AUTOMATED DRIVING FUNCTIONS

IMPACT POTENTIALS, CHALLENGES AND SOLUTIONS FROM THE POINT OF VIEW OF THE AZT

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### ALLIANZ CENTER FOR TECHNOLOGY – ACCIDENT RESEARCH

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cooperation with OEMs and Suppliers</strong></td>
<td><img src="image" alt="Volkswagen" />, BOSCH, <img src="image" alt="Ford" />, <img src="image" alt="BMW" />, <img src="image" alt="Continental" />, ...</td>
</tr>
</tbody>
</table>
| **Research projects/ field tests/ queries / ADAS tests** | - Research projects  
  - Mobileye field test  
  - AZT fleet |
| **Market observation relating the development of safety systems** | - Driver Assistance Systems  
  - Automated Driving  
  - C2x Communication |
| **Scientific cooperation with Universities** | - Diploma-, Bachelor-, Master-, Doctor Thesis's |
| **Development of in-depth claim data bases** | - TPL claims  
  - MoD claims |
| **Bodies and labor work**                   | ![FEARS](image), ![UAVS](image), ![RCAR](image), ![DVRV](image), ![GVD](image) |
| **Potential and efficiency analyses of ADAS** | - Support for the underwriting  
  - Risk evaluation  
  ± x % claims  
  ± y % claim costs |
| **Education / presentation / knowledge transfer** | - Internal courses for AZ experts  
  - Consulting of underwriting, claim department, actuaries  
  - Cooperation with Risk-Management for fleets |

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MARKET PENETRATION OF ADAS RELATED TO VEHICLE STOCK IN GERMANY

Penetration in %

0 10 20 30 40 50 60 70 80 90 100


- ABS
- Parking Assist
- ESP
- Lane Keeping
- Cruise Control
- Lane Change Assist
- Park Distance Control
- Curve Light
- Adaptive Cruise Control
- Automated Emergency Brake
**RELEVANCE OF ADAS**

= **theoretical maximum** accident avoidance potential only for a perfect system!

Passenger car insurance claims

- **ESC**: Electronic Stability Control
- **AEB**: Autonomous Emergency Braking for Longitudinal Traffic ahead only
- **AEBpc**: Autonomous Emergency Braking for Pedestrians and Cyclists ahead only
- **LDW/LKA**: Lane Departure Warning Lane Keeping Assist
- **LCA/BLIS**: Lane Change Assist Blind Spot Detection
- **PMA**: Parking and Maneuvering Assist

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TPL: Third Party Liability
MoD: Motor own Damage

(n = x ± 100%)
**OVERVIEW OF EFFICIENCY STUDIES RELATING THE REDUCTION IN NUMBER OF REAR-END COLLISIONS DUE TO DIFFERENT CRASH AVOIDANCE SYSTEMS**

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>System</th>
<th>Comparison Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audi A8 with AEB</td>
<td>(MoD-collision)</td>
<td>1 Comparison with the same vehicle model without system</td>
</tr>
<tr>
<td>EV's with AEB</td>
<td>(MoD-collision)</td>
<td>2 Comparison with EV's/PHEV's without system</td>
</tr>
<tr>
<td>PHEV's with AEB</td>
<td>(MoD-collision)</td>
<td>3 Comparison with vehicle models of same vehicle class without system</td>
</tr>
<tr>
<td>Volvo XC60 with VCS</td>
<td>(MoD-collision)</td>
<td></td>
</tr>
<tr>
<td>Mercedes B-class with CPA</td>
<td>(MoD-collision)</td>
<td></td>
</tr>
<tr>
<td>Mercedes E-class with AEB</td>
<td>(MoD-collision)</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sources:**
AZT-Studies 2016, 2017

**Abbreviations:**
MoD: Motor own Damage
AEB: Autonomous Emergency Braking
EV: Electric Vehicle
PHEV: Plug-In-Hybrid-Electric Vehicle
CPA: Mercedes Collision Prevention Assist
VCS: Volvo City Safety

Note: A direct comparison or ranking between efficiency studies of different crash avoidance systems is not possible due to e.g. small sample sizes, different driver clientele, different baseline groups and different analysis methods.

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ADAS – Efficiency Study from IIHS in US

US: Frequency of relevant accidents decreases (comparison vehicle with/without ADAS)

- Rear end collisions
- Lane departure accidents
- Lane change accidents
- Backward driving accidents

Database: police registered accidents and insurance claims in US

- Front Collision Warning (FCW)
- Autonomous Emergency Braking (AEB)
- Lane Departure Warning
- Lane Change Assist
- Rearward Camera
- Crossing Assist for Reverse Driving
- Reverse AEB

[IIHS, 2018]
ADAS – Efficiency Study from UMTRI/GM in US
Frequency of system relevant accidents decreases (comparison vehicle w/wo ADAS)
• Prognosis of the effectiveness of advanced driver assistance systems (ADAS) and highly automated driving functions (HAF) and impact on claims payments up to 2035

• Basis: Current research results of the Allianz Center for Technology (AZT) and the German Insurers Accident Research (UDV)

• Consideration of Motor Third Party Liability (TPL) and Motor own Damage (MoD) for passenger cars, trucks and buses

• Not all damages can be influenced by ADAS/HAF (e.g. limits of sensor technology, partial motor own damage losses: theft, hailstorm…)

• With HAF like motorway pilot only a small effect is to be expected, because only 4 % of TPL claims payments due to accidents on motorways
GDV-STUDY „AUTOMATED DRIVING“
RESULTS AT A GLANCE

TPL-Insurance – passenger cars: Reduction in claims payments resulting from ADAS and HAF – upper range
base year 2015

MoD-Insurance – passenger cars: Reduction in claims payments resulting from ADAS and HAF – upper range
base year 2015
GDV-STUDY „AUTOMATED DRIVING“
RESULTS AT A GLANCE

Motor vehicle insurance – passenger cars: Reduction in claims payments resulting from ADAS and HAF incl. development of vehicle stock and increase of repair costs

base year 2015

-30%
-25%
-20%
-15%
-10%
-5%
0%
5%

Upper range

Lower range

BEZUGSJAHR 2015
Untere Bandbreite
Obere Bandbreite

Kraftfahrtversicherung – Pkw-Gruppe: Reduktion des Schädenaufwandes durch FAS- und AF-Systeme inkl. Bestandsentwicklung und Erhöhung der Reparaturaufwendungen
EXPECTED BENEFIT OF L3+ FUNCTIONS
20 YEARS AFTER MARKET INTRODUCTION

Example: Urban Pilot, Motor own Damage Collisions

Relevance \* Efficiency \* Usage \* Penetration = Expected Benefit
19.1\% \* 37.6\% \* 48.8\% \* 61\% = 2.1\%

Motorway Pilot | Traffic-Jam Pilot | Parking Pilot state-of-the-art | Parking Pilot trajectory | Urban Pilot with intersections | Urban Pilot without intersections | TOTAL

TPL-Mat TPL-P MoD

Source: Ostermaier, AZT/TUM
NEW CHALLENGES AND RISKS
CRITICAL SCENARIOS

Transition of task

Interaction with traffic participants

Environmental conditions

Lane change

v = 120 km/h

v = 200 km/h

Obstacle

Convoy drive

Rescue alley

Transversely offset

(Workshop of August 22nd 2018)
KEY CRITERIA DEFINING SAFE AUTOMATED DRIVING

Source: Thatcham, ABI, Sept 2019
DSSAD VERSUS EDR

**DSSAD**
- AD system data
  - ON / OFF
  - Take Over Request
  - Take Over
  - Minimum Risk Manoeuver
  - Faults

**EDR**
- Detailed Event data

**Goal:**
- Responsibility?

**Registered Events**
[6 months] storage of AD system data

5 s before crash

Accident with EDR Trigger

Accident Analysis

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AHEAD
AGGREGATED HOMOLOGATION-PROPOSAL FOR EVENT-RECORDER-DATA FOR AUTOMATED DRIVING

- Definition and proposal of data elements for AD from a technical perspective
- Discuss and define necessary framework
  - expertise needed for INTERPRETATION of data
  - accuracy & precision of data
  - technical protection of data
- Based on claims experience, accident research and joint crash tests
- Considering various stakeholder needs
  - including drivers & keepers of vehicles, experts, accident analysts, regulator, periodical technical inspection, insurance industry
- Basis work for individual publications and individual position papers
AHEAD DATA MODEL

Subdivision of the data elements in 4 standardized categories:

- **Surroundings and Object Recognition**
  - Date, Timestamp, Location, Acceleration, Collision Speed, Seat Belt Status, Airbag, Restraint System…
  - Video feeds from front and rear-facing cameras, Sensor Data, Classified Objects, Object Position, Object Direction, Object Speed, Calculated Movement…

- **Driver Activity**
  - Steering, Seat Position, Pedal Positions, Driver Alertness…
  - Vehicle Status, Operation Mode (e.g. manual, autonomous, remotely controlled), Speed, Yaw Angle, DTC …
RELEVANCE OF EDR ON MOTORWAYS

Source: Bachelor Thesis Oliver Braxmeier, 2019
EDR DETECTION RATE ON MOTORWAYS - 8 LEVELS OF DETECTION

EDR Level 1
• Surrounding with 360° cameras and sensors
• Driver monitoring with cameras und sensors
• Driving data and crash data

EDR Level 2
• Surrounding with 360° cameras and sensors (front/back)
• Driver monitoring with cameras und sensors
• Driving data and crash data

EDR Level 3
• Surrounding with sensors
• Driver monitoring with cameras und sensors
• Driving data and crash data

EDR Level 4
• Surrounding with sensors
• Driver monitoring with sensors
• Driving data and crash data

EDR Level 5
• Surrounding with sensors (front/back)
• Driver monitoring with sensors
• Driving data and crash data

EDR Level 6
• Driver monitoring with sensors
• Driving data and crash data

EDR Level 7
• Driving data and crash data

EDR Level 8
• Driving data

Source: Bachelor Thesis Oliver Braxmeier, 2019
THANK YOU FOR YOUR ATTENTION!

Quelle: BMW
Die Merkmalverteilung lässt die Aussage zu, dass eine Airbagauslösung nicht als (einziger) EDR-Trigger ausreichen kann.