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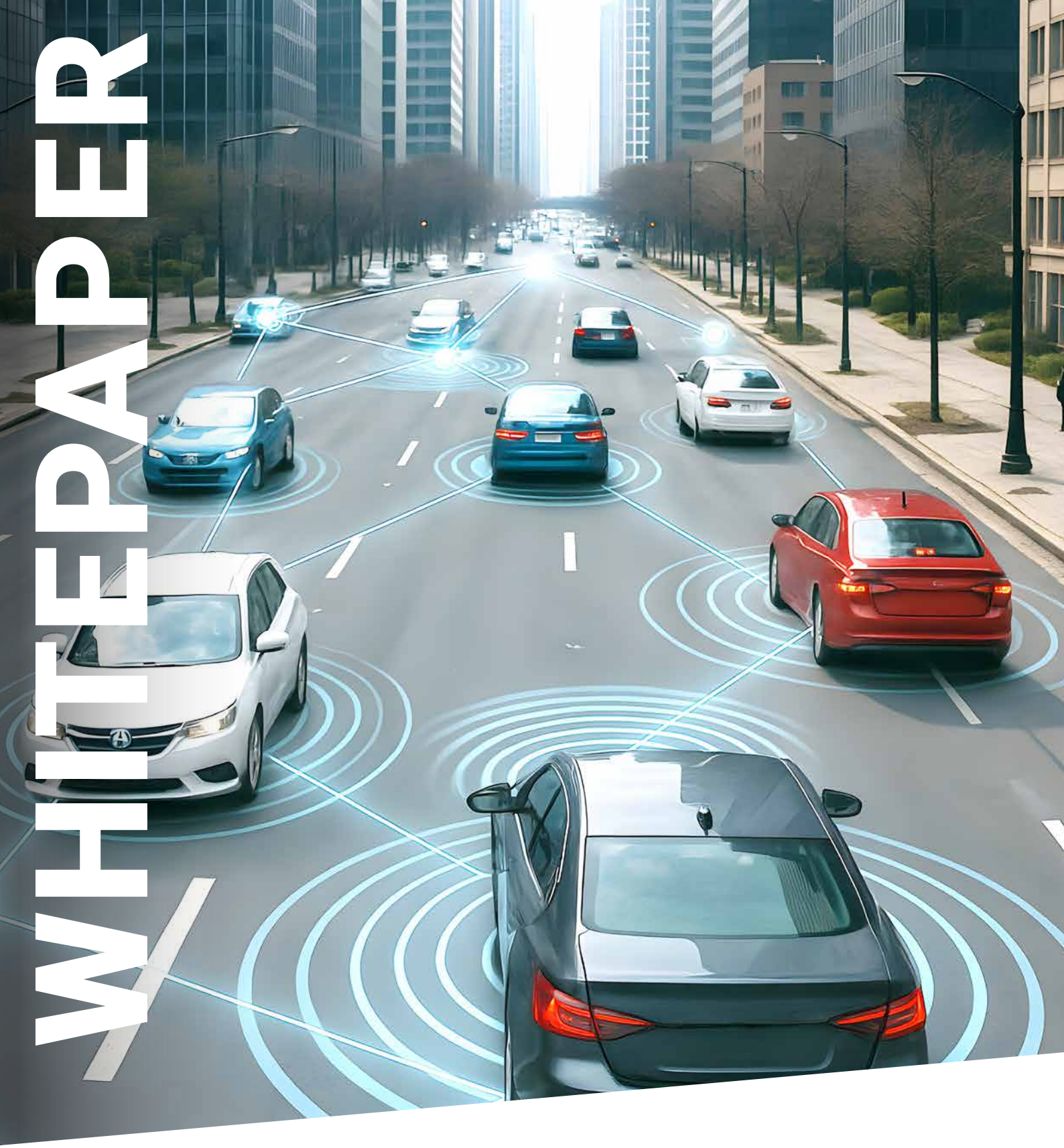

FUTURE-PROOF MOBILITY

ADAS CHECKS AS THE KEY TO ROAD SAFETY

MAHA

WHITEPAPER

Future-proof mobility
ADAS checks as the key to road safety

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1 INTRODUCTION

Advanced driver assistance systems (ADAS) driving innovation in the automotive industry

Advanced driver assistance systems (ADAS) constitute a key pillar of technological innovation in the automotive industry. These systems cover a wide range of highly developed technologies, including lane departure warnings [4], automatic emergency brake systems [6,7], adaptive cruise control (ACC) [1,25] and traffic sign recognition. Integrating these technologies can significantly improve both road traffic safety and driver support [3,18]. ADAS use a combination of modern sensors, including radar sensors, LiDAR (light detection and ranging), high-resolution cameras and advanced algorithms and methods and artificial intelligence (AI) methods [12,23,24]. The continuous real-time data analysis enables precise detection of environmental conditions and significantly helps to minimise road accidents [4].

ADAS mandatory in new vehicles

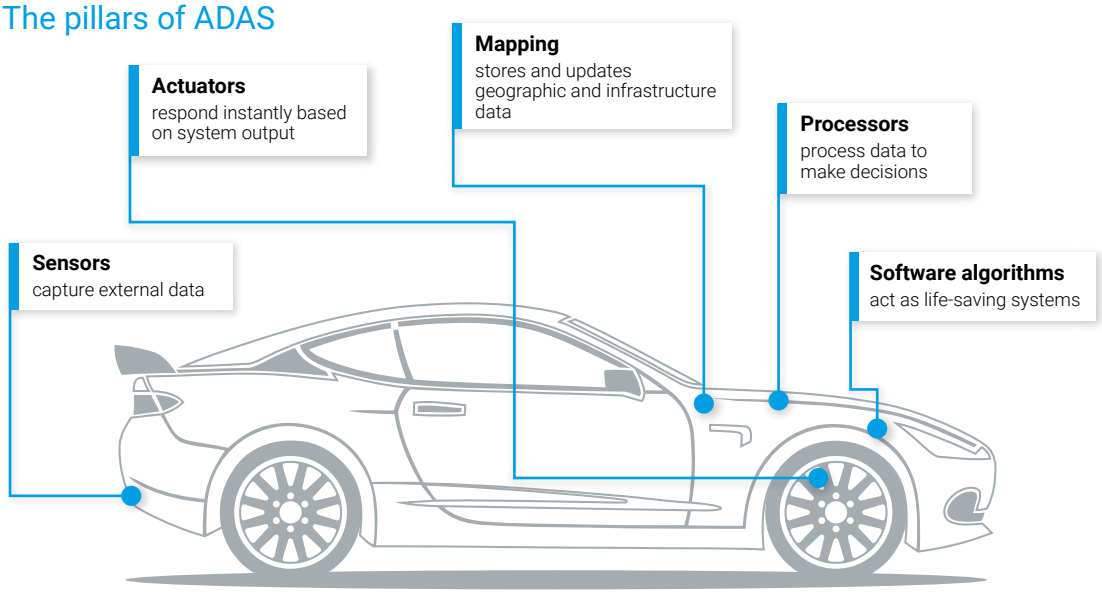
As of 2024, the EU requires new cars to be equipped with driver assistance systems such as emergency brake assistants, lane departure warnings and intelligent speed assistants. While these technologies improve road safety, they also pose new challenges for the maintenance and calibration of vehicles [35].

Sensor fusion and decision-making: the key to modern ADAS

One of the key components of ADAS is sensor fusion, with multiple sensor data sources combined to create a comprehensive and reliable mapping of the environment [12,23]. This technology improves not only the detection of vehicles, pedestrians and obstacles [4,24] but also the anticipation of potential dangers [3,13].

While cameras primarily provide very good lateral distances, radar systems are able to measure precise longitudinal distances and speeds [12,24]. Fusing this information enables robust interpretation of the traffic situation, which allows the system to issue early warnings or to intervene automatically [5,18].

The pillars of ADAS



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Automation and artificial intelligence in ADAS

The combination of increasingly powerful vehicle surround sensors and artificial intelligence forms the basis of the automated driving function and future autonomous driving [4,12,24]. An AI domain controller (Ambarella concept from Continental) could play a key role here, as a central processing element that fuses the data from up to 24 sensor flows – including cameras, radar, lidar and ultrasonic – in real time [6,26]. This deep fusion of sensor data makes it possible to create a precise model of the vehicle surroundings, enabling safe driving decisions to be made [13,30].

Maintenance and calibration: securing system integrity

One of the key challenges of ADAS is the continuous calibration and functional testing of these complex systems [9,20]. High-precision calibration tools and testing platforms, like those developed by MAHA, play a central role here [21,25]. They ensure that the systems remain reliable and strengthen consumer trust in modern vehicle technology [27]. Faulty calibration or system failure can pose considerable safety risks, and these risks can only be minimised by regularly technical testing [18,30].

Regulatory framework and international standards

The scientific and regulatory basis for ADAS is largely influenced by documents issued by the United Nations Economic Commission for Europe (UNECE), in particular WP.29 and the document ECE/TRANS/WP.29/2024/37 [33,34]. These documents emphasise the necessity of integrating ADAS into the periodic technical inspection (PTI) [19,31]. International initiatives aim at creating uniform standards for the calibration and inspection of ADAS, to promote technical consistency and road safety worldwide [33,34].

Empirical evidence and future prospects

Recent research, such as a study carried out by DEKRA (2023), show that vehicles with functioning lane departure warnings can reduce the frequency of accidents on road bends by up to 30% [6]. At the same time, up to 15% of the vehicles tested exhibited minor defects in their ADAS sensors, as documented in KÜS and TÜV analyses [31]. These findings show the importance of regular system checks [18,19]. Using MAHA technologies in the PTI process can play a key role in increasing road traffic safety and making lasting improvements in consumer confidence in advanced vehicle technology [20,21].

2 SCIENTIFIC BACKGROUND

2.1 FUNCTIONALITY AND IMPORTANCE OF ADAS

Advanced driver assistance systems (ADAS) have transformed road safety in recent years, thanks to their innovative technology. These systems provide a wide range of functions that both increase driving safety and make driving easier. The advanced technologies include adaptive cruise control (ACC), lane departure warning and emergency brake assistant, which, when used in combination, set new standards for safety-related vehicle functions [1,4,6].

Adaptive cruise control (ACC)

This system enables vehicles to automatically adjust their speed to match the vehicle in front of them, while maintaining a safe distance. Radar and camera systems are used to continuously monitor the vehicle's surroundings [1,12,24]. ACC not only improves traffic efficiency but also significantly reduces rear-end collisions [1,6].

Lane departure prevention (type 1)

These systems respond actively when the vehicle begins to depart from the lane where this was not intended by the driver. They use cameras to detect the road lane markings and intervene with targeted steering torque interventions to guide the vehicle back into the lane [4,12]. This function is often referred to as lane departure warning with edge guidance. It is particularly useful for preventing accidents caused by inattentiveness or fatigue [6,13].

Lane departure prevention with centre guidance (type 2)

This advanced warning system goes one step further, taking control of the lane guidance and keeping the vehicle in the centre of the lane [4,13]. It works continuously and provides stable support, in particular on long journeys on the motorway. This function provides an additional convenience factor and considerably reduces the driver's workload [1,25].

The distinction between these two types is important, as they provide different functions and different levels of safety. Type 1 is reactive and corrective, while type 2 is proactive and ensures constant stability [4,13].

Emergency brake assistant

This system detects not only obstacles such as stationary or braking vehicles but also complex traffic situations, including pedestrians crossing the road and cyclists or vehicles moving in or across the direction of travel [12,24]. If a collision is imminent, the emergency brake assistant actively intervenes to minimise the risk of an accident. Thanks to advanced sensors and algorithms, the system can analyse the vehicle's surroundings in real time and respond precisely [4,12]. Studies show that the emergency brake assistant is one of the most effective technologies for preventing accidents, considerably improving the safety of people inside the vehicle and other road users [26].

The relevant ECE regulation for emergency brake assistants (AEB, automatic emergency braking) in cars is UN Regulation No. 152. This regulation sets down the technical requirements and testing procedure for emergency brake assistant systems installed in cars and other vehicle classes.

Content of the regulation

Mandatory for new vehicle types:
AEB has been mandatory for new vehicles types in the EU since 2022. In 2024, AEB was made mandatory for all vehicle types (including existing ones).

- **Test requirements:** The regulation prescribes test protocols for various scenarios, such as: Rear-end collisions (e.g. with obstacle or vehicle in front). Collisions with pedestrians or cyclists.
- **Scope:** Vehicles in categories M1 (passenger cars) and N1 (light commercial vehicles) are affected. Systems must ensure effective braking in defined speed ranges and ambient conditions.
- **Aim of the regulation:** Reducing rear-end collisions and collisions with unprotected road users. Improving vehicle safety and general road safety.
- **Stipulations:** ECE Regulation No. 152 does not require all vehicles to have AEB. It only covers vehicles in the above-mentioned categories that were placed on the market after the specified dates. Vehicles that were approved before these data do not have to be retrofitted.

Technologically, ADAS (advanced driver assistance systems) are based on a combination of sensors and software. Radar and LiDAR sensors enable precise distance measurements, while cameras provide visual data that can be processed any analysed by advanced algorithms [12,24].

These technologies complement each other to provide information that is crucial for detective the vehicle's surroundings and classifying objects [4,13]. They enable objects such as pedestrians, vehicles and animals (e.g. dogs) to be identified reliably [12,24]. Integrating the sensors

with AI-supported algorithms allows ADAS systems to detect complex traffic situations in real time and to respond accordingly [4,12].

Machine learning plays a crucial role in the continuous improvement of the accuracy and reliability [4,13]. Fusing the sensor data makes it possible to create a comprehensive and detailed image of the vehicle's surroundings, enabling the vehicle to make sound decisions in a matter of milliseconds [4,12].

2.2 CHALLENGES AND TYPICAL SOURCES OF ERROR

Despite considerable progress, advanced driver assistance systems (ADAS) still face specific challenges that could impair the efficiency and safety of these technologies. These challenges can be divided up into three main categories: technical [19,31], software-based 14,15] and psychological [5,23].

Sensitivity to external influences

The functionality of the sensors used in ADAS is highly dependent on the ambient conditions. Weather conditions such as rain, snow or fog can impair the ability of the cameras, radar sensors and LiDAR systems to detect the vehicle's surroundings correctly [12,24]. These influences can lead to incorrect diagnosis or delay system reactions, which could jeopardise road safety [5].

Software and calibration requirements

Another problem is the software that interprets the sensors' raw data. Errors in algorithms or insufficient updates can prevent the traffic situation from being analysed precisely [14,15]. Furthermore, the sensors need to be calibrated regularly to ensure they are still in correct working order [9,21]. Even minor deviations from the target values can significantly impair the reliability of the systems [10].

Human-machine interaction

The interaction between the driver and the system is a crucial factor. Scientific studies show that drivers often have difficulty in assessing the limits and capacities of ADAS correctly. This can result in the driver either trusting the systems excessively or failing to use them effectively [22].

Regulatory and standardised testing requirements

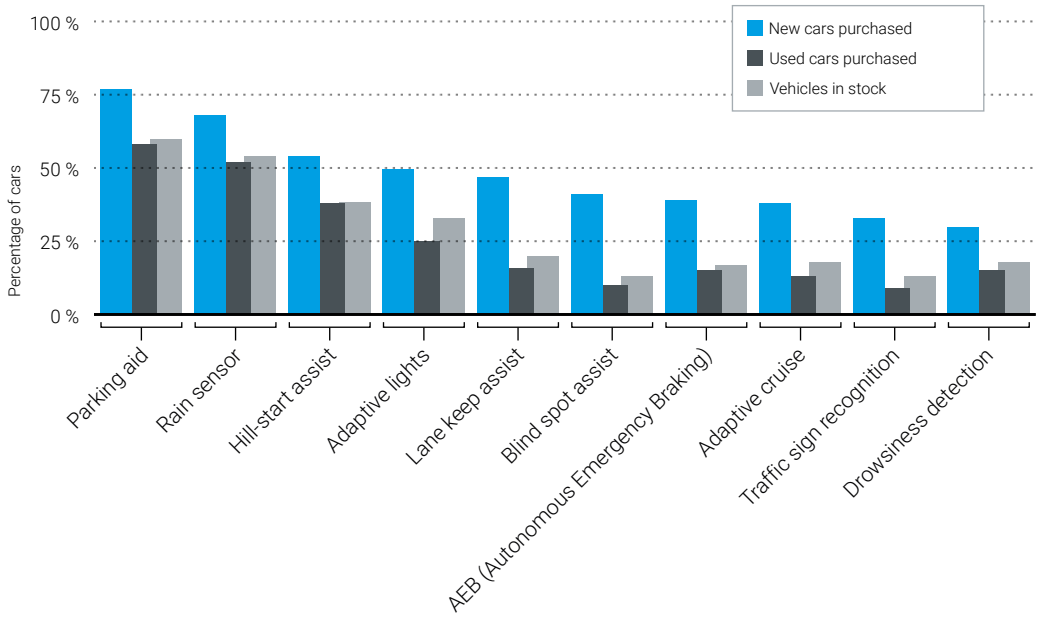
To ensure that ADAS remain reliable, the systems need to be inspected on a regular basis [19,31]. However, there is at present no comprehensively standardised test procedure that can be applied consistently worldwide [33,34]. This makes it difficult to ensure the long-term functionality and safety of these systems [18,30].

Solution strategies

To tackle these challenges effectively, the following are needed:

- **Advanced algorithms:** Development of robust software solutions that can handle a wide variety of environmental scenarios [14,15].
- **Regular calibration and maintenance:** Ensuring that sensors and cameras function perfectly [9,21].
- **Driver-centred design:** Improvement of the user interfaces and human-machine interaction to optimise driver involvement [5,22].
- **Standardisation of testing:** Introduction of global standards for assessing and inspecting ADAS, for example as proposed by UNECE WP.29 [33,34].

Proportion of passenger cars equipped with selected driver assistance systems in Germany in 2019



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3 PROBLEMS IN OPERATING ADAS VEHICLES

3.1 SENSOR AND SYSTEM FAILURE

Despite their technological progress, ADAS systems remain vulnerable to various sources of error, influences by internal and external factors. Common problems include:

- **Wear and environmental influences:** Long-term use leads to mechanical and electrical wear,

in particular in highly sensitive components like cameras and radar sensors [12,24]. Environmental conditions like dust, snow or insects can considerably impair functionality, limiting the reliable detection of obstacles and road users [5].

- **Faulty calibration** is one of the most common challenges for ADAS (advanced driver assistance systems), in particular after maintenance work or when system components have been changed. This occurs when sensors or cameras deviate from their target values, and can impair system reliability [9,21]. It is caused by mechanical changes, such as bumpers or windscreens being changed, and imprecise calibration, as the result of failure to perform alignment, inadequate tools or untrained personnel [20,21]. Software incompatibility, such as faulty updates, and external influences, like uneven calibration surfaces or poor lighting, exacerbate the problem [14,19,24]. Precise calibration methods and trained personnel are therefore essential for reliable ADAS [20,30].

- **Software problems:** A key vulnerability of advanced driver assistance systems (ADAS) is the software that processes and interprets the sensor data. Errors in algorithms or insufficient updates can result in traffic conditions not being detected correctly, making malfunctions more likely to occur [14,15].
  One example of this is a rear-end collision that occurred in the US, where an automatic emergency braking (AEB) system incorrectly initiated an abrupt brake although no danger was present. This incident, which was investigated by the National Highway Traffic Safety Administration (NHTSA), shows the potential risks of faulty software [7].

  Such incidents emphasise the necessity of regular updates and robust testing methods to ensure that the systems are working reliably [14,19,26].

- **Solution strategy:** Regular maintenance and calibration are essential for ensuring the reliability of advanced driver assistance systems (ADAS). Studies shows that even minimal misalignments in the sensors can lead to major malfunctions [9,21].
  Integrating ADAS-specific tests into the periodic technical inspection (PTI) makes it possible to detect potential deficiencies early on. Standardised procedures guarantee consistent quality assurance [18,30]. The PTI service portal of Deutsche Automobil Treuhand (DAT), for example, provides inspectors with vehicle-specific data that they can use to carry out technical vehicle inspections in line with regulations [9].

  Laboratories like Lab4PTI are also developing new testing procedures to meet the increasing demands of automated driving functions. Their strategy covers inspector qualification, partial automation and innovative driving trials to make future PTIs efficient and reliable [10].

  With a combination of regular maintenance, precise calibration and standardised PTI procedures, the functionality of ADAS can be assured throughout the vehicle's entire service life [9,18,30].

3.2 HUMAN FACTORS AND BEHAVIOUR ADAPTATION

The introduction of advanced driver assistance systems (ADAS) has far-reaching effects on driving behaviour:

- **'Out of the loop' effect:** Drivers who strongly rely on automated systems often lose active control and respond less quickly to emergency situations. This phenomenon is worsened by excess dependence and lack of understanding of system limits [13,22].
- **Passive driving style:** Using adaptive cruise control or lane departure warning systems can result in a more passive driving style. Studies show that this can lengthen reaction times in emergency situations [13,21].
- **Incorrect understanding of system abilities:** A considerable percentage of accidents in ADAS vehicles are the result of incorrect expectations of the system performance. Increasing driver awareness and sensitivity is essential for mitigating these problems [14,33,34].
- **Solution strategy:** Measures such as clearly formulated manuals, targeted driver training and the integration of ADAS training into the periodic technical inspection (PTI) can increase awareness of risks and optimise the interaction between human and machine [14,33,34].

3.3 COST PRESSURE AND CONFIDENCE RISKS IN THE AUTOMOTIVE INDUSTRY

The automotive industry faces the challenge of developing innovative technologies like ADAS under high cost pressures:

- **Shorter development times:** Competition and the demand for innovation often lead to companies shortening their test phases and reducing quality control. This increases the risk of defective systems that can trigger unexpected braking or fail to detect obstacles [15].
- **Comparison with the 'Dieselgate' scandal:** As was the case for emission standards, the reliability of ADAS systems can be jeopardised by a lack of external checks and short-term cost reductions. The resulting loss of consumer confidence would affect the entire automotive industry [16].
- **Solution strategy:** Independent tests like the periodic technical inspection (PTI) are necessary to ensure that systems are updated and check for correct functioning on a regular basis. This increases consumer confidence and ensures compliance with international standards, like those set down in the UNECE WP.29 document [29,33,34].

4 THE BENEFIT OF PTI FOR ADAS SAFETY

4.1 RETROSPECTIVE: THE CONTRIBUTION PTI MAKES TO ROAD SAFETY

Over a period of decades, the periodic technical inspection (PTI) has proved to be an indispensable tool for ensuring road safety. Studies show that subjecting vehicles to regular technical inspection can significantly minimise the risk of accidents. The introduction of the PTI in Germany in 1951, for example, led to a considerable drop in technology-related accidents. According to a report issued by the Deutscher Verkehrssicherheitsrat (DVR), faulty brakes and defective lighting systems have become significantly less common causes of accidents since the PTI was launched [18]. Similar results have been found in other European countries. A Transport Safety Council (ETSC) study shows that regular vehicle testing in countries with PTI programs reduced accident rates by up to 20%, as this allows critical defects to be detected and rectified early on [19].

4.2 RELEVANCE OF ADAS TESTS IN THE PTI

Advanced driver assistance systems (ADAS) are a key technology in modern vehicles. Functions such as adaptive cruise control, lane departure warning systems and automated emergency brake assistants considerably increase safety in road traffic, but require precise calibration and regular maintenance. Without systematic testing, severe safety risks could occur. Miscalibrated cameras and sensors, for example, can impair obstacle detection and lane departure prevention. Furthermore, outdated algorithms may not respond appropriately to new traffic conditions [19,33,34].

Practical examples highlight the importance of the PTI: In the US, an incorrectly calibration emergency brake assistant interpreted a shadow as an obstacle, resulting in an abrupt brake and a rear-end collision. Similar problems have occurred with lane departure warning systems that failed to detect lane markings and adaptive cruise control that assessed speeds incorrectly. These incidents show that regular ADAS tests can reveal technical deficiencies while increasing consumer confidence [19,33,34].

Integrating specific ADAS tests into the PTI makes it possible to detect faults early on and ensure correct functioning over the long term. In addition to technical inspections, drivers can be informed of the capacities and limits of the systems, which will help to improve human-machine interaction. In addition, the PTI creates awareness of the functionality, safety and maintenance requirements of these technologies, promoting both consumer acceptance and responsible use [19,33,34].

4.3 REQUIREMENTS OF THE UNECE REGULATIONS

The regulations of the United Nations Economic Commission for Europe (UNECE), such as ECE/TRANS/WP.29/2024/37, define clear requirements for ADAS systems. These include:

- **Operating limits:** ADAS systems need to operate reliably within the defined speed and value ranges.
- **Error tolerance:** Systems should switch off securely in the event of technical problems and include risk minimisation measures.
- **Driver monitoring:** The driver must always be able to intervene in any critical situation [33,34].

To integrate these requirements into the PTI, specific test protocols are needed. This includes calibration of sensors and cameras, tests performed under varying traffic and weather conditions and checking of software versions. These measures ensure that the algorithms meet the latest standards and that ADAS systems can retain their functionality over the long term [19,33,34].

4.4 CONCLUSION: PTI AS THE KEY TO A SAFE ADAS FUTURE

Integrating ADAS-specific tests into the PTI as an indispensable step towards ensuring road traffic safety. The UNECE Regulations provide a clear basis for standardising these test processes and making the future of mobility safe and efficient [18,19,33,34].

Regular checks of sensors, cameras and software versions enables potential malfunctions to be detected and rectified early on. This not only increases consumer confidence in modern vehicle technologies but also significantly reduces accident rates. Over the long term, such measures help to further increase the acceptance of driver assistance systems and autonomous driving functions.

5 MAHA SOLUTIONS FOR ADAS TESTING AND CALIBRATION

The MAHA Adaptive System Tester (MAST) is a future-oriented development in the efficiency testing of advanced driver assistance systems (ADAS). This system was developed especially for the efficient and comprehensive testing of modern driver assistance systems both in the periodic technical inspection (PTI) and in workshops. With a test time of less than five minutes and a modular design, MAST has advantages for both large testing stations and smaller operations [21]

Thanks to its innovative technology, including dynamic calibration functions and over-the-air testing (OTA), the MAST enables precise testing and adjustment of ADAS systems like lane departure warning systems, adaptive cruise control (ACC) and emergency brake assistants. Thanks to its seamless integration into existing testing processes and its support of cutting-edge simulation technologies like radar and image simulation, the MAST can create realistic test conditions that are crucial both for OEMs in the end-of-line segment and for workshops and PTI stations.

These comprehensive functionalities make the MAHA Adaptive System Tester an indispensable tool for ensuring correct functioning and safety in modern vehicle technologies.

Technological innovations

Over-the-air test function (OTA)
The MAST enables testing of ADAS functions like lane departure warnings and adaptive cruise control without accessing the vehicle physically. Instead, the vehicle is simulated and stimulated by a combination of image and radar signals. These OTA test functions create a realistic testing environment without requiring a direct connection to the vehicle, allowing efficient and precise functional testing [21].

Simulation technology
The prototype is based on a dynamic driving platform that can simulate realistic driving situations. Visualisation software generates appropriate image content and controls radar simulators produced by partners such as Rhode & Schwarz, dSPACE and Konrad Technologies [23,24]. This combination makes it possible to precisely reproduce driving manoeuvres and environmental conditions, allowing ADAS systems to be tested and optimised under controlled and reproducible conditions.

The MAST has proven to work effectively with test vehicles like the VW ID.4 or Audi Q3, although the test set-up currently requires the test vehicle to be firmly held in place. A dynamic closed-loop control concept is set to make this unnecessary in future and enable more realistic measurements [21].

Practical applications in PTI and workshops
The MAST is a practical solution for systematic ADAS testing in PTI stations and workshops. With fast testing in under five minutes and a modular structure, the system can support both large test stations with high throughput requirements and smaller operations [21].

Advantages in the PTI and the workshop
Efficient testing of lane assist, ACC and road sign detection. Can be adjusted to suit OEM requirements, enable versatile use in special projects. Potential for standardising ADAS tests thanks to the use of innovative technologies and collaboration with PTI organisations. The MAST is not only a test system but also a prototype that can establish new standards for ADAS testing. This increases the confidence that OEMs, associations and consumers have in the safety of modern driver assistance systems [21,33,34].

Use in end-of-line and development departments of OEMs

In the end-of-line process (EOL), the MAST is an indispensable solution for ensuring that all vehicles are supplied with optimally calibrated ADAS systems. The MAST's dynamic calibration function enables ADAS components like cameras, radar sensors and LiDAR systems to be tested and adjusted under realistic conditions. Thanks to the patented steering technology and the dynamic stabilisation, vehicle steering and sideways movements can be simulated, enabling precise tests without the vehicle having to be fixed firmly in place.

For development departments, the MAST can be used to test and validate new ADAS functions. With partner solutions like the radar simulators from dSPACE, Rhode & Schwarz or Konrad Technologies, the MAST integrates cutting-edge simulation technologies in order to create realistic scenarios. This enables efficient testing and optimisation of functions like lane departure warning systems, adaptive cruise control and emergency brake assistants.

Dynamic calibration: a step towards the future

Dynamic calibration refers to sensors being aligned during the vehicle movement – a process that cannot currently be mapped in the workshop environment. In practice, this alignment has always been performed when the customer drove the vehicle for the first time, without any reliable check of the calibration quality.

With the planned extension of the MAST, this process will in future be carried out under reproducible, test-bench-like conditions. This means that calibration processes for safety-related systems like emergency brake assistants and lane departure assistants can be performed targetedly and precisely.

Future developments

- **Patented steering technology:** A central goal of the further development of the MAHA Adaptive System Testers (MAST) is the introduction of patented steering technology that eliminates the need to fix the vehicle firmly in the test set-up. This closed-loop controller system works with dynamic stabilisation, which directly compensates for the steering and sideways movements of the vehicle. This allows the vehicle to move 'freely' in a simulated driving situation with its stability precisely controlled. This technology enables more realistic test conditions, as the vehicle is able to respond to external stimuli as it would on the actual road. The testing process is also made more efficient, as the tests require considerably less set-up and preparation [21].
- **MAIA as a complement:** The MAIA system (MAHA Autonomous Inspection Assistant) will play a key role in future in the initial measurement and positioning of the vehicle on the MAST. MAIA will reference the exact position of the vehicle relative to the direction of travel and to the test equipment like the radar target simulators and visual display systems. This is essential for creating a precise and repeatable test environment [21].
  MAIA also enables correct alignment and positioning of technical equipment like the radar target simulator, making it possible to test lane departure, adaptive cruise control (ACC) and emergency brake assistants.

6 SUMMARY AND CALL TO ACTION

Summary

Advanced driver assistance systems are an integral part of modern vehicles and significantly help to improve road safety. Their effectiveness is highly dependent on regular maintenance and calibration, however. Sensor errors, software problems and inadequate calibration can pose considerable safety risks. This white paper has shown the ADAS must undergo regular testing to ensure its functionality and safety. The MAHA Adaptive System Tester is a practical solution for carrying out these tests in a quick and cost-effective way. The integration of ADAS tests into the PTI also underpins the importance of new safety standards.

Call to action

The future of safe mobility requires all relevant players to work together. Legislators need to introduce clear regulations for regular ADAS testing as part of the PTI and promote international standards in harmony with the UNECE regulations. PTI organisations should adapt existing test protocols to integrate specific ADAS tests and enable use of innovative systems like the MAST. OEMs should be actively involved in developing uniform test standards to ensure interoperability and support cost-effective solutions for efficiency tests.

Invitation to collaborate

MAHA invites all stakeholders to work together to shape the future safe mobility. Politics, PTI organisations and OEMs can make a decisive contribution to road safety with pilot projects, the integration of new technologies and the development of standardised testing protocols.

With the MAST as a driving force, MAHA shows that ADAS efficiency testing is not only necessary but also plausible.

Conclusion

The automotive industry faces the challenge of making ADAS technologies safe and reliable. With innovation, collaboration and clear standards, technical quality can be improved and consumer confidence in life-saving systems can be strengthened. With the MAST, MAHA is setting new standards and showing that the safe mobility of tomorrow can be shaped today.

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ABBREVIATIONS

ACC	Adaptive cruise control – for automatic speed and distance control.
ADAS	Advanced driver assistance systems – for improved safety and driver support.
AEB	Automatic emergency braking
ATR	Auto Technology Support – publications relating to ADAS technologies.
DAT	Deutsche Automobil Treuhand – provider of vehicle data and services.
DEKRA	Deutsche Kraftfahrzeug-Überwachungsorganisation – German vehicle testing organisation.
DLR	Deutsches Zentrum für Luft- und Raumfahrt – German Aerospace Center – organisation for technological research.
DVR	Deutscher Verkehrssicherheitsrat – organisation promoting road safety.
ECE	Economic Commission for Europe.
ETSC	European Transport Safety Council.
HAL	Exam qualifying for university admission – may refer to semiconductor technology in some contexts.
IHRA	International Harmonized Research Activities – international working group for safety principles.
AI	Artificial intelligence – technology simulating human intelligence.
MAHA	Maschinenbau Haldenwang GmbH & Co. KG – manufacturer of testing and diagnostics technology.
MAIA	MAHA Autonomous Inspection Assistant
MAST	MAHA Adaptive System Tester – test platform for ADAS.
NHTSA	National Highway Traffic Safety Administration – US traffic safety authority.
OTA	Over-the-air – technology for wireless communication and simulation.
PTI	Periodic technical inspection – regular safety check for vehicles.
UNECE	United Nations Economic Commission for Europe.
VW	Volkswagen – German automotive manufacturer.

About the author

I have been involved in innovation for 25 years and began working on test vehicles incorporating high-end technologies at an early stage. My focus is on developing and optimising new technologies. Today, as Managing Director of MAHA, I stand for practical innovations and reliable solutions in inspection and workshop technology.

'Find out more about ADAS and ADAS testing as a key factor in road safety – in this whitepaper'

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