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Vehicle Automation and Man – from Reaction to Takeover

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for Driver Testing

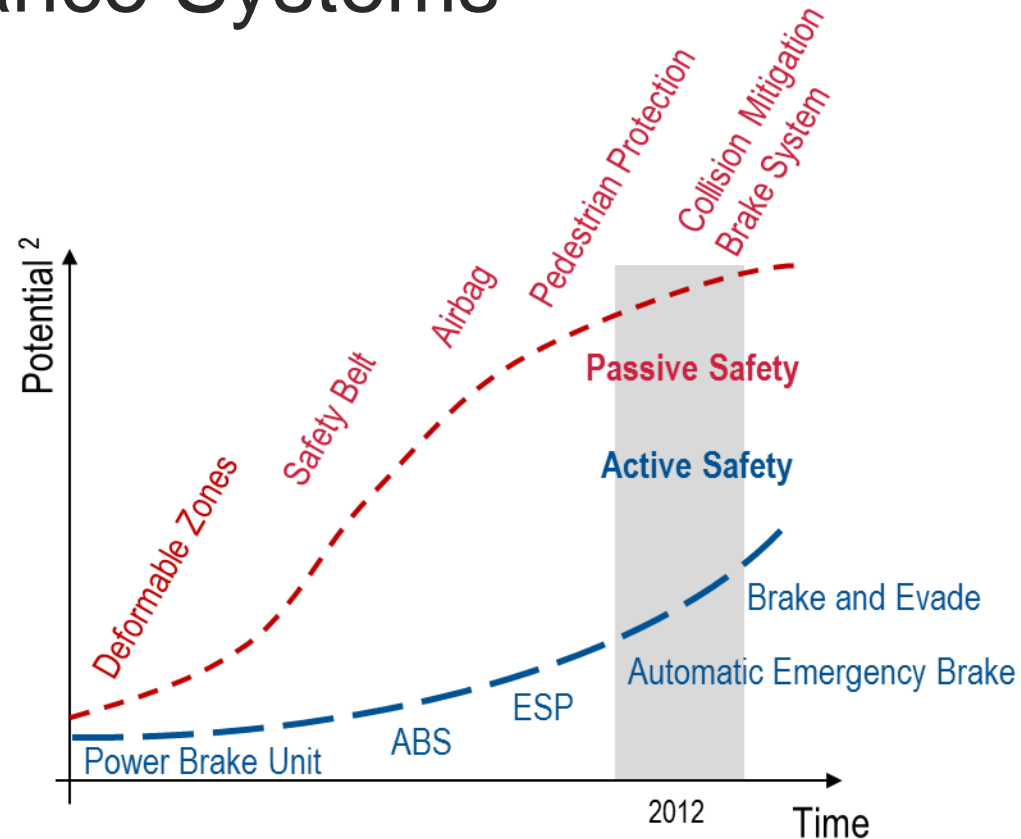


Topics

1. Advanced Driver Assistance Systems
2. From Assistance to Automation
3. Benefits and Problems
4. Experimental Examples
5. Summary
6. Conclusion

Advanced Driver Assistance Systems

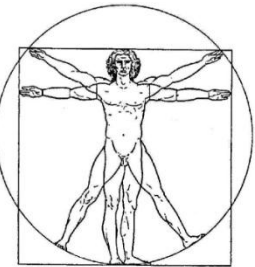
- **Passive Safety:**
 - Accident Mitigation
 - Potential largely exhausted
- **Active Safety:**
 - Accident Avoidance
 - Increasing power and quality
- **Human failure as main cause for accidents¹ (93,5 %)**



➔ **Advanced Driver Assistance Systems (ADAS) to reduce human failure**

¹ GIDAS-Database ² Heißing 2006

From Assistance to Automation



Benefits and Problems

- **Benefits:**

- Increasing comfort due to a relief from the driving task
- Increasing safety by active accident avoidance



- **Further potential benefits:**

- Sustained mobility for elderly drivers
- Enhanced traffic flow based on Car-to-X
- Utilization of traveltime (job-related / private)
- ...



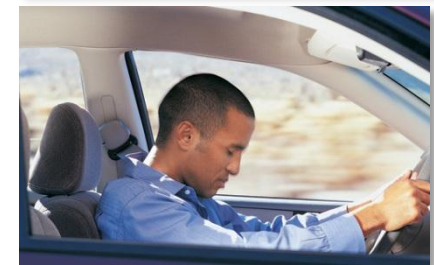
Benefits and Problems

- **Problems today:**

- Several independent assistance systems
- Partially complicated and confusing to operate
- Distracting information overflow

- **Potential future problems:**

- Situation Awareness
- Mode Awareness
- Controllability / Take Over
- Liability



Experimental Examples – Automation Degree

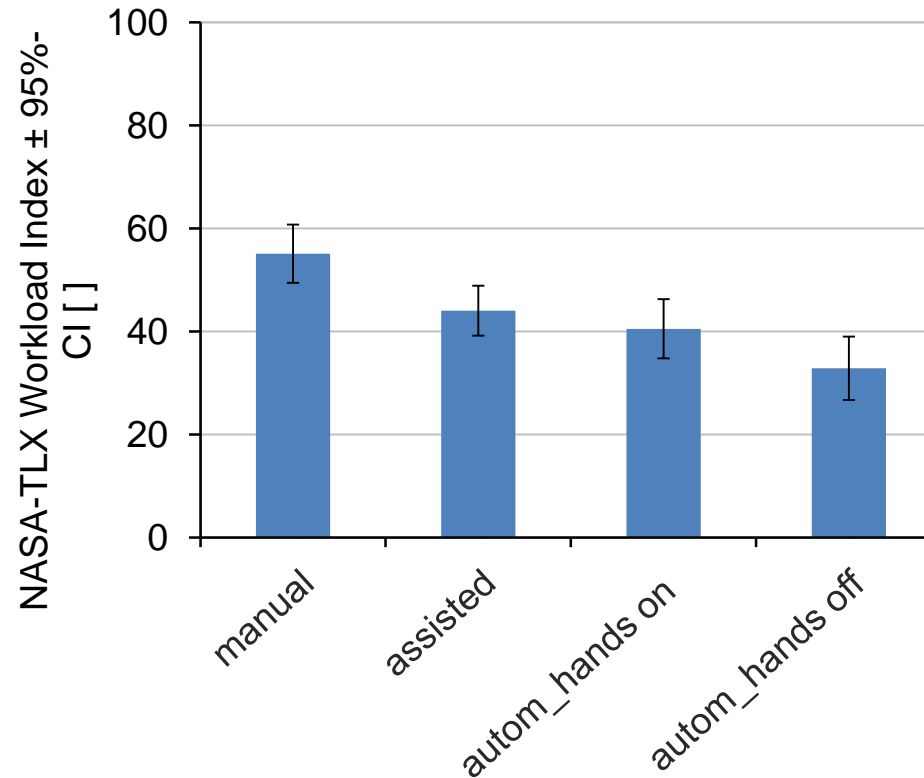
- **Influence of the degree of automation on driver performance**

- Static driving simulator
- 24 subjects
- Average age = 30,5 years (SD = 9,0 years)
- 4 degrees of automation
- Visual detection task as secondary task



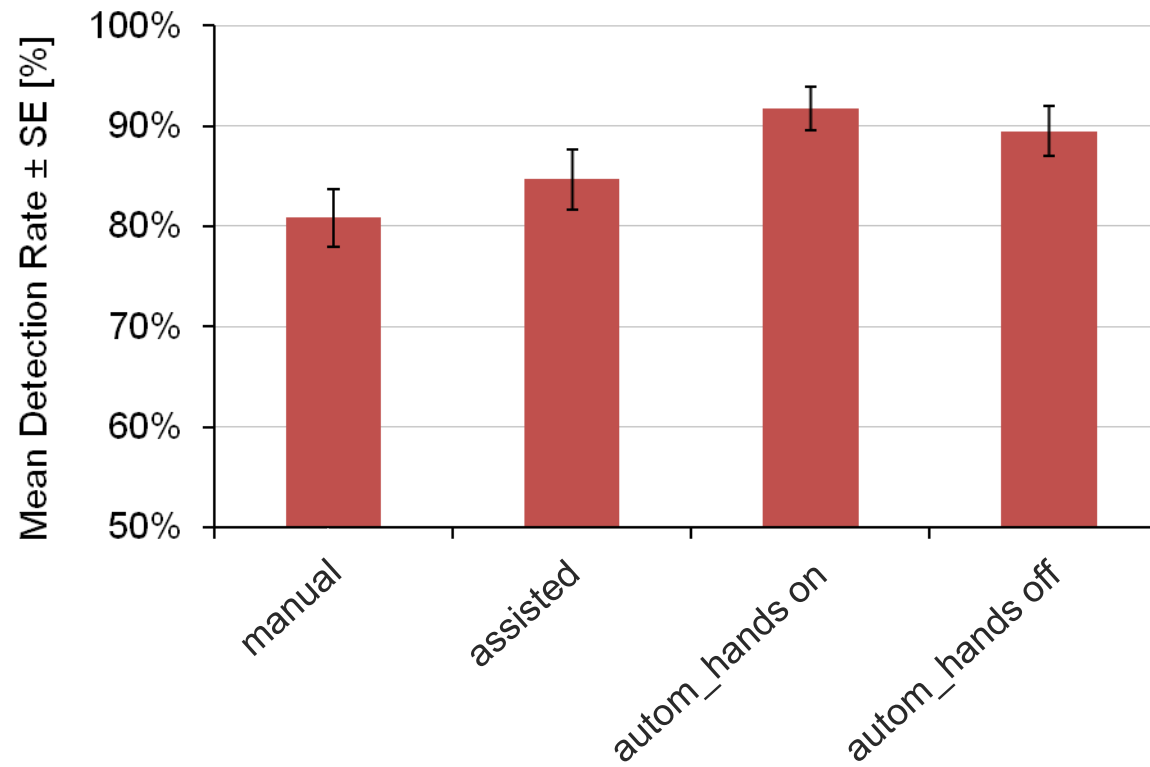
Experimental Examples – Automation Degree

- Increasing automation leads to a decreasing driver workload



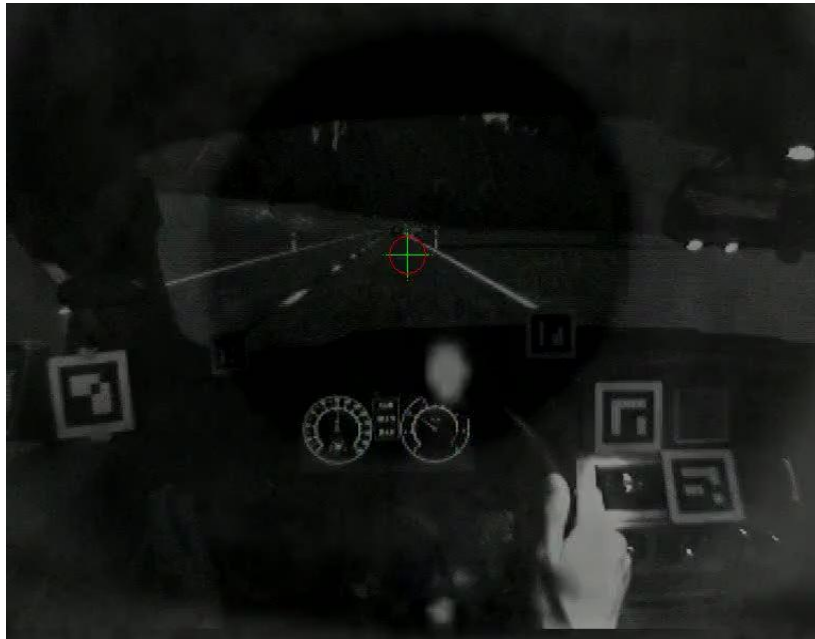
Experimental Examples – Automation Degree

- Increasing automation leads to a increasing secondary task performance



Experimental Examples – Automation Degree

- **Change in gaze behaviour – attention allocation from the road to the secondary task**



manual



automated „hands off“

Experimental Examples – Take Over

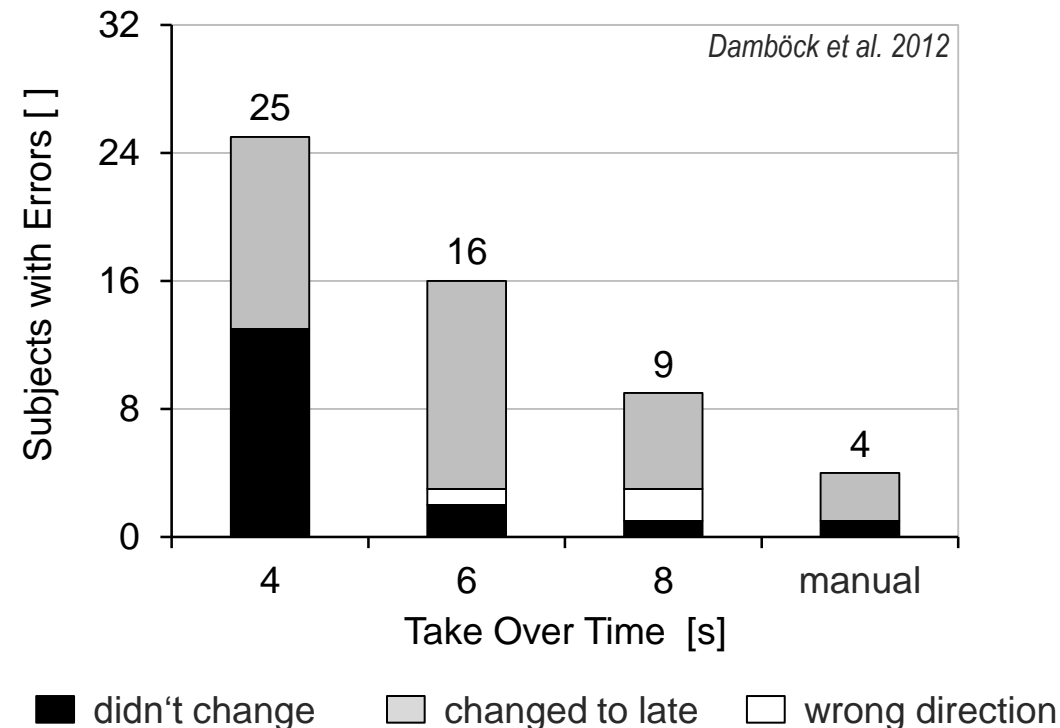
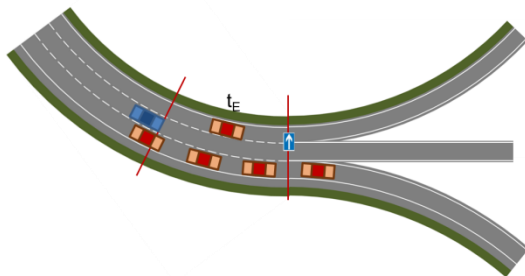
- „Take Over Time“ of a completely distracted driver
 - Static driving simulator
 - 32 Subjects
 - Average age = 44.9 years (SD = 16.7 years)
 - Automated driving (hands off)
 - „Worst Case“ scenario
 - Drivers fully distracted
 - Take over requests due to system limits



Experimental Examples – Take Over

- Relation between time budget and take over behaviour for a comfortable lane change in a specified direction

- Different time budgets for Take Over (4, 6, 8 seconds)
- Focus on **comfortable** take over



Summary

- **Increasing number and quality of driver assistance systems**
- **Increasing safety and comfort**
- **The role of the driver is about to change from actually driving the car to monitoring the automation status**
- **In case of a necessary reaction the driver will need more time to become aware of the situation and the appropriate actions**
- **Beyond reaction also the longer „Take Over Time“ has to be taken into account**

Conclusion

- **In the near to mid term future additionally to the basic driving skills, drivers need to know...**
 - the behaviour of assistance / automation systems. *What is it doing?*
 - the limits of assistance / automation systems. *What can it do?*
What does it need?
 - how to operate and supervise these systems. *What do I have to do?*
- **In the mid to long term future...**
 - the monitoring task will come to the fore and active driving will be reduced.
 - drivers must be able to handle „Take Over Situations“ safely.

Thank you for your attention!