RUMBA

Achieving a positive user experience through user-friendly design of the vehicle interior for automated driving functions

Supported by:

Federal Ministry for Economic Affairs and Climate Action

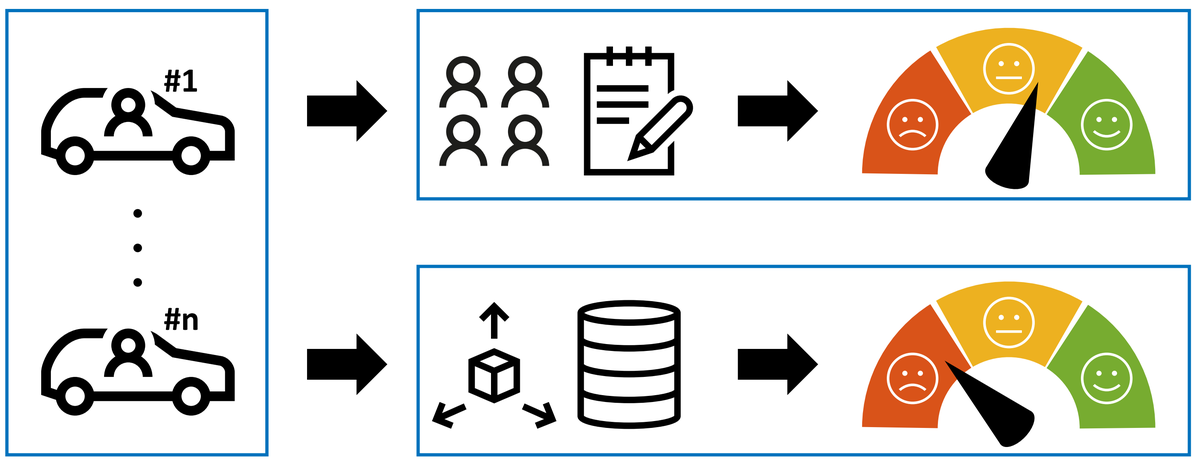
on the basis of a decision by the German Bundestag

Driving behaviour and performance objectification

1 | Motivation & goals

Assessment of driving behaviour & performance for different drivers and driving systems

Subjective rates based on **evaluators**
→ potentially biased and/or inconsistent, harder to replicate (e.g. evaluators mood, evolution of evaluators rating process)

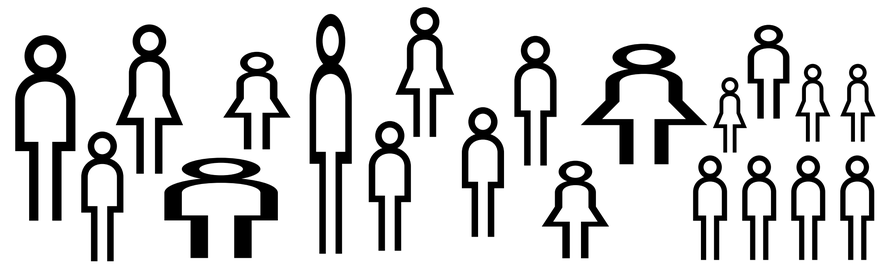


Objective rates (metrics) based on **measurements**
→ well defined, consistent, easier to replicate (e.g. vehicle speed, steering angle, GPS data)

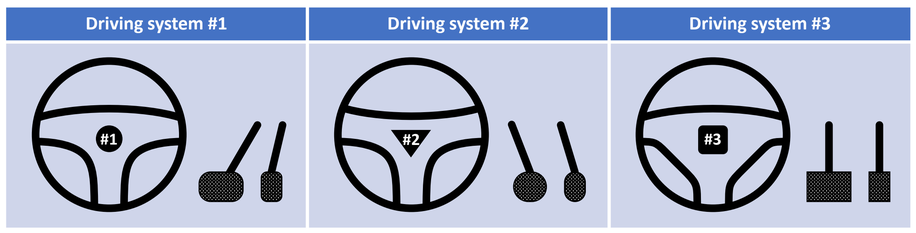
Goal: consistent & replicable assessment of driver behaviour & performance via objetive metrics

2 | Experimental setup & metrics

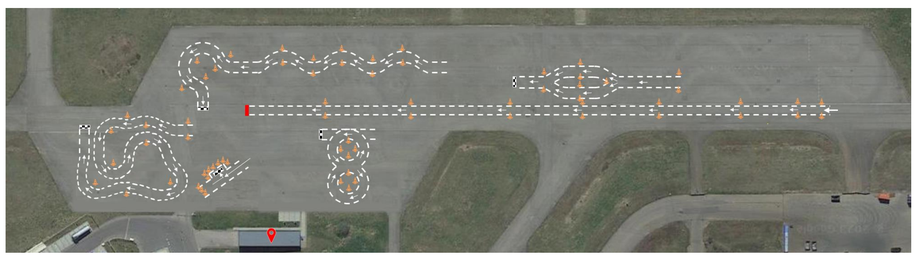
Experimental setup



36 **drivers** with different background



Three **driving systems** with different lateral and longitudinal control



Driving of 6 **maneuvers** with focus on specific vehicle dynamical characteristics

List of computed metrics (grouped by vehicle dynamics)

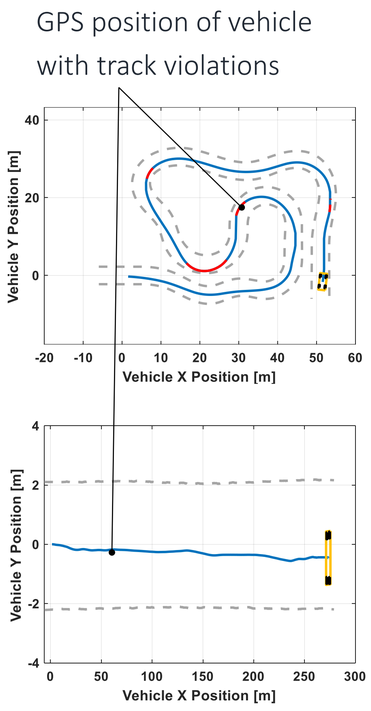
General/total dynamics	Lateral dynamics	**Longitudinal** dynamics
1 Mean percentage deviation lane center	2 Max. abs. grad. lat. acc.	2 Max. abs. grad. long. acc.
1 Total no. track violations	2 Max. abs. device angular speed	2 Std. dev. veh. speed error
1 Max. dist. track violations	2 Max. abs. peak-2-peak device angle	2 Integral veh. speed error
1 Wrong lane (evasive)	2 Integral device angle	2 Settling time vehicle speed error
1 Mean dist. track violations	2 Max. abs. target rack position	2 Braking time veh. stops
1 Total dist. track violations	2 Max. abs. torsionbar torque	2 Max. abs. grad. throttle activity
2 Maneuver duration	3 Lateral driving	2 Integral throttle activity
2 No. of stops during maneuver		2 Max. abs. grad. brake activity
3 Steering behavior		2 Integral brake activity
3 Throttle/brake behavior		2 Throttle activity right device
3 General/overall driving		2 Brake activity right device
		3 Longitudinal driving

1 **Path-based** (GPS) metrics
2 **Non path-based** (non GPS) metrics
3 **Subjective ratings** from vehicle supervisor

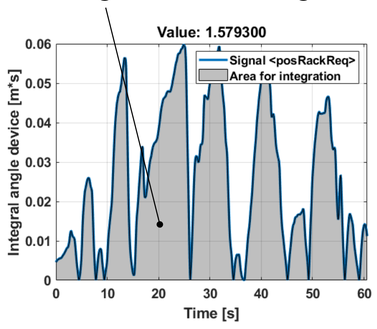
3 | Computed metrics & first statistics

Examples for **computed metrics**

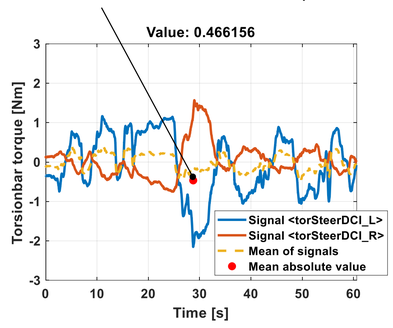
GPS position of vehicle with track violations

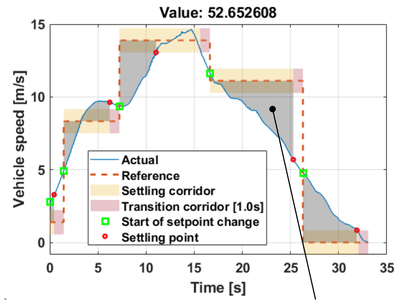


Integral of device angle

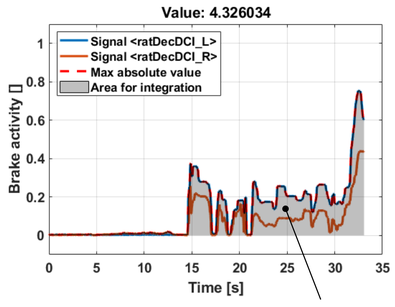


Max. abs. torsionbar torque





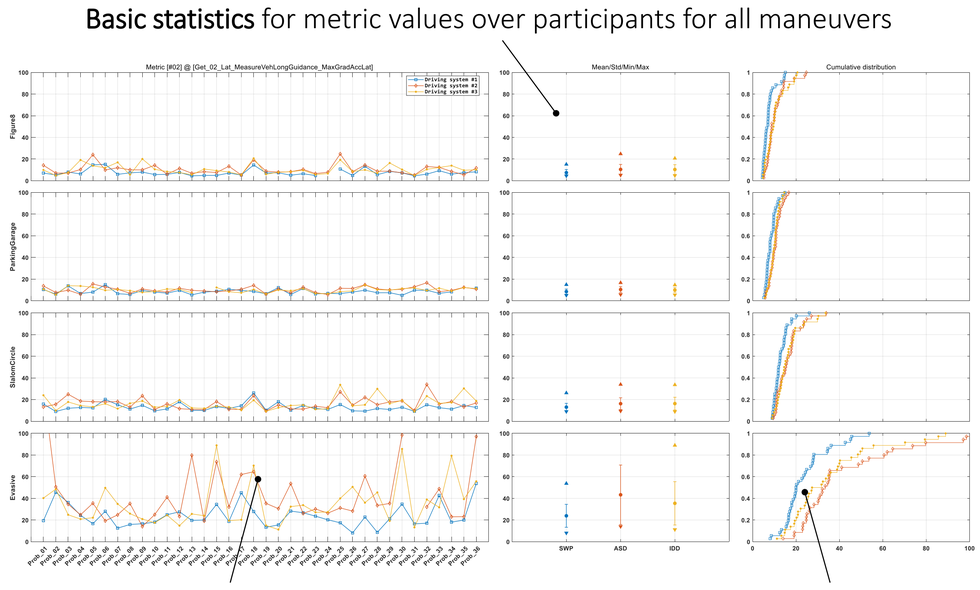
Integral of vehicle speed error



Integral of brake activity

Examples for first **statistical analysis** of computed metrics

Basic statistics for metric values over participants for all maneuvers



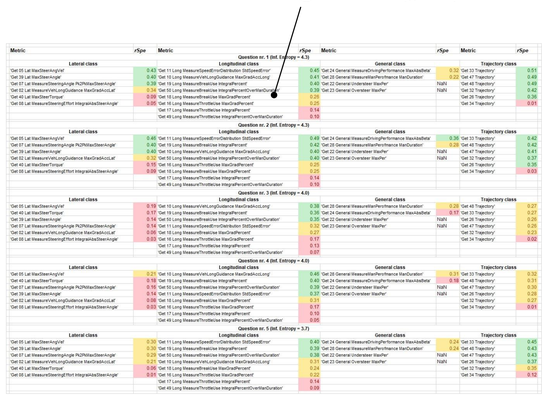
Metric value over participants for all maneuvers (here: very large values for “extreme“ maneuver Evasive)

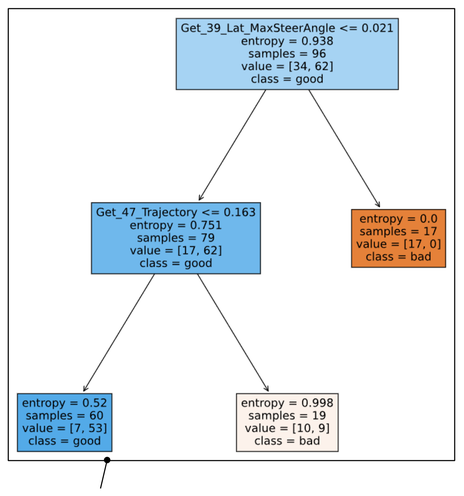
Cumulative distributions show simlar behaviour between two driving systems and difference for one system (“extreme“ maneuver Evasive observable)

4 | Outlook metric selection & modelling

Goal: Modelling of driving performance based on objective ratings

Metric selection for modelling based on **correlation cofficient** magnitude („importance“)





Decision tree based on selected metrics to classifiy “good“/“bad“ driving performance for specific maneuver