Japanese-German Research Cooperation on Connected and Automated Driving

CAD Japan Germany

Human Factors

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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
- **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
Facing a complex research situation with simultaneous technical development and introduction
## CAD Japan Germany - Human Factors

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<td>External communication between low-speed &amp; fully automated vehicles and surrounding road users</td>
<td>TU Munich&lt;br&gt;TU Chemnitz&lt;br&gt;TU Dresden&lt;br&gt;Ulm University&lt;br&gt;DLR</td>
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Participating

- Technical University of Munich
- Ulm University
- Technische Universität Dresden
- Technische Universität Chemnitz
- DLR

(GEFÖRDERT VOM Bundesministerium für Bildung und Forschung)
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
Work Package 1 – Communication and Interaction (TUC)

- 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
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 automated 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 misuse (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