

Modelling and Simulation of ADAS systems and Scenarios in Traffic: Analysis of the Effect of EEBL

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Aims and Objectives

Aim: Calibration of driver models for simulation of ADAS features

Objectives:

- Model a test track
- Identify driver model parameters suitable for modelling ADAS response
- Develop algorithm for EEBL source and EEBL receiver

ADAS Overview

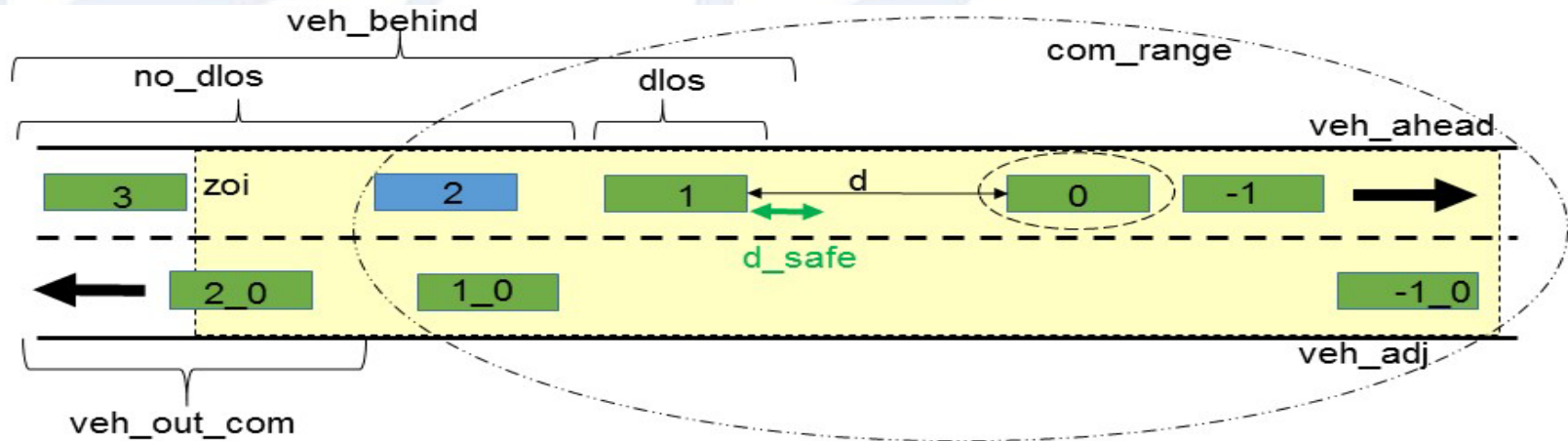
ADAS features can be divided into 2 broad groups

- Safety based:
 - Electronic emergency brake light (EEBL)
- Eco based:
 - Traffic condition warning

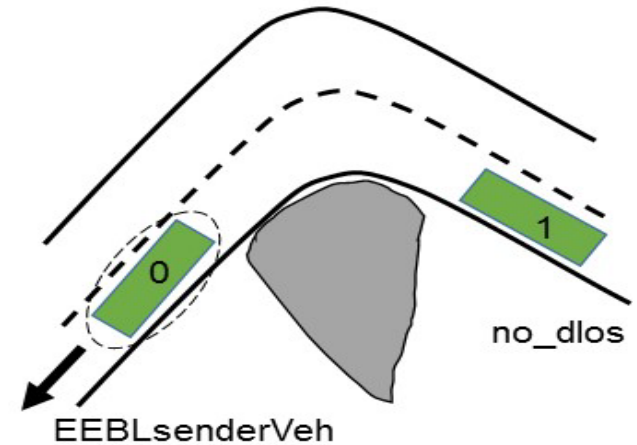
Motivation for EEBL

- Vehicle performing hard braking sends to other vehicles emergency electronic brake light signal
- The EEBL as a safety ADAS application requires V2V communication
- The features associated with the EEBL form a good starting point for developing algorithms and studying driver behaviour

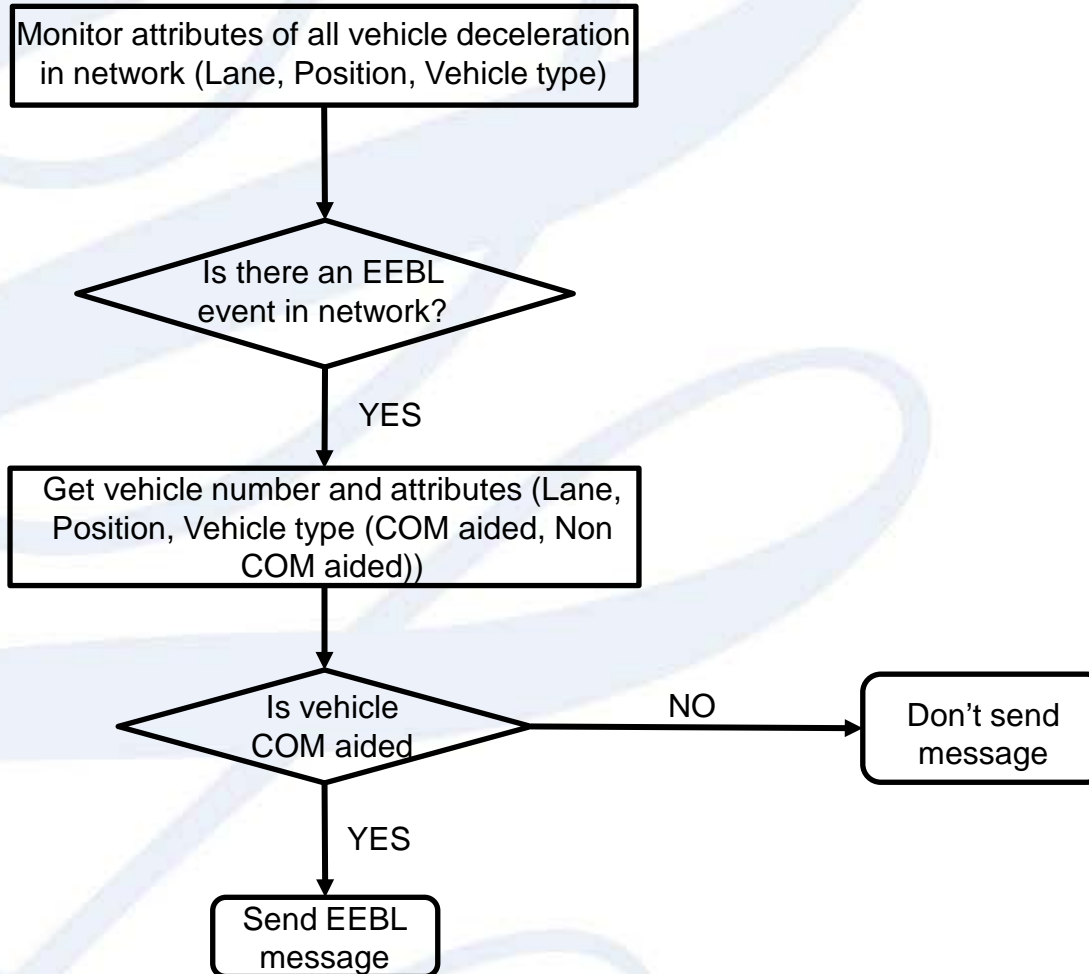
EEBL Variables



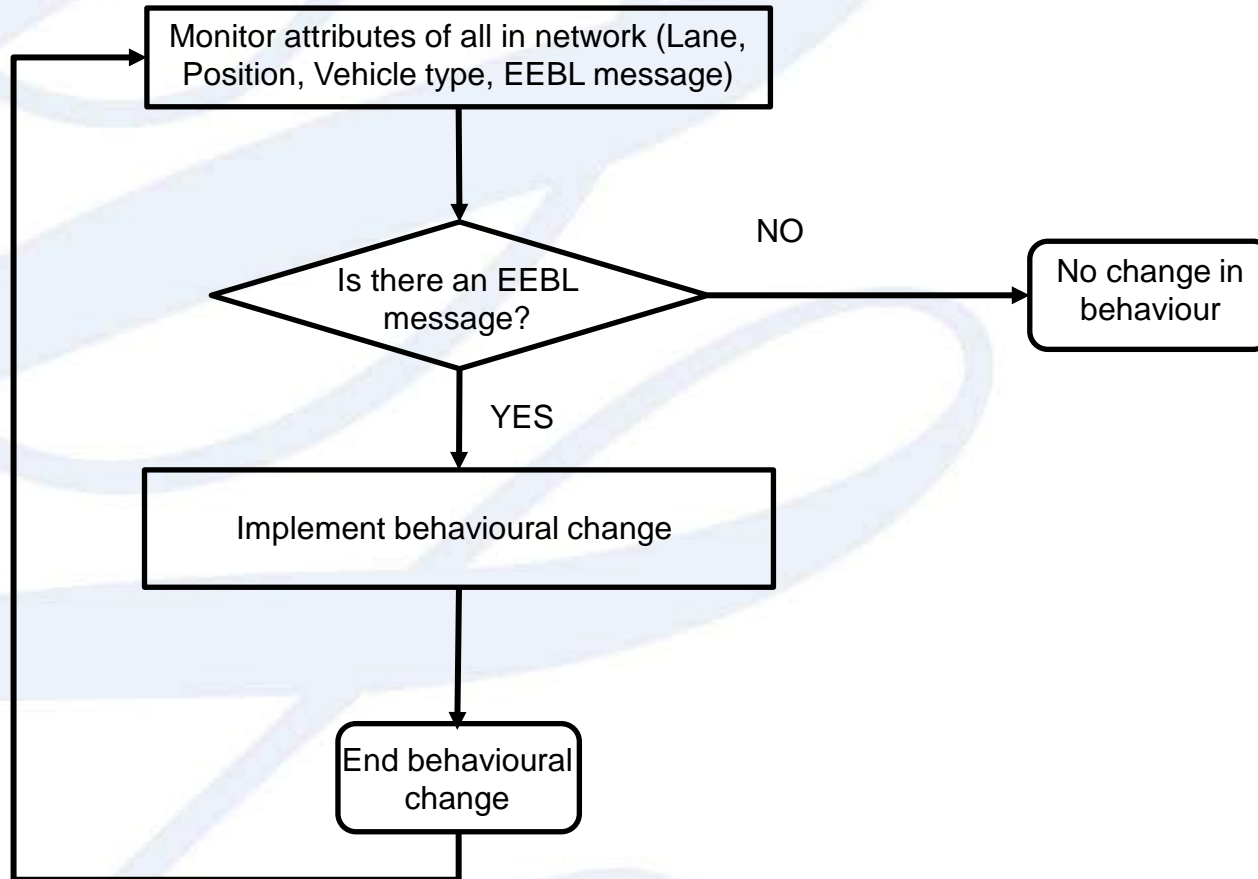
- veh_com: Vehicle with com
- veh_no_com: Vehicle with no com
- EEBLsenderVeh: Source of EEBL message
- com_range: Com range of EEBLsenderVeh
- zoi: Zone of interest
- d: Distance between vehicles
- dlos: Direct line of sight
- no_dlos: No direct line of sight
- d_safe: Safe distance
- veh_ahead: Vehicle ahead of EEBLsenderVeh
- veh_behind: Vehicle behind EEBLsenderVeh
- veh_adj: Vehicle in opposite lane to EEBLsenderVeh
- veh_out_com: Com outside com_range
- Direction of travel:



EEBL implementation (Sender)



EEBL implementation (Receiver)



Driver model selection

Vissim: **Wiedemann74 model**

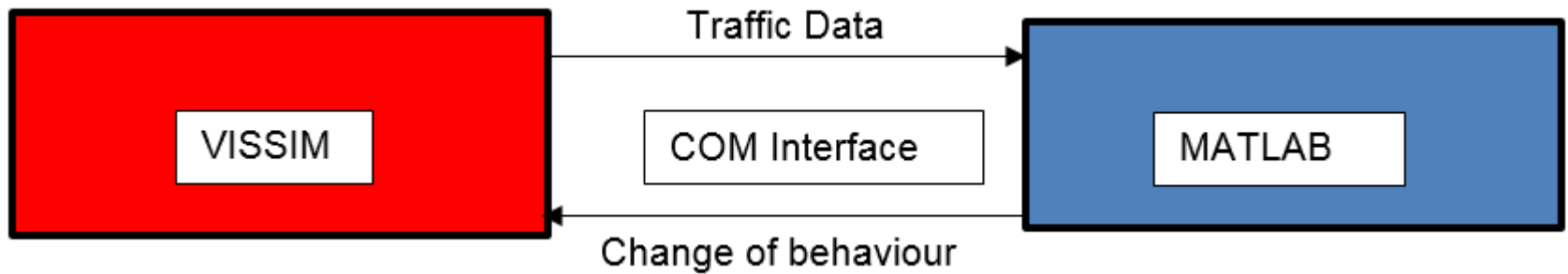
- **Parameters:**
- **Average standstill distance (ax)**
- **Additive part of safety distance**
- **Multiplicative part of safety distance**

$$d = ax + bx$$

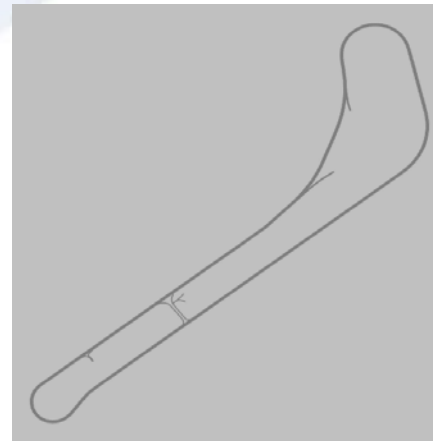
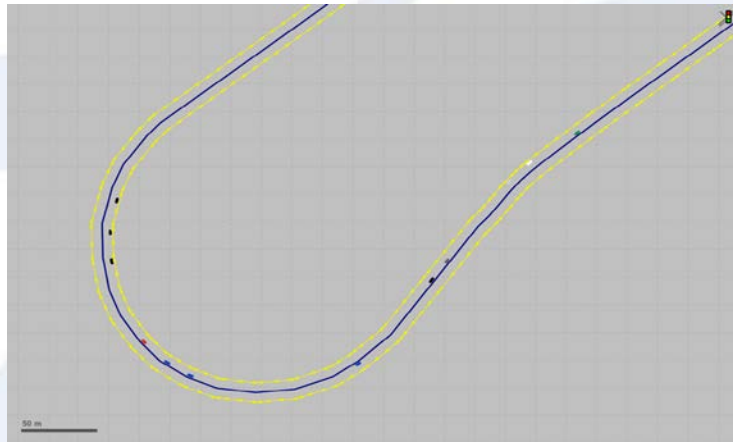
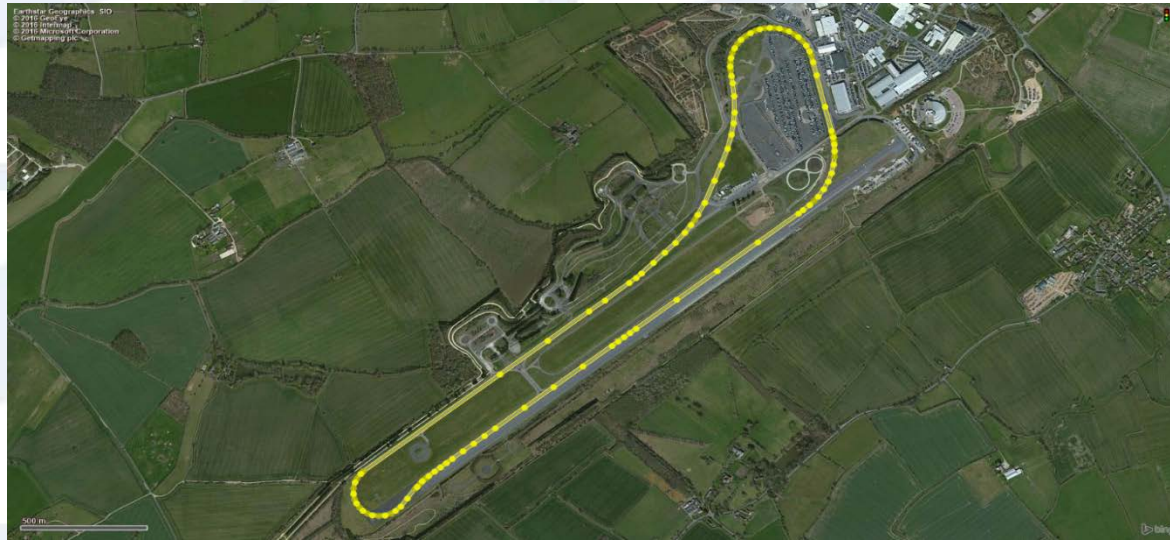
$$bx = (bx_{add} + bx_{mult} * z) * \sqrt{v}$$

The screenshot shows the 'Driving Behavior' configuration window for a vehicle model. The window title is 'Driving Behavior' and it has a standard Windows interface with a question mark and close button in the top right. The 'No.' field is set to '1' and the 'Name' field is 'Urban (motorized)'. The 'Following' tab is selected, showing various parameters for car following behavior. The 'Car following model' dropdown is set to 'Wiedemann 74'. The 'Model parameters' section includes: 'Average standstill distance' set to 2,00 m, 'Additive part of safety distance' set to 2,00, and 'Multiplic. part of safety distance' set to 3,00. Other parameters include 'Look ahead distance' (min: 0,00 m, max: 250,00 m), 'Look back distance' (min: 0,00 m, max: 150,00 m), 'Temporary lack of attention' (Duration: 0 s, Probability: 0,00 %), and checkboxes for 'Smooth closeup behavior' and 'Standstill distance for static obstacles' (set to 0,50 m). The 'Observed vehicles' field is set to 4. The 'OK' and 'Cancel' buttons are at the bottom right.

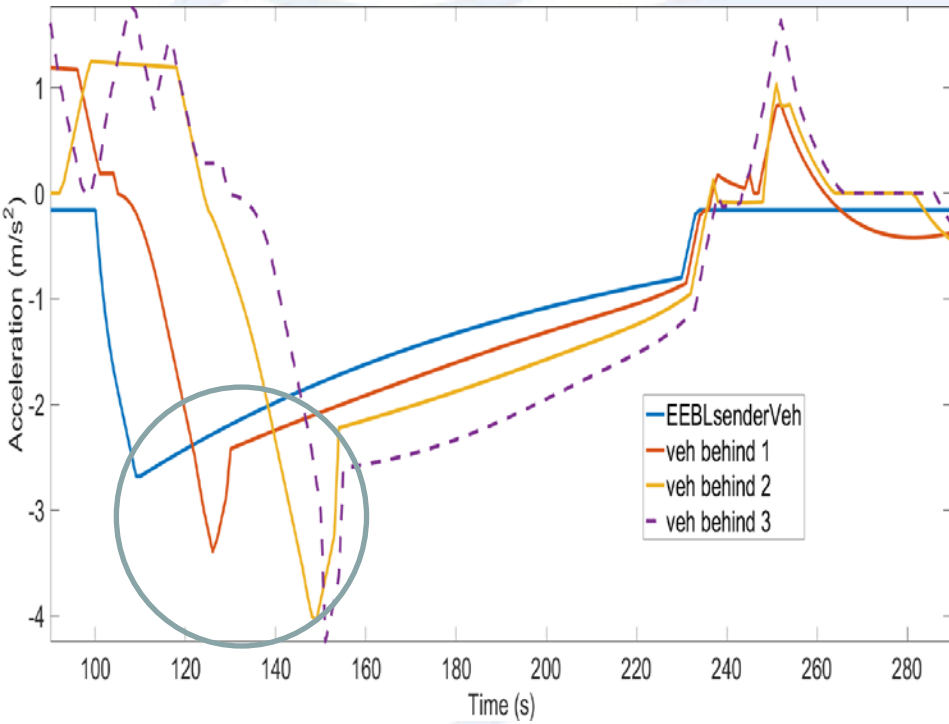
Modelling and Simulation



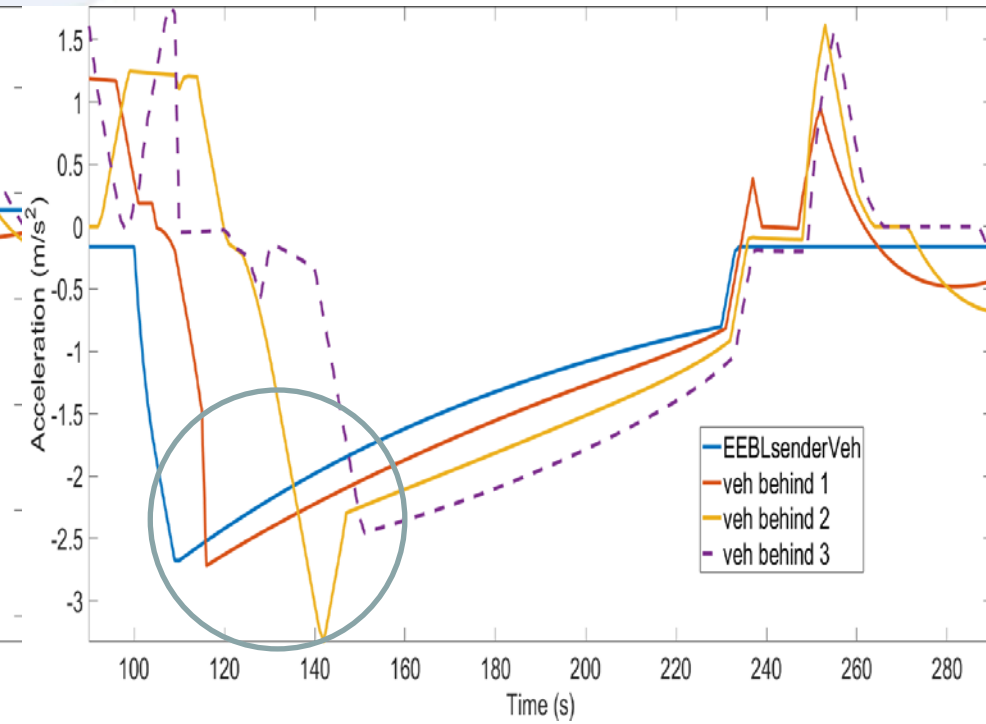
Modelling and Simulation



Simulation results

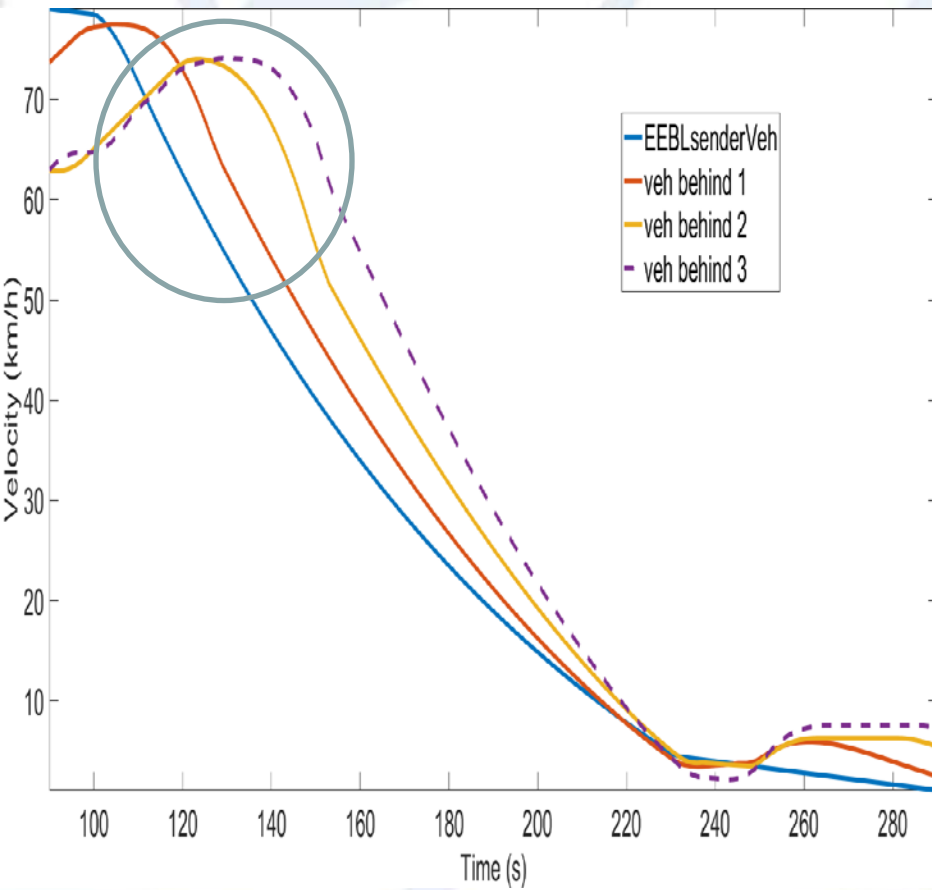


No EEBL

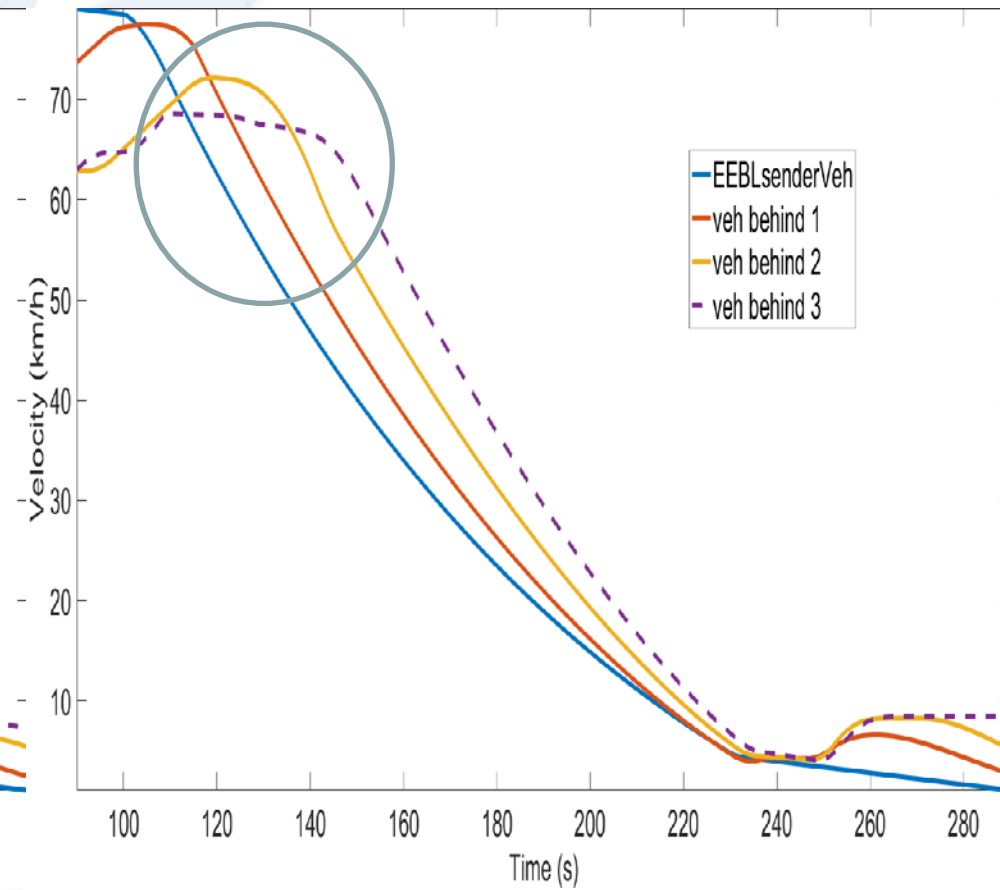


EEBL

Simulation results

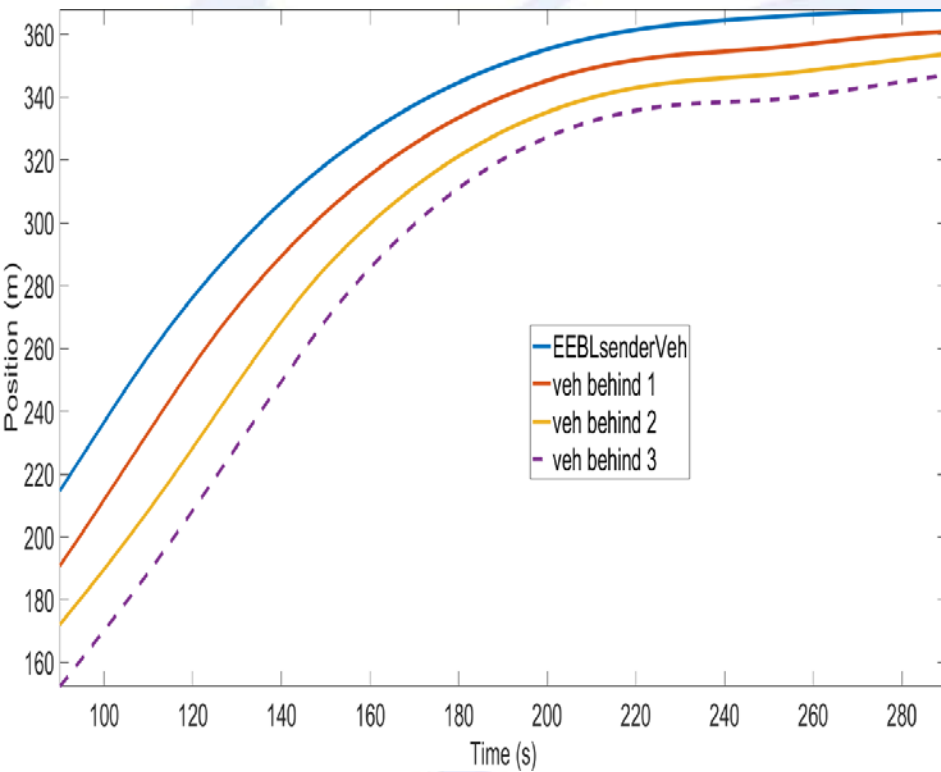


No EEBL

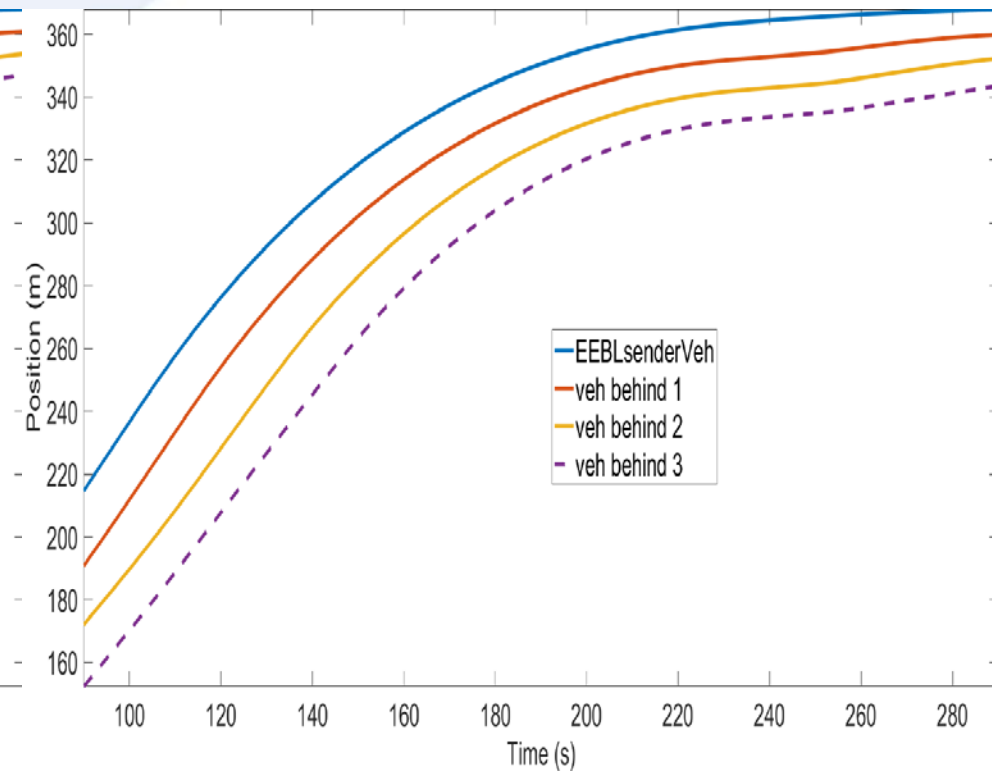


EEBL

Simulation results



No EEBL



EEBL

Conclusions

- Need to modify driving parameters to match driving behaviour
- Fewer harsh braking events have been reported as one of the measures of effectiveness of the EEBL
- The parameters for the Wiedemann74 model are effective for simulating the ADAS effect on driver behaviour
- To do: Tune microscopic car following model to match experimental data collected on Gaydon track