ADAS AND AUTOMATED DRIVING FUNCTIONS

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

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AZT Automotive GmbH

Quelle: BMW
Automated Driving will improve Road Safety significantly." (Lemmer, 2016)

What is the Safety Benefit of ADAS and Automated Driving Functions?
## Cooperation with OEMs and Suppliers

- Volkswagen
- Bosch
- Continental
- Audi
- Opel
- Ford
- Mercedes
- Volvo
- ZF
- ... 

## 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
- HWR
- TU Graz
- ... 

## Development of in-depth claim data bases

- TPL claims
- MoD claims

## Bodies and labor work

- 3FARS
- Umfallforschung der Versicherer
- GdV
- RCAR

## Potential and efficiency analyses of ADAS

- Support for the underwriting
- Risk evaluation

## Education / presentation / knowledge transfer

- Internal courses for AZ experts
- Consulting of underwriting, claim department, actuaries
- Cooperation with Risk-Management for fleets

\[ \pm x \% \text{ claims} \]
\[ \pm y \% \text{ claim costs} \]
MARKET PENETRATION OF ADAS RELATED TO VEHICLE STOCK IN GERMANY

Penetration in %


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

GMTTB 2019 | AZT | Dr. Gwehenberger, Dr. Lauterwasser, Borrack
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[DAT-Report, 2000-2019]
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

![Graph showing the percentage of claims reduced by ADAS features](chart.png)

- **TPL major claims with bodily injury (n=362)**
- **TPL claims with bodily injury (n=833)**
- **TPL claims with material damage (n=1000)**
- **MoD collisions (n=983)**

TPL: Third Party Liability
MoD: Motor own Damage
OVERVIEW OF EFFICIENCY STUDIES RELATING THE REDUCTION IN NUMBER OF REAR-END COLLISIONS DUE TO DIFFERENT CRASH AVOIDANCE SYSTEMS

<table>
<thead>
<tr>
<th>System</th>
<th>Sources: AZT Studies 2016, 2017</th>
<th>Abbreviations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audi A8 with AEB</td>
<td>AZT</td>
<td>MoD: Motor own Damage</td>
</tr>
<tr>
<td>(MoD-collision)¹</td>
<td></td>
<td>AEB: Autonomous Emergency Braking</td>
</tr>
<tr>
<td>EV's with AEB</td>
<td></td>
<td>EV: Electric Vehicle</td>
</tr>
<tr>
<td>(MoD-collision)²</td>
<td></td>
<td>PHEV: Plug-In-Hybrid-Electric-Vehicle</td>
</tr>
<tr>
<td>PHEV's with AEB</td>
<td></td>
<td>CPA: Mercedes Collision Prevention Assist</td>
</tr>
<tr>
<td>(MoD-collision)²</td>
<td></td>
<td>VCS: Volvo City Safety</td>
</tr>
<tr>
<td>Volvo XC60 with VCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MoD-collision)³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercedes B-class with CPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MoD-collision)³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercedes E-class with AEB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(MoD-collision)¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comparison

1. Comparison with the same vehicle model without system
2. Comparison with EV's/PHEV's without system
3. Comparison with vehicle models of same vehicle class without system

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.
ADAS – Efficiency Study in US

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

Database: police registered accidents and insurance claims in US
GDV-STUDY

02

Technology poised to drive down car insurance premiums

Insurers should brace themselves for a drop of up to 80 per cent in car insurance premiums as technology disrupts one of the mainstays of the industry, according to research from Boston Consulting Group and Morgan Stanley.

Autonome Autos: Versicherungen drohen Milliardenverluste

Self-Driving Cars to Cut U.S. Insurance Premiums 40%, Aon Says

Automotive revolution – perspective towards 2030

Up to 90% lower average crash repair per autonomous vehicle
GDV-STUDY “AUTOMATED DRIVING”
STATUS QUO, OBJECTIVES AND TASKS OF THE GDV WORK GROUP

• 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”
THE METHODOLOGY AT A GLANCE

Step 1: Prognosis of the loss-preventing impact of the systems
Basis: Research of the German Insurers Accident Research (UDV) and the Allianz Center for Technology (AZT)
Determination of four parameters for each individual ADAS/HAF

- **Relevance:** Proportion of the total claims burden that could be **maximally avoided in theory**
- **Efficiency:** Proportion of the maximum avoidable (=relevant) damage under real conditions in road traffic
- **Utilization:** Indicates how often drivers use an existing system
- **Market penetration:** Proportion of vehicles with ADAS/HAF in vehicle stock

By multiplying these four parameters, we can calculate the actual expectable claims reduction in the year 20XX

<table>
<thead>
<tr>
<th>Relevance</th>
<th>Efficiency</th>
<th>Utilization</th>
<th>Market Penetration</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>16%</td>
<td>70%</td>
<td>90%</td>
<td>37/78%</td>
<td>3.7/7.9%</td>
</tr>
</tbody>
</table>

Example in MoD: Parking and Manoeuvring Assistant
Scenarios of market penetration

- Fast penetration
- Slow penetration

Proportion in vehicle stock [%] vs. Years after market introduction

- Corresponds to ESP
- Corresponds to ABS
Step 2: Estimation of the development of repair costs

• ADAS/HAF require installation of additional technology on vehicles, which cause higher repair costs in the event of damage

Step 3: Passenger car vehicle stock development in Germany up to 2035

• Prediction is based on the study „Shell passenger car scenarios up to 2040“
GDV-STUDY „AUTOMATED DRIVING“
RESULTS AT A GLANCE

Parking/Manoeuvring assistant
Emergency braking assistant
Lane change assistant
Lane keeping system
Motorway pilot
City and rural road pilot

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Lower range</th>
<th>Upper range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>-30%</td>
<td>-25%</td>
</tr>
<tr>
<td>2016</td>
<td>-25%</td>
<td>-20%</td>
</tr>
<tr>
<td>2017</td>
<td>-20%</td>
<td>-15%</td>
</tr>
<tr>
<td>2018</td>
<td>-15%</td>
<td>-10%</td>
</tr>
<tr>
<td>2019</td>
<td>-10%</td>
<td>-5%</td>
</tr>
<tr>
<td>2020</td>
<td>-5%</td>
<td>0%</td>
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<tr>
<td>2021</td>
<td>0%</td>
<td>5%</td>
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<tr>
<td>2022</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>2023</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>2024</td>
<td>15%</td>
<td>20%</td>
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<tr>
<td>2025</td>
<td>20%</td>
<td>25%</td>
</tr>
<tr>
<td>2026</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>2027</td>
<td>30%</td>
<td></td>
</tr>
</tbody>
</table>

Bezugsjahr 2015
Untere Bandbreite
Obere Bandbreite

Kraftfahrtversicherung – Pkw-Gruppe: Reduktion des Schadenaufwandes 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 x Efficiency x Usage x Penetration = Expected Benefit
19.1% x 37.6% x 48.8% x 61% = 2.1%

Source: Ostermaier, AZT/TUM
NEW CHALLENGES AND RISKS

03
MACHINE VS. DRIVER: MINIMUM CRITERIA FOR AUTOMATED SYSTEMS (LEVELS 3/4)
CRITICAL SCENARIOS

Transition of task
- Lane change
  - v = 120 km/h
  - v = 200 km/h

Interaction with traffic participants
- Obstacle
- Convoy drive

Environmental conditions
- Rescue alley

Transversely offset
- v = 200 km/h
- v = 120 km/h

(Workshop of August 22nd 2018)
IT SECURITY OF VEHICLES

- AZT project with partners (OTH Regensburg / Fraunhofer SIT)
- Risks of telematics devices based on OBD2: significant weaknesses:
  - Data and vehicle security compromised
  - Scalable attack on fleets
- Connected cars under investigation
- IT security throughout lifetime of a vehicle model
Targets of the working group:

- Advance VERONICA-II results, include new technologies and create extended data elements for an EDR for highly automated driving

- Subdivision of the data elements in 4 standardized categories:
  - Driving Data
  - Driver activity
  - Surroundings- and object recognition
  - Crash

- Development of an EDR prototype for highly automated vehicles
VISION ZERO - LESSONS LEARNED?
DEVELOPMENT OF THE NUMBER OF ROAD FATALITIES IN THE EUROPEAN UNION SINCE 1991

Source: Berg, VKU Heft 2/2019
It is certain that the EU goal “cutting the number of fatalities by 50 %” will be not reached

New modes of traffic mobility coming up quickly like e.g. electro scooter or car sharing. This will most likely influence traffic safety negatively!

ADAS have an positive impact and help to reduce severe accidents. But, there are limitations (e.g. technology, penetration rate, acceptance).

New L3+ Functions like e.g. motorway pilot will have only a small effect as only 4 % of accidents happen on motorways. Nevertheless, the enhanced technology will help to improve safety also in further domains.

“Vision Zero” is important and valid but should be clearly communicated as a “Vision”!

Traffic Safety Methods have to be strengthened by all stakeholders with clear goal-orientated focus!
THANK YOU FOR YOUR ATTENTION!
GDV-STUDY „AUTOMATED DRIVING“
RESULTS AT A GLANCE - TPL INSURANCE: PASSENGER CARS

<table>
<thead>
<tr>
<th></th>
<th>Parking and manoeuvring assistant</th>
<th>Emergency braking assistant (EBA)</th>
<th>EBA incl. pedestrian and cyclist detection</th>
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<th>Lane change assistant</th>
<th>Motorway pilot</th>
<th>City and rural road pilot</th>
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</thead>
<tbody>
<tr>
<td>Relevance in %</td>
<td>21</td>
<td>21</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>Efficiency in %</td>
<td>70</td>
<td>40</td>
<td>10-30</td>
<td>20-40</td>
<td>75</td>
<td>90³</td>
<td>90³</td>
</tr>
<tr>
<td>Utilization in %</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>50</td>
<td>90</td>
<td>10-50</td>
<td>10-50</td>
</tr>
<tr>
<td>Market penetration¹ up to 2035 in %</td>
<td>37 / 78</td>
<td>49 / 95</td>
<td>43 / 87</td>
<td>57 / 98</td>
<td>55 / 97</td>
<td>37</td>
<td>13</td>
</tr>
<tr>
<td>Reduction 2035 in %</td>
<td>4.9 / 10.4</td>
<td>4.0 / 7.7</td>
<td>0.9 / 1.8</td>
<td>0.3 / 0.6</td>
<td>1.4 / 2.5</td>
<td>0.1 / 0.1</td>
<td>0.8 / 0.8</td>
</tr>
<tr>
<td>Compared to 2015 ²</td>
<td></td>
<td></td>
<td></td>
<td></td>
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¹ Slow penetration / Fast penetration  
² Reduction potential compared to claims payments 2015 considering already available ADAS  
³ Combination of ADAS lead to efficiency increase up to 90%
GDV-STUDY „AUTOMATED DRIVING“
RESULTS AT A GLANCE

TPL-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

MoD-Insurance – passenger cars: Reduction in claims payments resulting from ADAS and HAF incl. development of vehicle stock and increase of repair costs
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</thead>
<tbody>
<tr>
<td>Relevance in %</td>
<td>17</td>
<td>7</td>
<td>-,-</td>
<td>2</td>
<td>2</td>
<td>-,-</td>
<td>-,-</td>
</tr>
<tr>
<td>Efficiency in %</td>
<td>70</td>
<td>40</td>
<td>10-30</td>
<td>20-40</td>
<td>75</td>
<td>90³</td>
<td>90³</td>
</tr>
<tr>
<td>Utilization in %</td>
<td>90</td>
<td>100</td>
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<td>37</td>
<td>13</td>
</tr>
<tr>
<td>Reduction 2035 in %</td>
<td>3.7 / 7.9</td>
<td>1.3 / 2.6</td>
<td>-,-</td>
<td>0.2 / 0.4</td>
<td>0.7 / 1.2</td>
<td>0.0 / 0.0</td>
<td>0.3 / 0.3</td>
</tr>
<tr>
<td>Compared to 2015²</td>
<td>3.7 / 7.9</td>
<td>1.3 / 2.6</td>
<td>-,-</td>
<td>0.2 / 0.4</td>
<td>0.7 / 1.2</td>
<td>0.0 / 0.0</td>
<td>0.3 / 0.3</td>
</tr>
</tbody>
</table>

¹ Slow penetration / Fast penetration
² Reduction potential compared to claims payments 2015 considering already available ADAS.
³ Combination of ADAS lead to efficiency increase up to 90%.
HOW EFFECTIVE ARE PARKING AND MANEUVERING ASSISTANCE SYSTEMS?

Vehicles with and without PDC have closely the same frequency of parking and maneuvering accidents.

Parking and Maneuvering Accidents with/without PDC

- Without PDC: 41%
- With PDC: 50%

With PDC: 38%

Without PDC: 40%
01 AZT In-depth-Analysis - Results

RELEVANCE OF ADAS

- theoretical maximum accident avoidance potential only for a perfect system!

Heavy duty truck insurance claims with bodily injury

<table>
<thead>
<tr>
<th>ADAS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEBS</td>
<td>Advanced Emergency Braking System</td>
</tr>
<tr>
<td>LCA</td>
<td>Lane Change Assist</td>
</tr>
<tr>
<td>ISA</td>
<td>Intersection Assist</td>
</tr>
<tr>
<td>RTA</td>
<td>Turning Assist (Right)</td>
</tr>
<tr>
<td>RA</td>
<td>Reversing Assist</td>
</tr>
</tbody>
</table>

Graph shows:

- Percentage distribution of accident avoidance potential for different ADAS systems.
- Yellow bars represent the cumulative accident avoidance potential (n=320).
- Red and orange bars indicate the proportion of accidents with fatalities (n=14) and seriously injured (n=51) respectively.

Accidents with fatalities (n=14)
Accidents with seriously injured (n=51)