Automated Vehicles: a Review of Road Safety Implications as a Driver of Change

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Motivation

Google reports more than 500,000 miles of testing of AVs on public highways, while several auto manufacturers have announced the release of AVs within the next five years.

- Some believe that AVs can potentially transform our lives and our transportation systems in the near future (Mui C. and Carrol P.B., 2013)

- Others provide a cautiously optimistic picture and present a long way ahead (several decades) before the many benefits of AVs can be fully realized (Litman T., Victoria Transport Policy Institute , 2013)

Background

Growing interest in using motivational techniques to change behavior

Need to explore the impact of potential behavioral changes relating to:

- change in longitudinal movement of vehicles;
- the ability to modify following behavior based on the capability of the lead vehicle;
- different levels of gap acceptance and lane changing behavior; and
- connectivity to represent better provision of inform decision making.

Background

Studies have proved that automated driving systems have the potential to decrease traffic congestion by reducing the time headway (THW), enhancing the traffic capacity and improving the safety margins in car following.

Additionally, driving AVs can reduce situation awareness and intensify driver drowsiness, especially in light traffic.

To investigate the influences of AV on traffic performance, a simulation case study consisting of a 100% AV scenario and a 100% CV scenario was performed using microscopic traffic simulation.

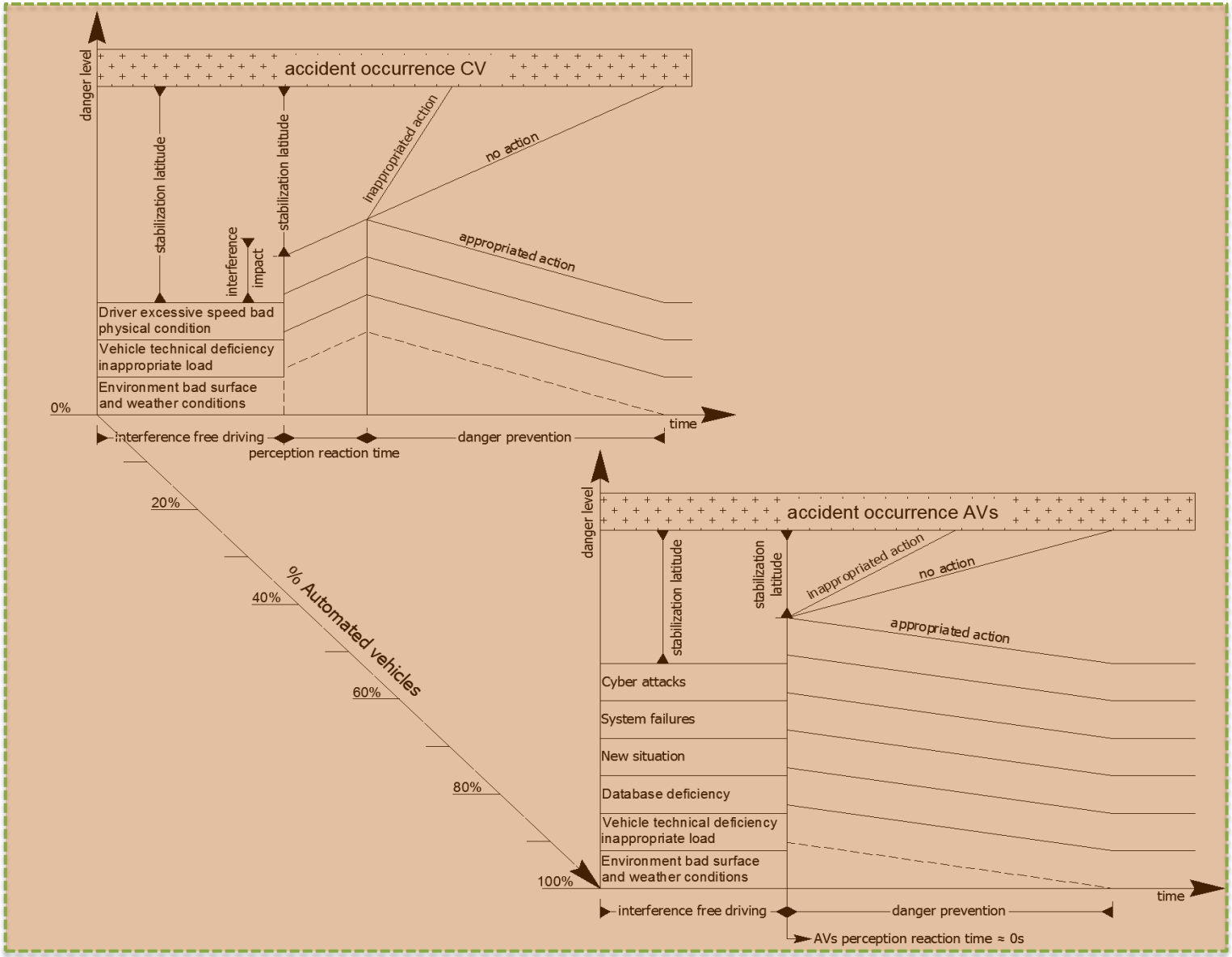
AVs technical details and effects on operational parameters

AVs use several information acquisition systems for both vehicle-road and vehicle-vehicle communication.
These systems are essential for the proper operation of AVs in order to ensure safety with the different active safety mechanisms (LIDAR, VELD, DLD, IPM, ISA, ACC, etc.)

Starting from these new kinds of safety issues, it has been tried to describe the variation of the danger level depending on the percentage of AVs within the road traffic flow.

Shift of driving danger level

Accident occurrence paradigma (CV / AV)



Effort needed for a new road design

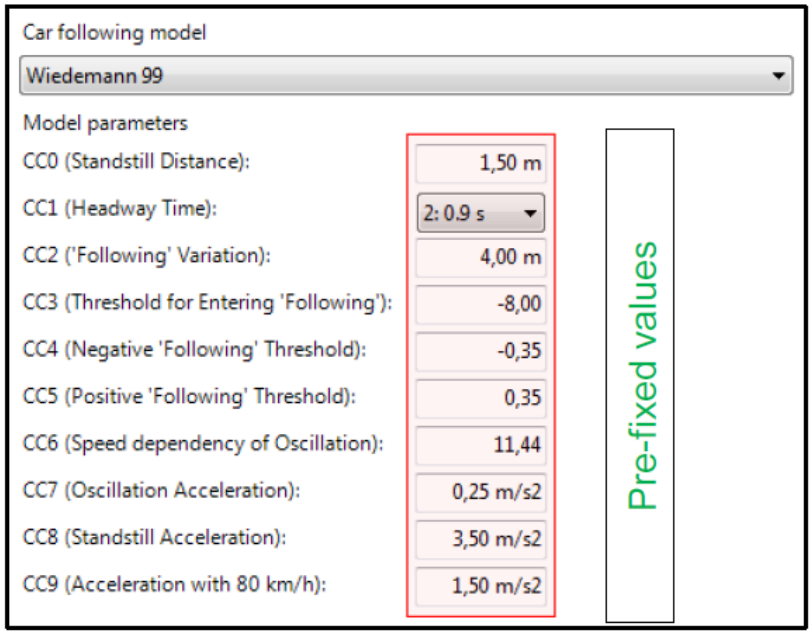
As is well known, a specific Transportation Research Board commission verified, modified and developed 35 AMFs in order to help practitioners and researchers to both improve and develop them.

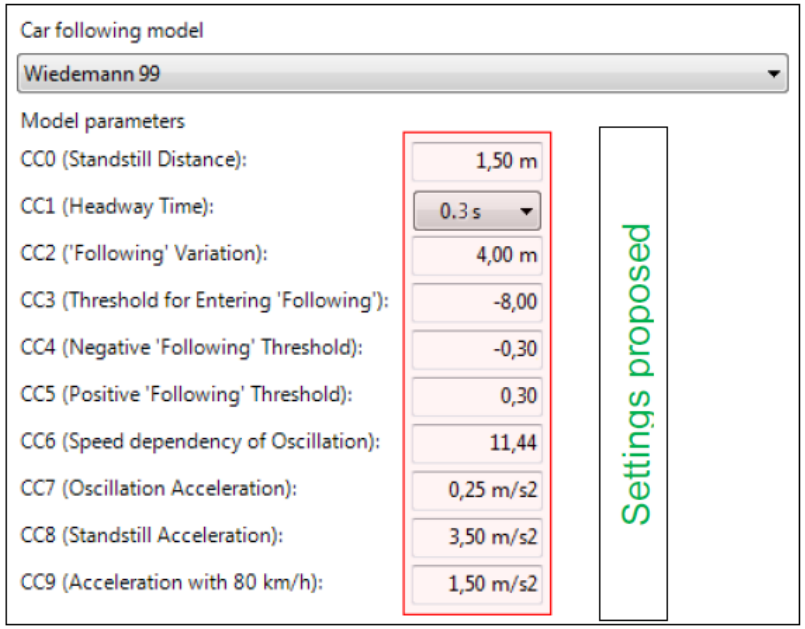
All of these findings were obtained considering that the traffic flow is 100% composed of CVs.

Traffic micro simulation is then a good way to investigate how safety and operational traffic characteristics will change when AVs circulate in the street and how to think about the outlook for new AMFs in the next future.

New border in traffic microsimulation

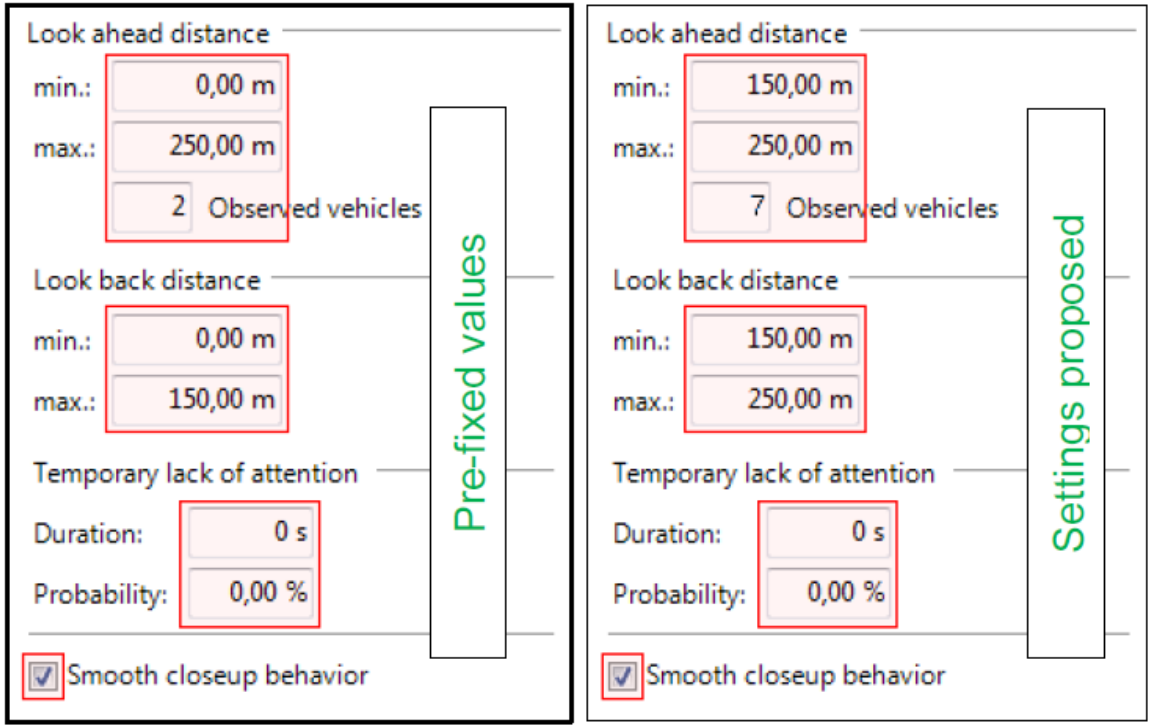
Wiedemann 99 editable parameters in VISSIM CAR – Following model





New border in traffic microsimulation

Wiedemann 99 editable parameters in VISSIM
Parameters related to the queuing behavior



New border in traffic microsimulation

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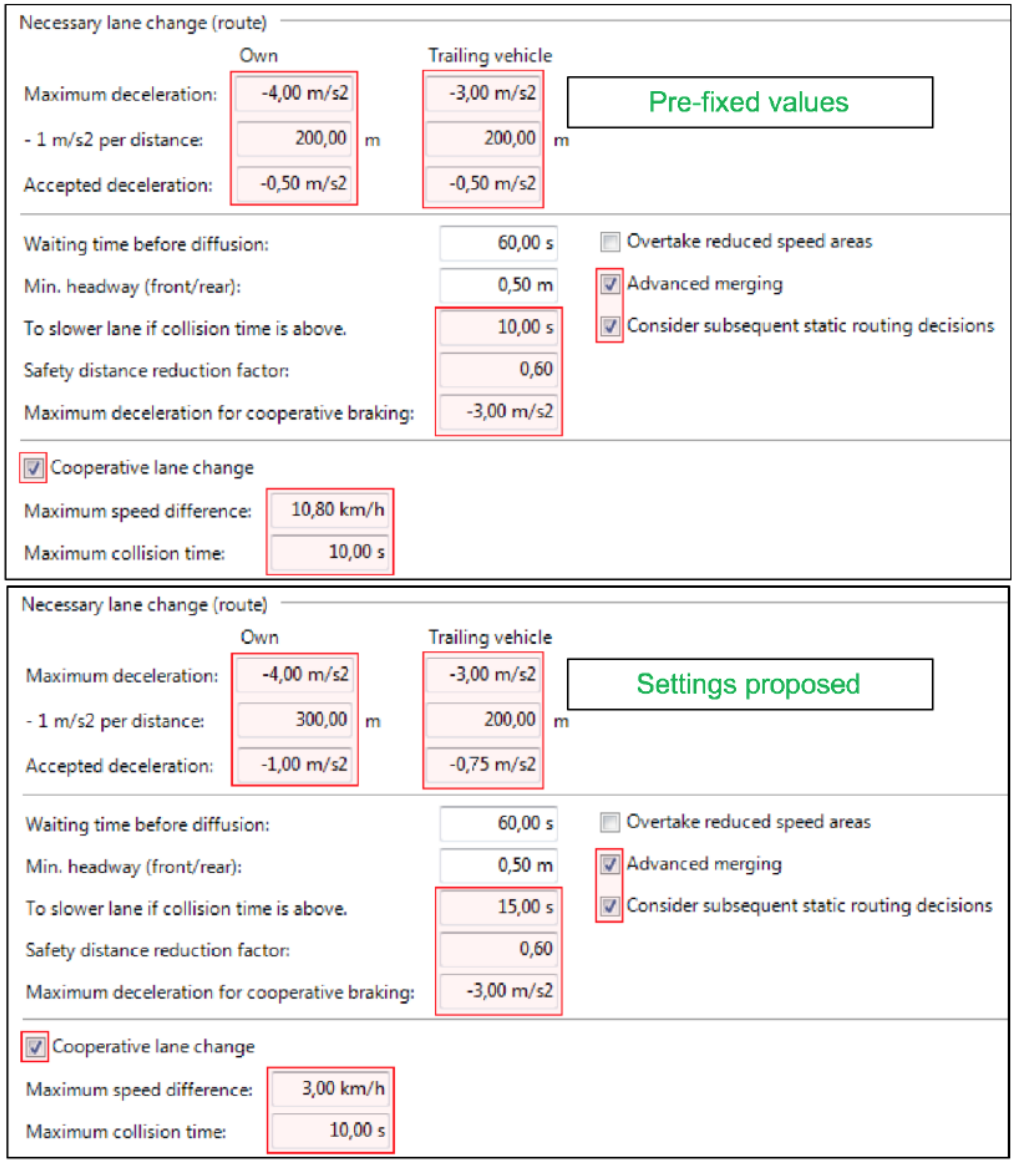
Parameters related to the lane changing behavior



Overlook

AVs will have great impact on our lives.
They will make driving safer, more convenient, less energy intensive and cheaper.

A study of the danger level modification during the transition from traditional car traffic to total AV traffic was carried out.
Several new crash risk factors were highlighted.

Micro simulation is a good way to investigate how safety and operational traffic characteristics will be changed when AVs circulate in the street and how to think about the outlook for new AMFs.

Acknowledgments

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