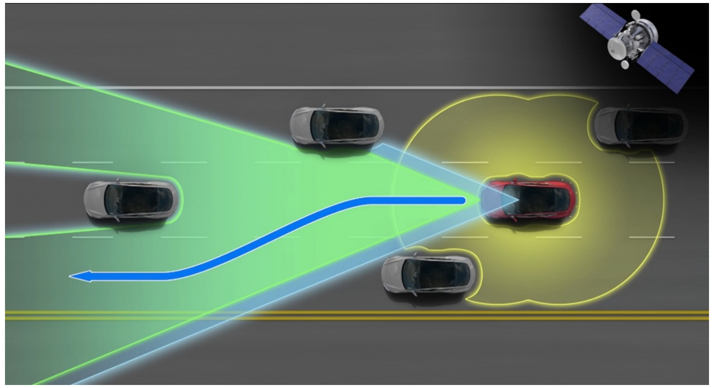
Connectivity (ii)



Perception Tasks for Automated Driving: A Conceptual Model for Microscopic Traffic Simulation

- Develop a conceptual model for the perception tasks and that ensures consistency in perception and transparency about assumptions.
- Capture differences in perception performance between sensor-based perception, perception based on connectivity and human perception.

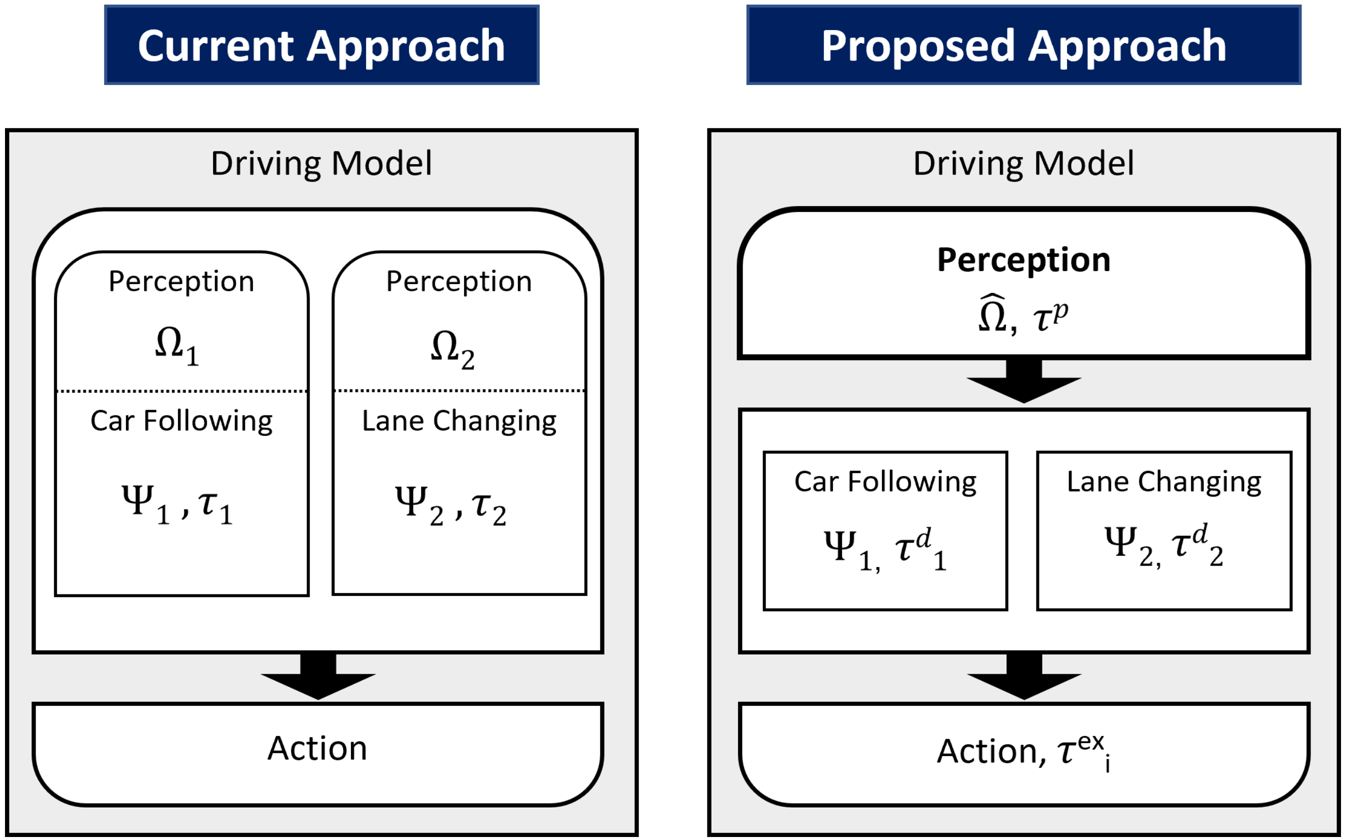
Perception for automated driving



- How is the information obtained/what are the sensing capabilities?
  - Mode of perception
  - Range – Accuracy
- Which vehicles/objects can be perceived?
- What information?
  - Position – Speed – Intentions
- When is the information obtained?
  - Frequency – Latency – Delay

Capture in a consistent way the differences between human perception, sensor-based perception and connectivity-based perception.

Change in microscopic driving model



- $\mathbf{\Omega}$: state variables
- $\mathbf{\Psi}$: submodel parameters
- τ : delay (reaction time)

Change to:

- $\widehat{\mathbf{\Omega}}$: estimated state variables
- τ : disaggregated delay

$$\tau = \tau^p + \tau^d + \tau^{ex}$$

Modeling perception performance

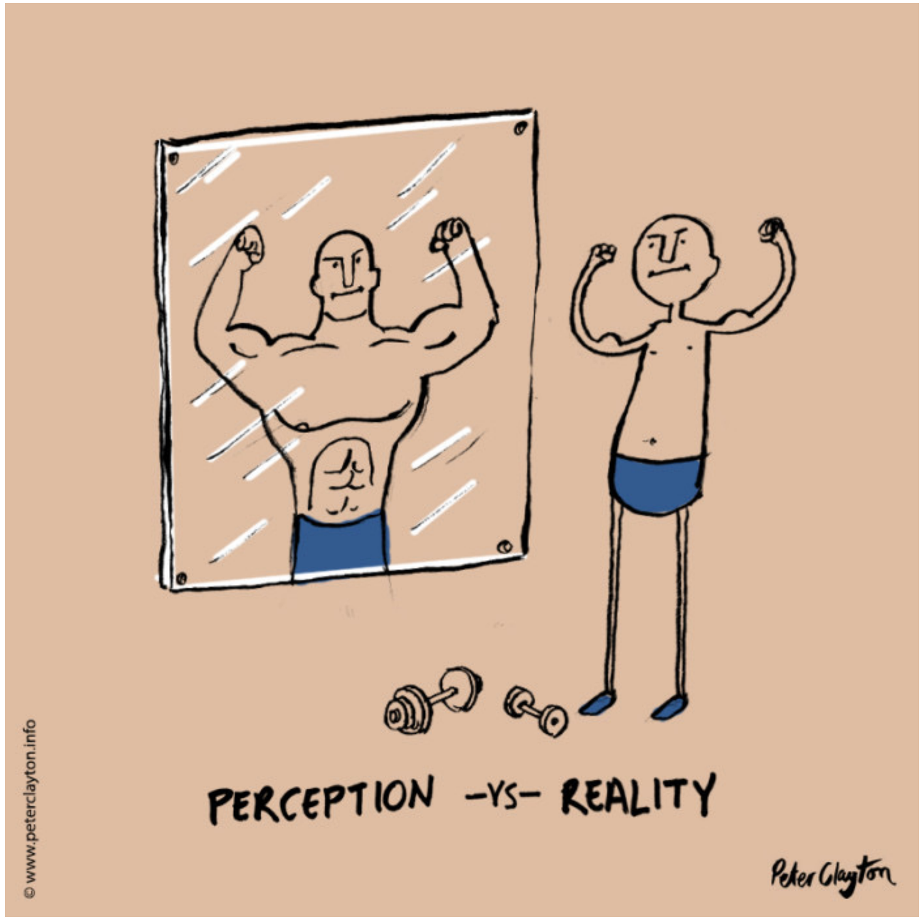
- Accuracy -- ϵ
- Delay -- τ
- Range
  - Weather – Time of the day – Visibility

$$\hat{\boldsymbol{\Omega}}(t) = f\left(\boldsymbol{\Omega}, P_n\right)$$
$$f\left(\boldsymbol{\Omega}, P\right) = \boldsymbol{\Omega}(t - \tau_n^p) \pm \epsilon_p^{\boldsymbol{\Omega}}$$

- $\boldsymbol{\Omega}$: state variables
- $\widehat{\boldsymbol{\Omega}}$: estimated state variables
- P : perception mode
- τ^p : perception delay
- ϵ : error

Future work

- Implement perception model in open-source traffic simulator.
- Obtain numerical results.



Thanks for your attention!

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