

VMAD SG2:Simulation

REQUIREMENTS FOR VIRTUAL VALIDATION

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ESSENTIAL PARTS FOR ADS SIMULATION





Scenarios

Out of scope in this presentation





Out of scope in this presentation















Models

- → Sensors
- → Vehicle dynamics
- → ADS function
- \rightarrow ...

Simulation tools

- → Datamanagement
- → Testmanagement
- → Scenario generation
- → Simulation execution
- \rightarrow ...

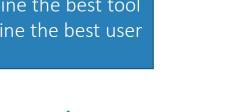
Simulation results

ESSENTIAL PARTS FOR ADS SIMULATION



A bad model could

- Undermine the best tool
- Undermine the best user





A bad user could

- Feed wrong models
- Configure simulation tool the wrong way
- Bad users, models and tools can produce correct results
- Best user, models and tools can produce incorrect results











A bad tool could

- Undermine the best models
- Undermine the best users

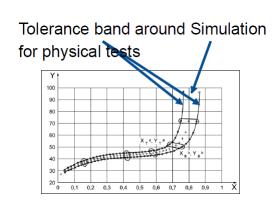
All parts shall be validated

MODEL VALIDATION





Vehicle dynamics model



Deterministic model validation

ISO 19364:2016

Passenger cars — Vehicle dynamic simulation and validation — Steady-state circular driving behaviour

ISO 19365:2016

Passenger cars — Validation of vehicle dynamic simulation — Sine with dwell stability control testing

ISO/DIS 22140

Passenger cars — Validation of vehicle dynamics simulation

— Lateral transient response test methods

Applicable standards



All models must be validated according state of the art or state of research

Models have dedicated scenarios & metrics for validation defined by standards

More details in presentation VMAD-SG2-11-02 from AVL:

https://wiki.unece.org/download/attachments/117510393/VMAD-SG2-11-02%20AVL%20Presentation%20rev..pdf?api=v2

TOOL QUALIFICATION & VALIDATION



Reproducability: Is the calculation reproducable?

Feasability: Can I implement my scenarios, e.g. are traffic lights supported?

</>
Simulation tools

Is my simulation environment scalable?

Traceability: After 10 years: Which scenario variants have been used?

The user can rely on the correct functioning of the tool.

The user can rely on the compliance of the tool with its safety report.

Tool qualification



CERTIFICATION ACCORDING TO ISO 26262-8:2018

Road vehicles — Functional safety — Part 8: Supporting processes

The user can rely on the quality of the functionalities of the tool.

The user can rely on the suitability of the tool for virtual validation of ADS.

Fit for purpose check

QUALITY CHECK BY

- Ideally: technical service
- Alternatively: user's independent department, responsible for quality of external tools
- Alternatively: independent third party

VALIDATION OF SIMULATION RESULTS







Technical services shall perform spot checks for correlation between simulation results and test track results



Validation scenarios & evaluation metrics for simulation results should be the same [in principle] as for ADS validation, because virtual validation of ADS should produce same results for the evaluation metric in the same scenarios as on test track.



Test track results must not be resimulated to avoid manipulation of simulation results

Validation scenarios must not match training scenarios for the simulation

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IT'S ABOUT TRUST IN VIRTUAL VALIDATION (1/2)





Applied processes for model validation according state of the art or state of research

Calculation of model accuracy





Simulation tool documentation

Documentation of the used tool (version, configuration etc.) for traceability

Documentation of tool qualification

Documentation of fit for purpose check

IT'S ABOUT TRUST IN VIRTUAL VALIDATION (2/2)





Simulation results documentation

Submission of all simulation results for traceability and reproducability purposes

Submission of training and validation scenarios to ensure validation by technical service won't happen with training scenarios

Proof that the ADS passed all simulations under consideration of all uncertainties for simulation results, under consideration of model accuracy



User documentation

Documentation of experience & educational background

Documentation of trainings, certificates

Documentation of regular practice in simulation area



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