GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

Japanese-German Research Cooperation on Connected and Automated Driving

CAD Japan Germany

Human Factors

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AUTONOMOUS
DRIVE
START

Challenges of AD in Urban Scenarios

Complex environment

- Short reaction times, high information density
- Heterogeneous dynamic scenarios
- Complex trajectories

Interaction with other traffic participants

- Intention and behavior of TPs
- Prognosis and negotiation
- Mixed traffic scenarios

Interaction between driver and AV

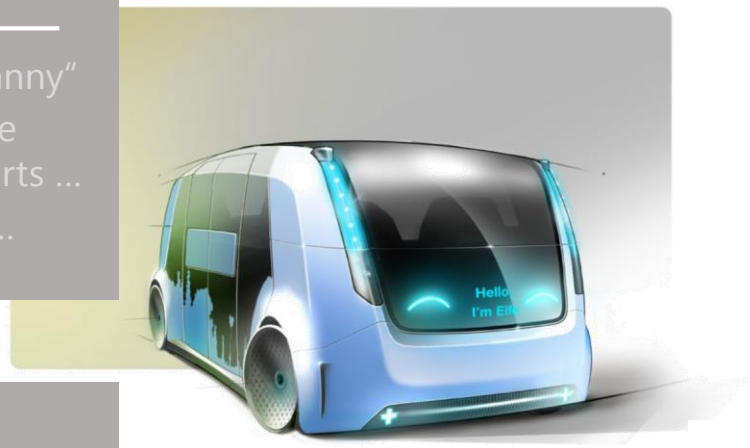
- User oriented transitions
- Changing roles of drivers

cf. www.atcity-online.de

unicar agil

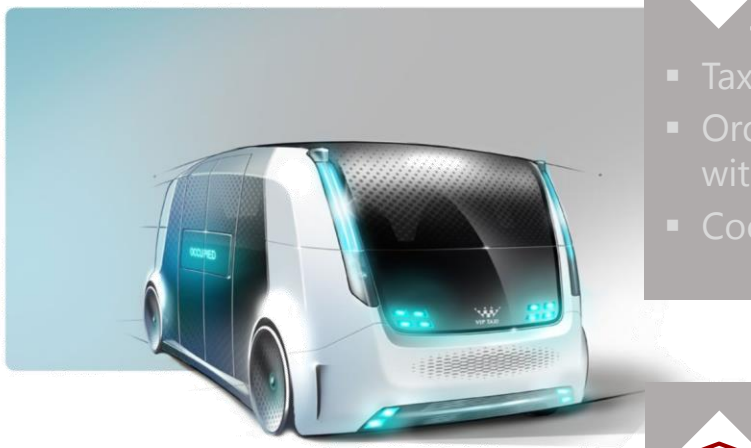
AUTOelfe

- Private „Butler / Nanny“
- Carrying out private trips to school, sports …
- Private, individual …



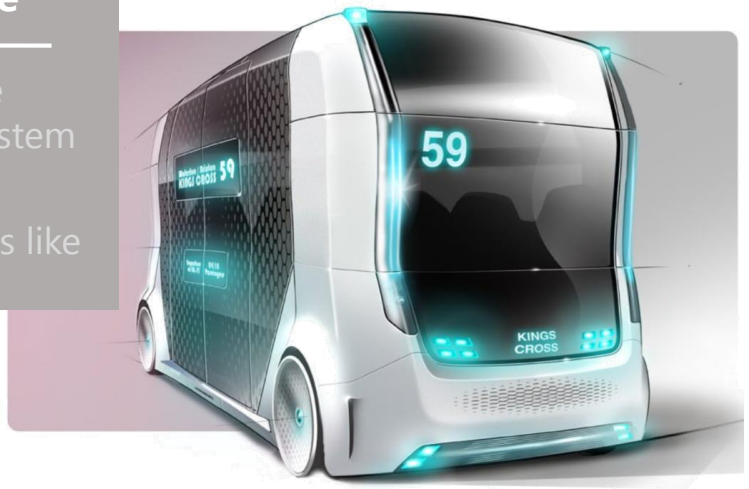
AUTOtaxi

- Taxi-service
- Order, open, interact with CE device
- Cooperative and agile …



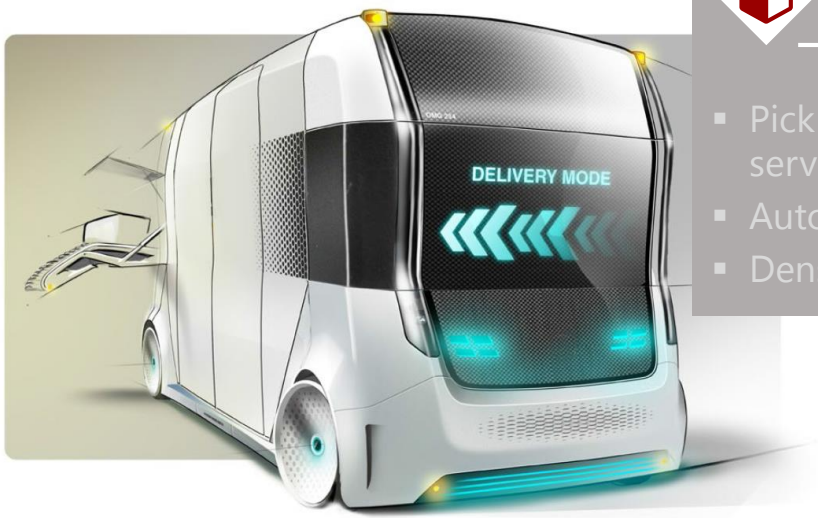
AUTOshuttle

- Supplementing the public transport system
- 6 – 8 persons
- Moves and behaves like a rail vehicle



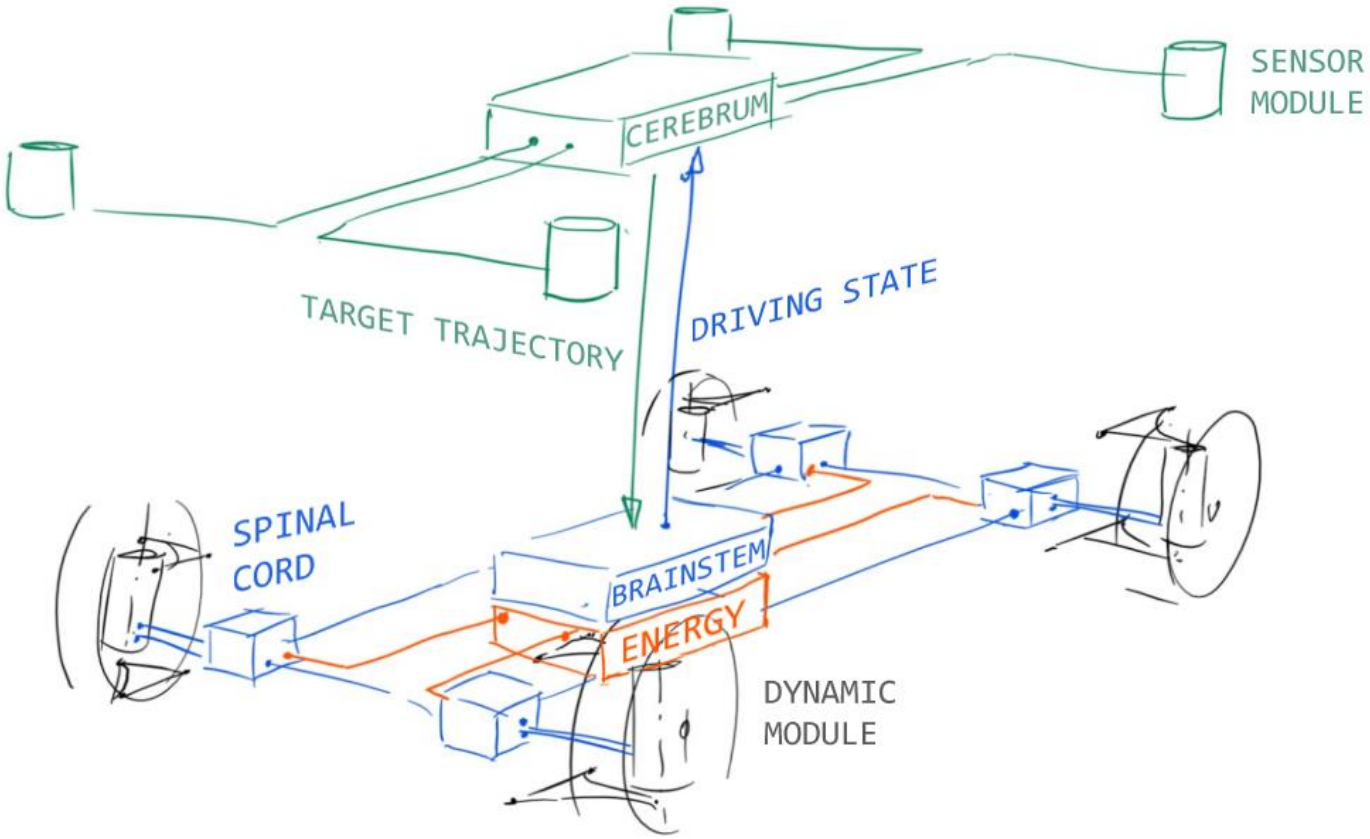
AUTOliefer

- Pick up and delivery service
- Automated handover
- Dense storage system

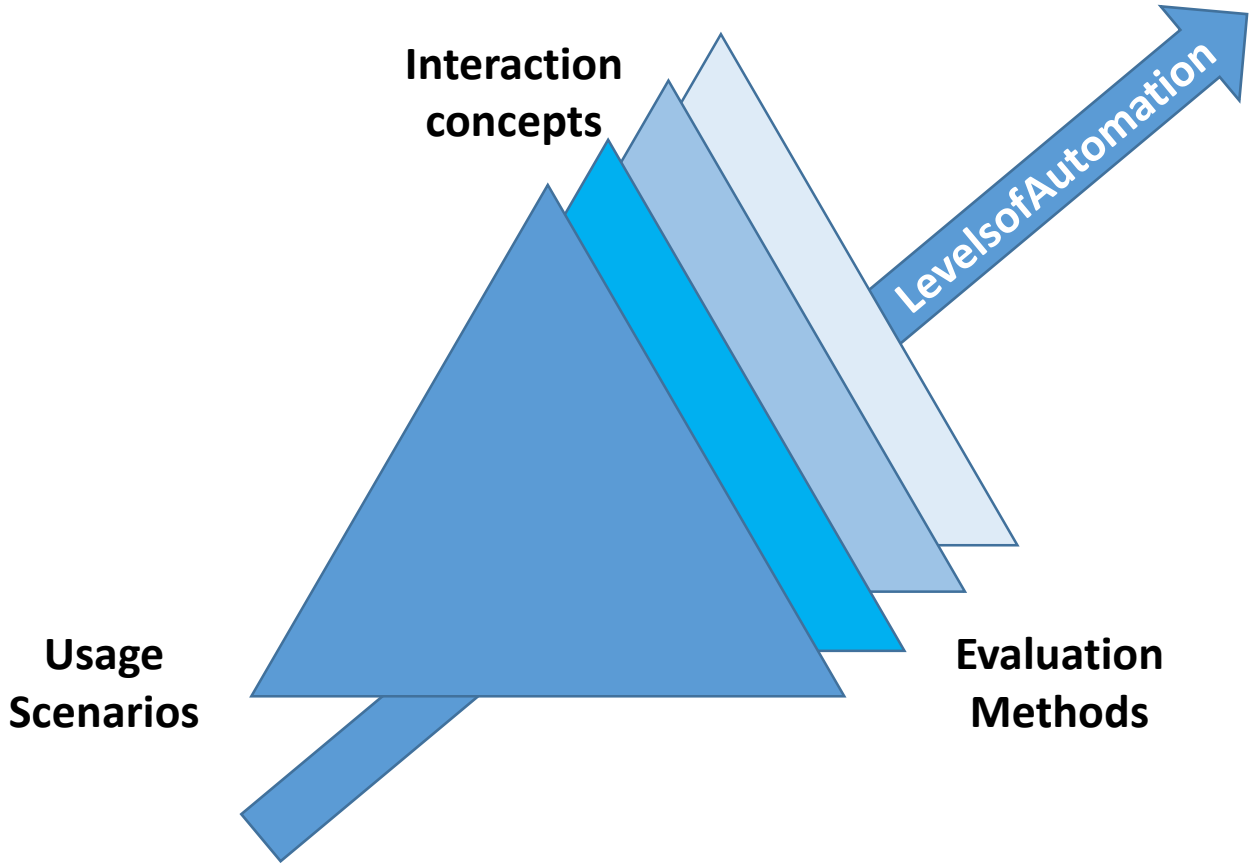


Woopen et al. 2018)

2. The Mechatronic Architecture



From a Human Factors Perspective



Facing a complex research situation with simultaneous technical development and introduction

CAD Japan Germany - Human Factors

WP	Research item	Institutes
1	External communication between low-speed & fully automated vehicles and surrounding road users	TU Munich TU Chemnitz TU Dresden Ulm University DLR
2	Education and training	TU Dresden TU Munich
3	Drivers' interaction with the systems in local urban traffic	TU Munich Ulm University

Participating

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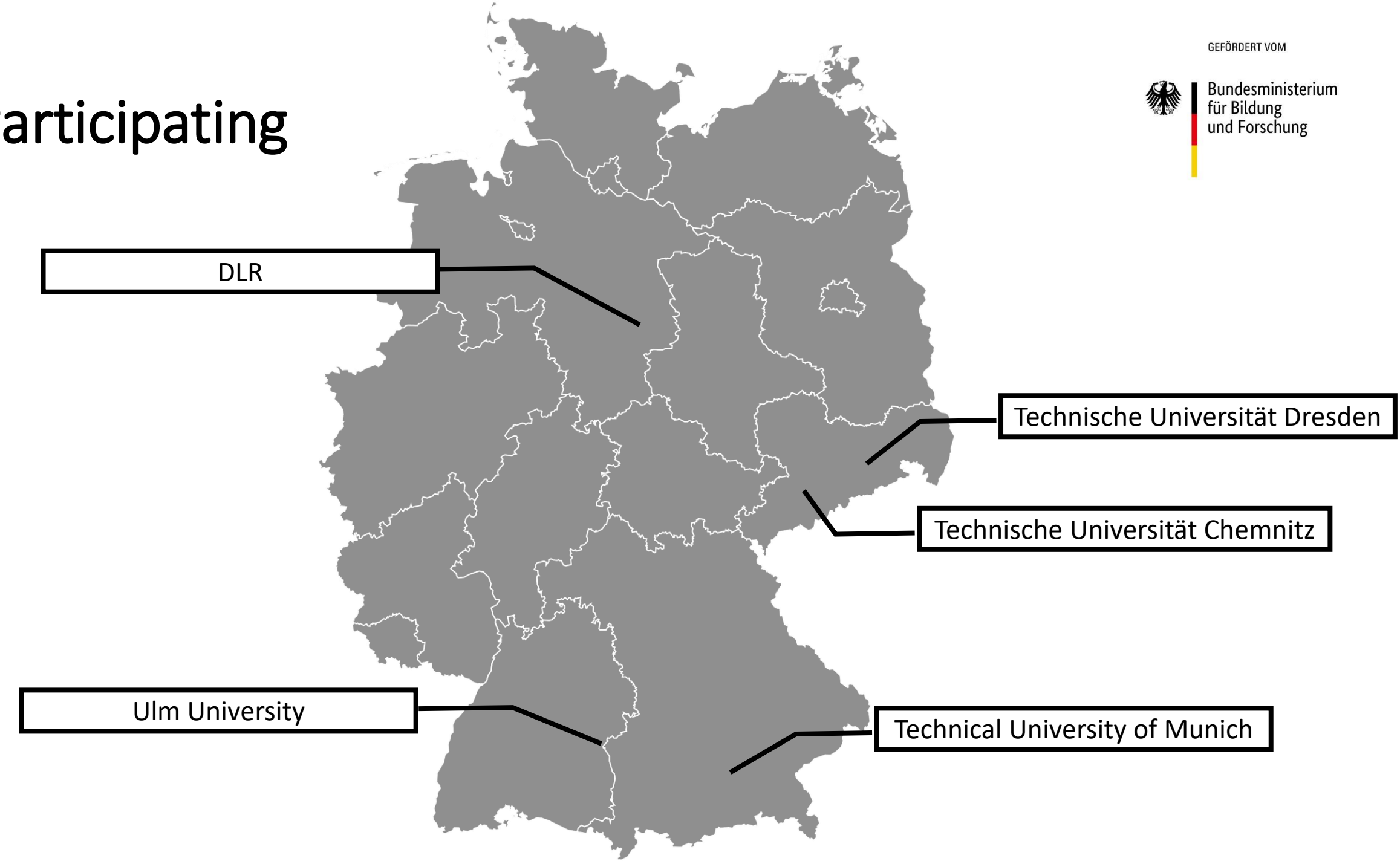


WP 1 - External communication

- Legibility of trajectories and AV motion behavior (TUM)
- Interaction with cyclists and their motion behavior (TUC)
- External HMI for surrounding road users (DLR, TUD)
- General model for communication and cooperation in the urban area (UU)

Synchronized intercultural experiments

Formulation of methodologies, interaction and design guidelines

Work Package 1 – Communication and Interaction (TUC)

TECHNISCHE UNIVERSITÄT CHEMNITZ

- Re-analyzing existing (naturalistic cycling) data from former projects

- Videosimulation (LabView):
  - full experimental control of instructions,
  - including augmented videos
  - presentation via PC or beamer (including a static bicycle)

- Focus group discussions

a. Projection on the street surface

b. LED display on the radiator grille

c. LED light strip on the windscreen

d. Projection on the windscreen

e. LED display on the windscreen

Work Package 1 – Communication and Interaction (TUM)

Methods

- Multi-user simulation environment (vehicles, pedestrians, cyclists)
- Traffic observations

Work Package 1 – Communication and Interaction (UU)

Focus on communication and interaction between automated vehicles and other motorized road users

- Cooperative behavioral scripts and strategies
- Information needs and communication of intentions and action plans

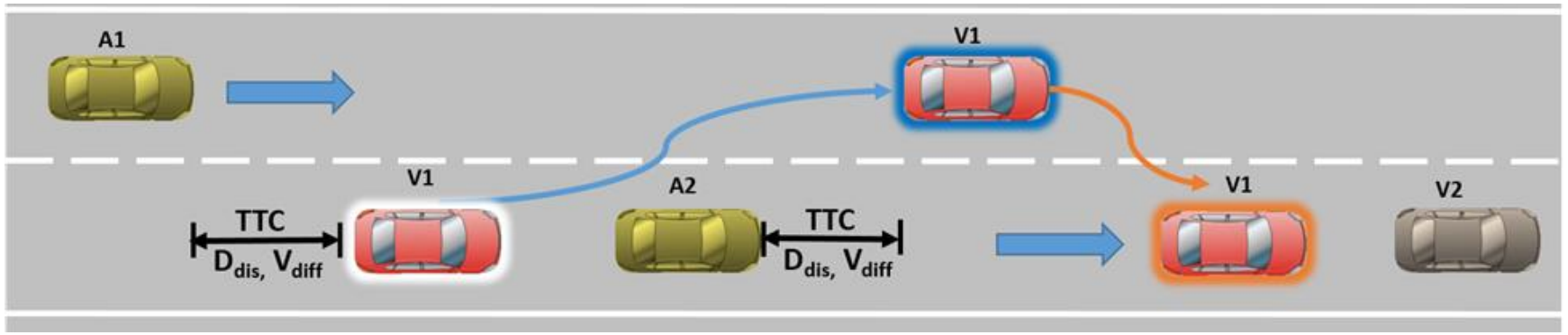
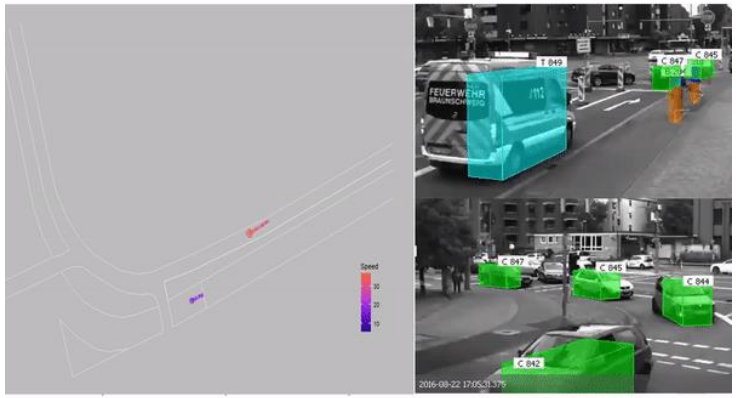


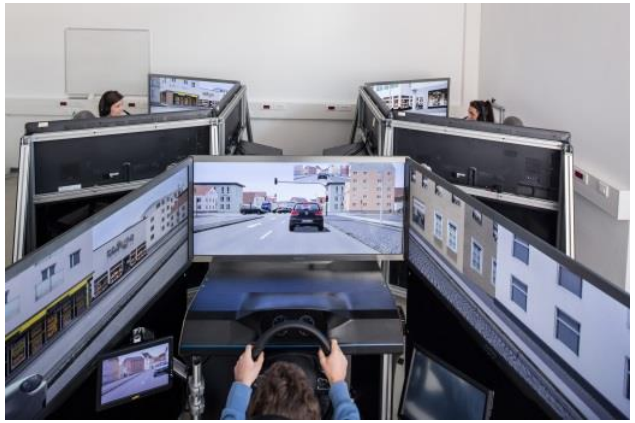
Figure 1. The subject vehicle with the human driver (V1) follows a slowly driven automate vehicle (A2) following another vehicle with the human driver (V2), while another automated vehicle (A1) approaches faster on the left lane (TTC: Time to Collision; Ddis: distance gap; Vdiff:: closing speed).

Work Package 1 – Communication and Interaction (German Aerospace Center, DLR)

Methods:

- Analysis of real traffic data → AIM Research Intersection
- Empirical Study in the multi-driver simulator MoSAIC





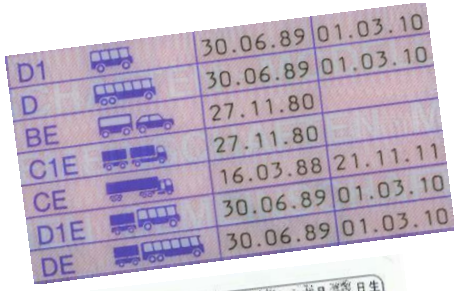
WP 2 -Education and training

- Education and training systems/concepts (TUD)

- Mental models of end users and potential foreseeable missuse (TUM)

Methods

- Status quo analysis
- Interviews
- Online questionnaires



Work Package 2 – Education and training (TUM)

Application and **test** of developed methods

- Influence of training concepts on driver mental models of automated systems

Status quo, international comparison, proposals for formal and informal training

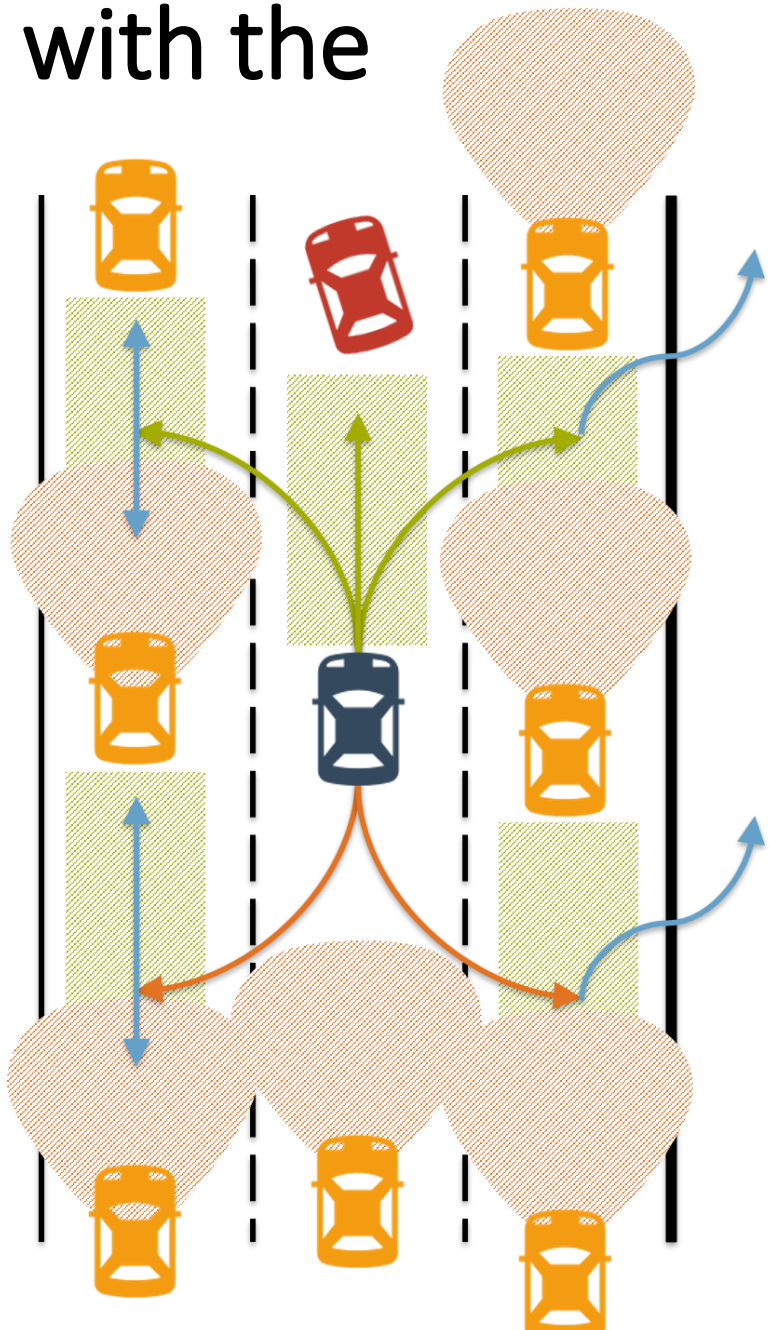
WP 3 - Drivers' interaction with the systems in local urban traffic

- Cooperative HMI for L2 and L3 automation in urban areas (U Ulm)
- Minimum requirements for non driving related tasks and take over time for L2 automation in Japanese vs. German urban areas (TUM)

- Synchronized intercultural experiments

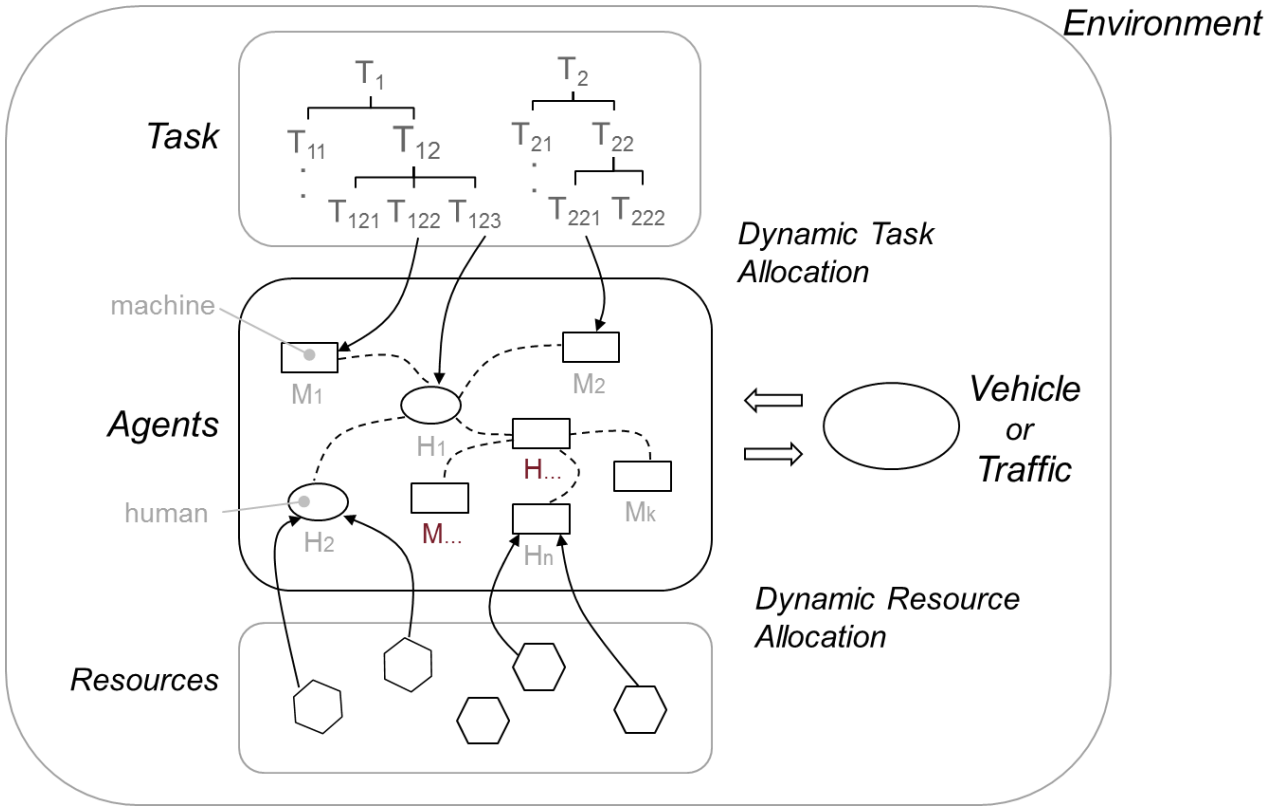
Work Package 3 – Drivers' interaction with the systems in local urban traffic (TUM)

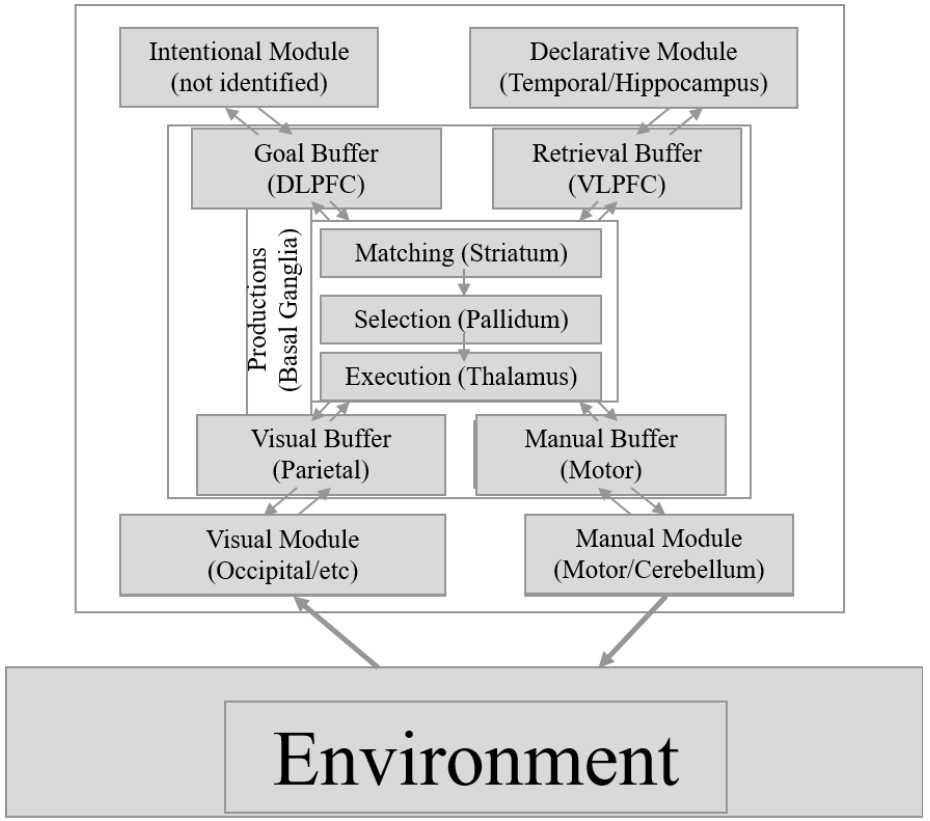
- Analyzing the **driver interaction** with the automated vehicle during **transition phases including minimal risk maneuvers**



Work Package 3 - Drivers' interaction with the systems in local urban traffic (UU)

Cognitive processes underlying the dynamic allocation of tasks between human and automation:

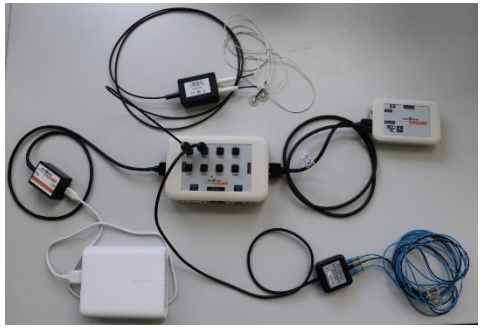


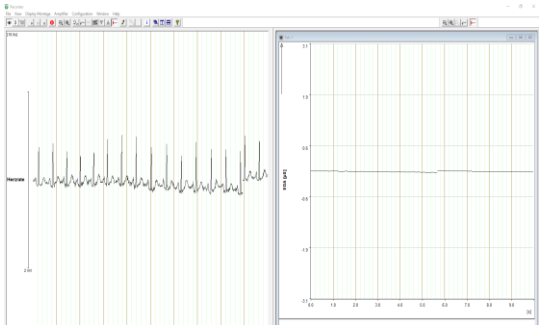


Work Package 3 - Drivers' interaction with the systems in local urban traffic (UU)

Methods:

- Driving simulator experiments
- Deployment of neurophysiological measurements
- Cognitive modelling of the driver state





Outlook on Japanese German Collaboration

- Networking and synchronization of research activities
- First synchronized experiments in 2020
- Joint workshops with industry experts
- Exchanging staff and students
- Networking of education and invited talks
- Dissemination of results - Coauthoring publications

Accelerate successful introduction of safe automated vehicle technology
Increase social acceptance of automated systems for broader international markets base
Cross-cultural comparisons