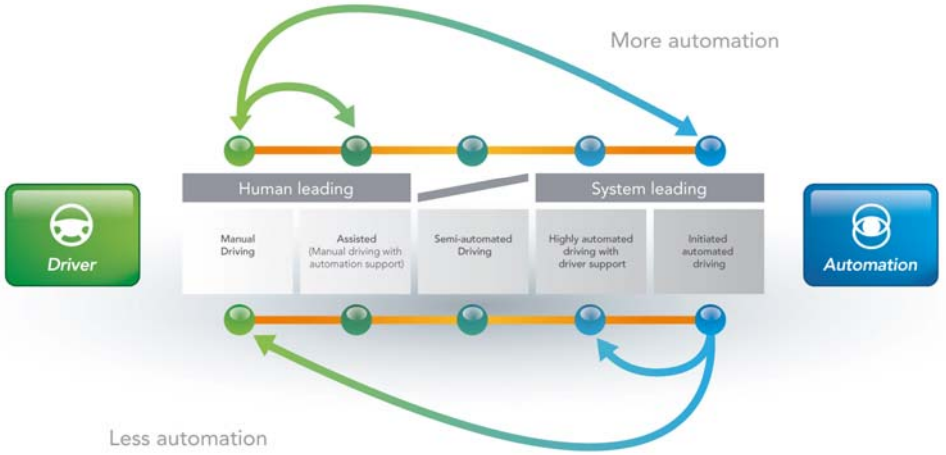
The importance of driver state assessment within highly automated vehicles

Nadja Rauch, Armin Kaussner, Hans-Peter Krüger, Serge Boverie, Frank Flemisch

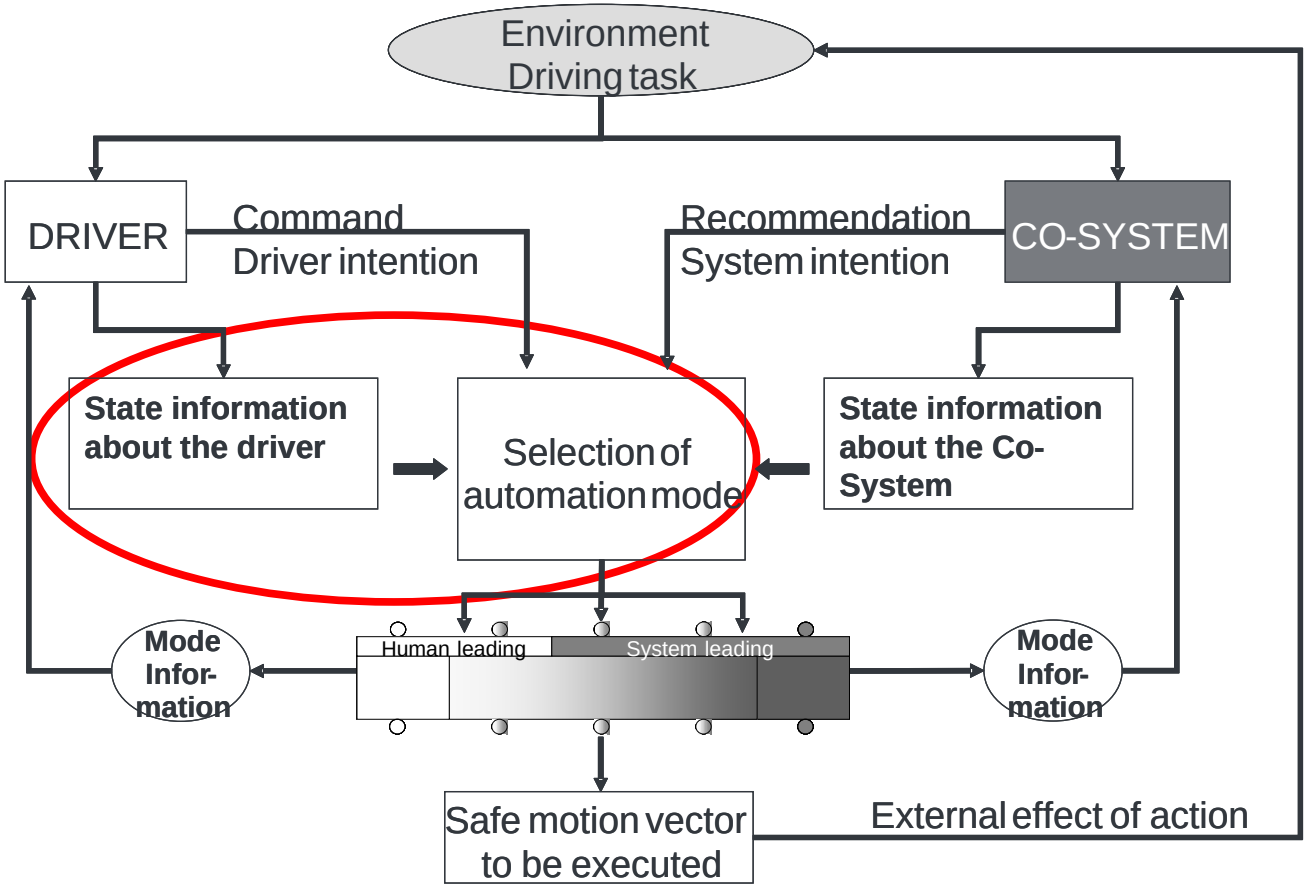
Wuerzburg Institute for Traffic Sciences (WIVW GmbH), Germany
Continental Automotive France SAS (CAF), France
German Aerospace Center (DLR), Germany

The Project HAVEit

- Project within the 7th framework programme of the EC
- „HAVEit aims at the realization of the long-term vision of highly automated driving for intelligent transport.“
- Includes a dynamic task repartition between the driver and a co-driving system

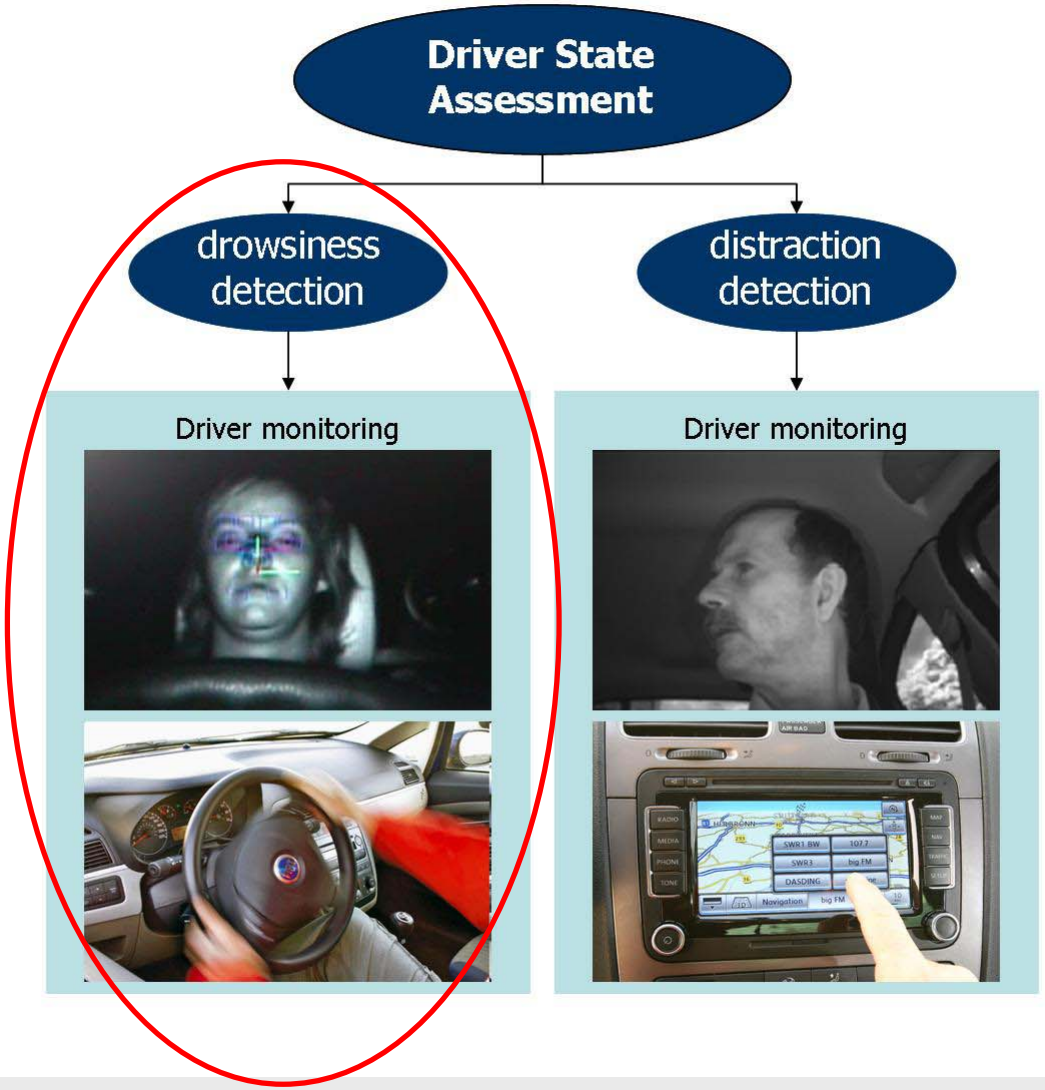


Joint System concept in HAVEit



Is the driver in the loop when required? Is he able to react to critical situations?

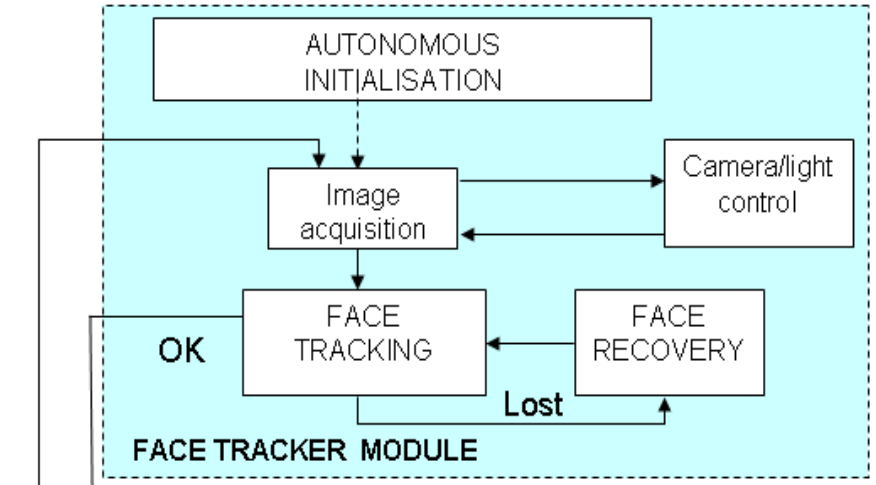
General concept for Driver State Assessment (DSA)



Direct Driver Monitoring System (DMS) by CAF

CAF Camera integrated into VW Golf V

DMS algorithm principle



Facial Features Position

FACIAL MEASUREMENTS

Eye Opening Calculation

Blink Detection

ON/OFF road measurement

Head Pose

Blink Duration

On/Off road

Head Pose

DIAGNOSTICS

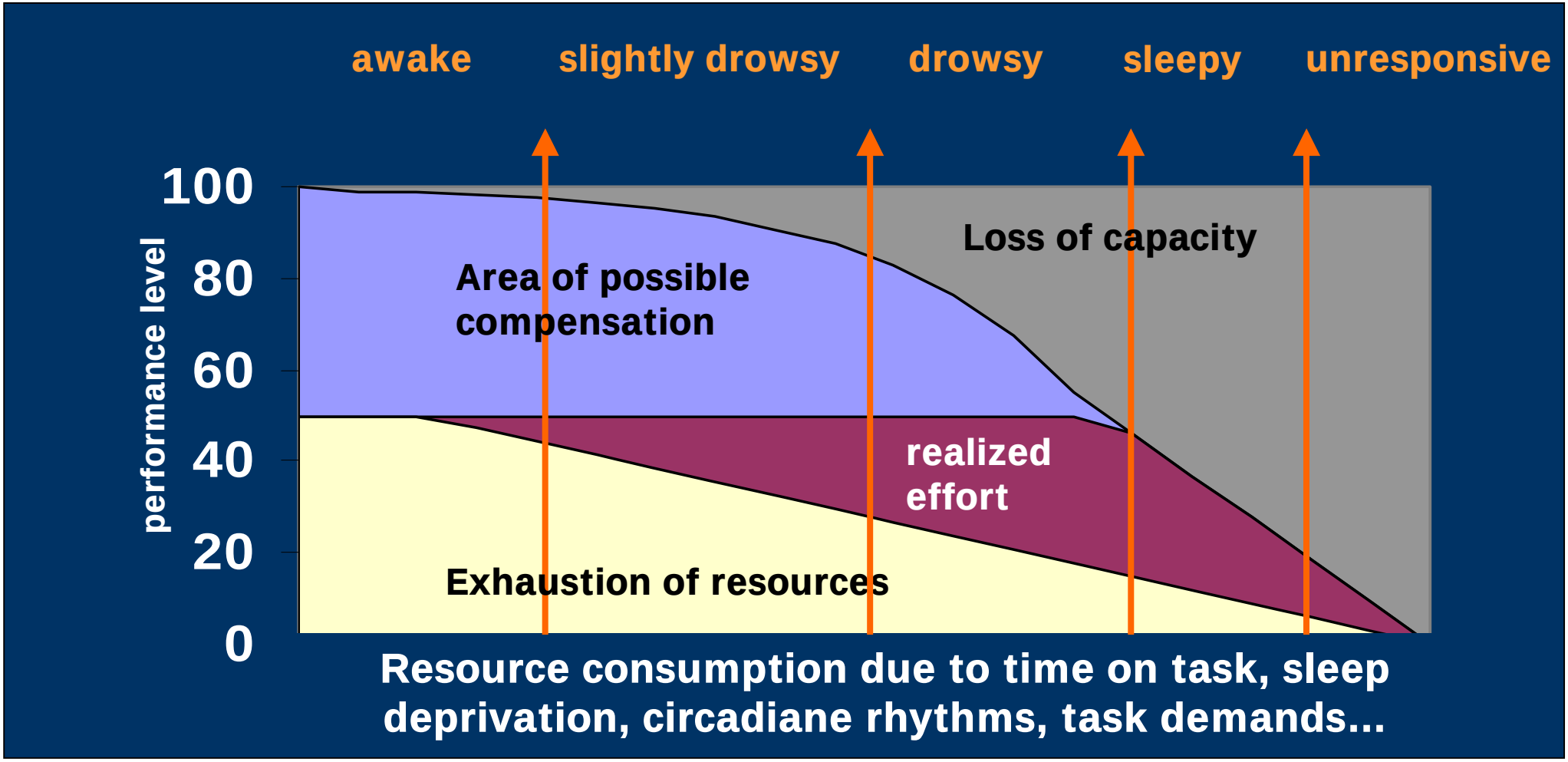
Drowsiness Diagnostic

Inattentiveness Diagnostic

DDM:
- Sleepy
- Drowsy
- Slighty Drowsy
- Alert

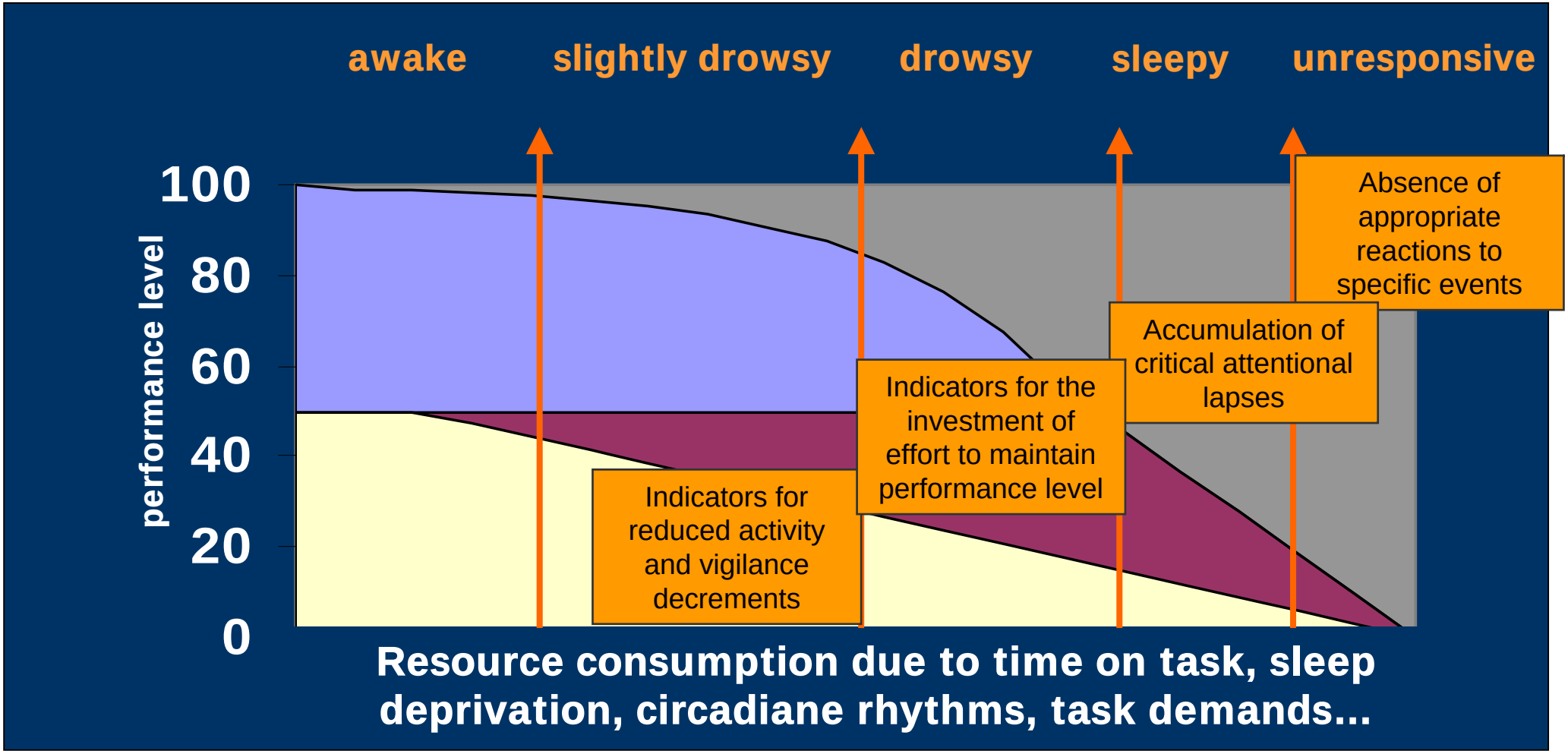
DIM:
- Inattentive
- Attentive

Indirect driver monitoring: observe effects of drowsiness on driver‘s performance



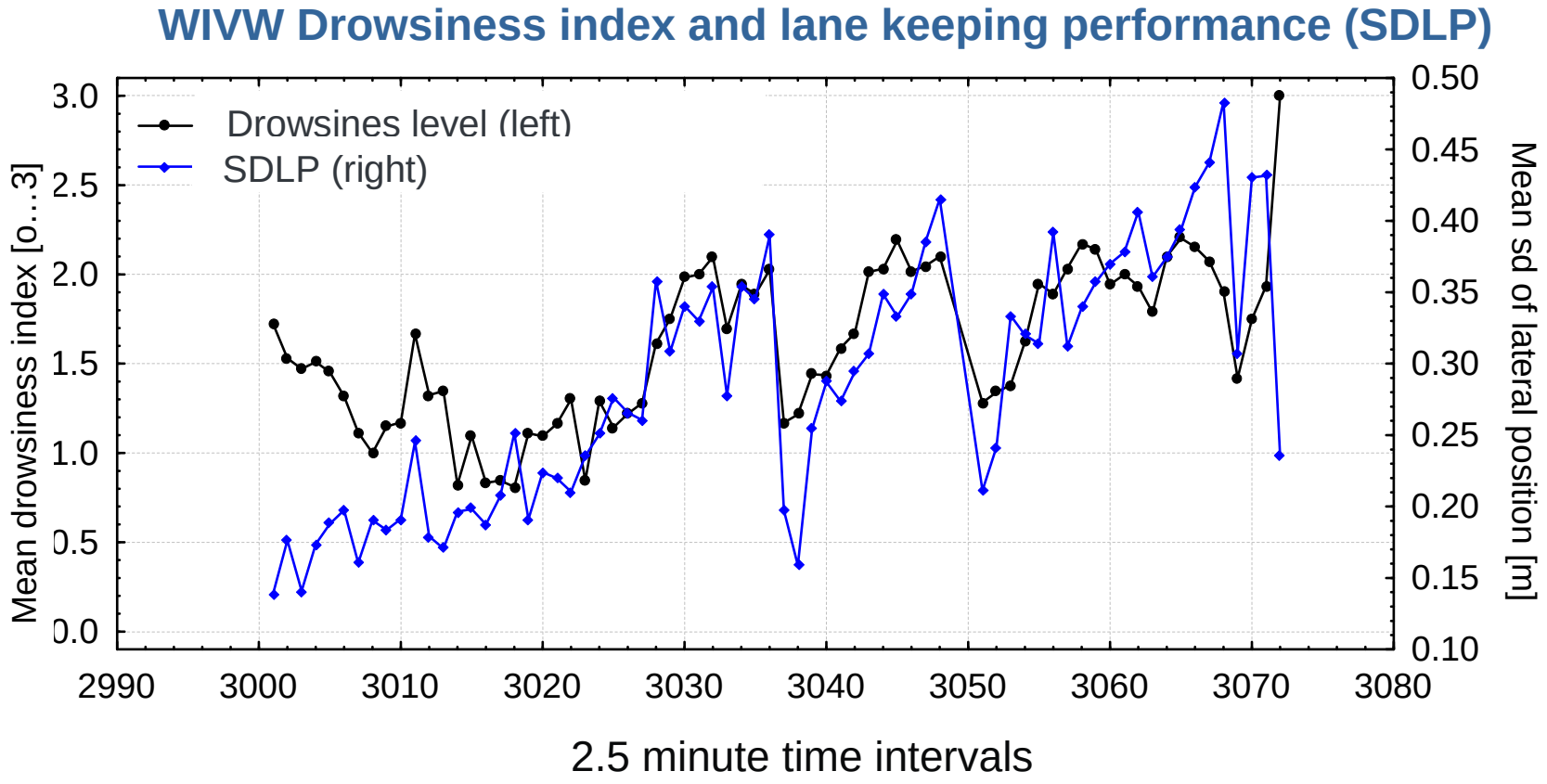
(after Krüger & Hargutt, 2000)

Differentiated parameter set on each level

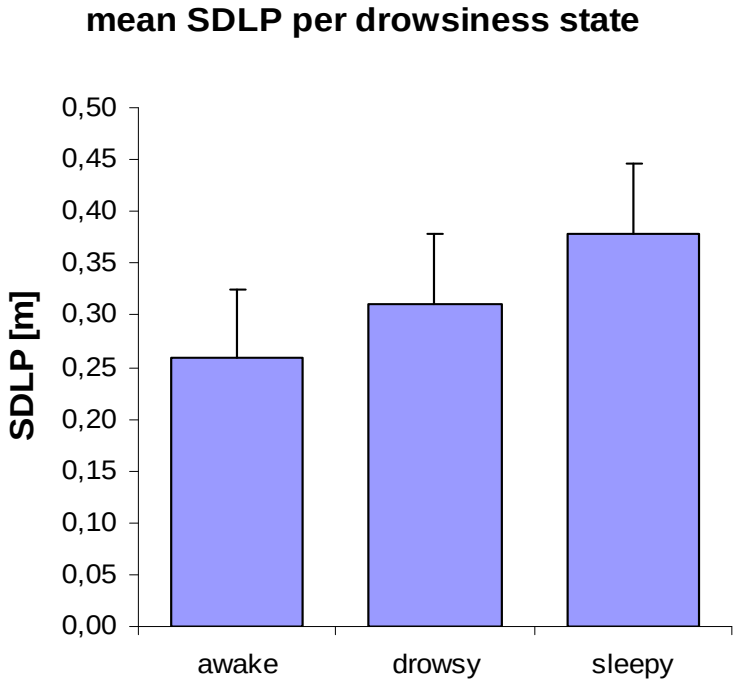


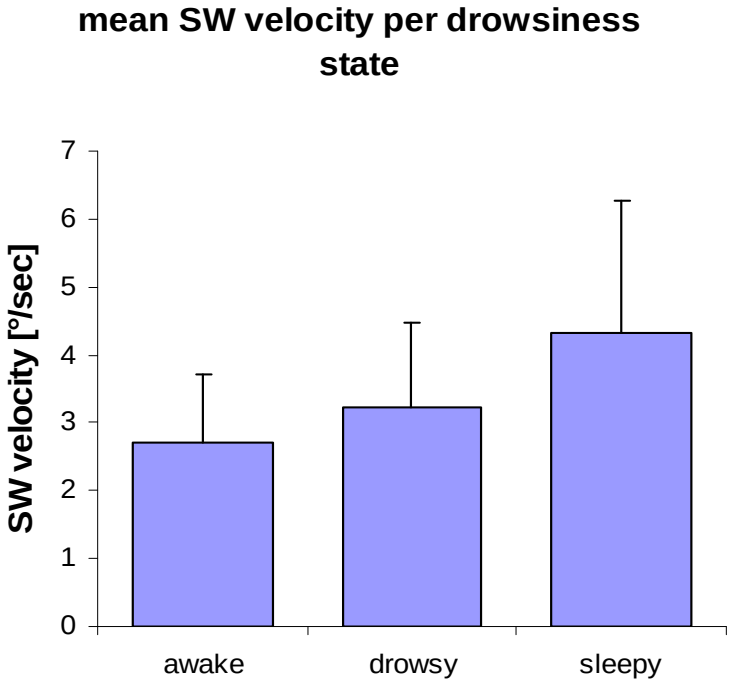
Identification of suitable indicators

- Re-analysis of driving simulator data from N=23 drivers
- 5 hours monotonous driving conditions



Indicators for drowsy state

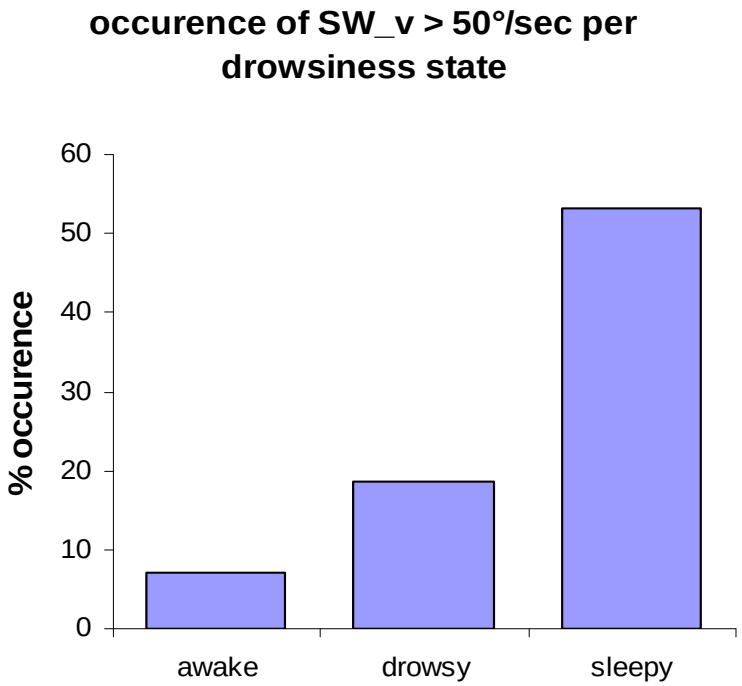


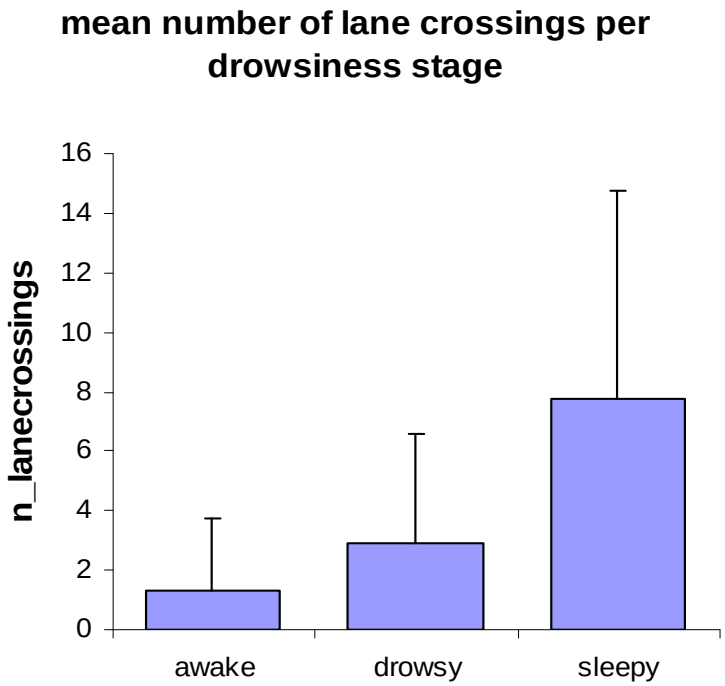


Re-analysis of driving simulator data from N=23 drivers, driving for 5 hours

- **Observation of lane keeping performance and steering activity over longer time intervals**
- **Comparison with individual baseline necessary**

Indicators for sleepy state





Re-analysis of driving simulator data from N=23 drivers, driving for 5 hours

- **Accumulation of severe attentional lapses**

Conclusions: defined principles for DSA-drowsiness detection

- Combination of direct and indirect measures
- Multi-level concept of drowsiness detection
- differentiated set of parameters for each level
- Calibration phase for individual adaptations of algorithms required
- Maneouvre detection and classification required (esp. lane changes, sharp curves)
- Consideration of current automation level

Currently working on…

- Further specification of the algorithms for DSA
- validation of the SW module in the WIVW driving simulation
- Evaluation of intervention strategies

Thank you for your attention!