
VDA
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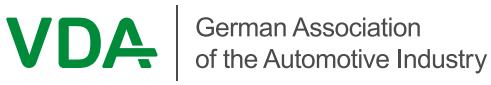
The VDA Flagship Initiative Connected and Automated Driving

COLLABORATIVE RESEARCH WITH AN IMPACT

Partners of VDA Flagship Initiative Connected and Automated Driving



CONTENT

FOCUSING INTERESTS

Thinking CAD Together and Acting Decisively

Mobility issues of the future are closely tied to digitalization and even more to the development of artificial intelligence.

A large part of the current challenges in the mobility system is expected to be adressed through digitalization. Self-driving vehicles on road and rail are pivotal to forward-thinking transportation and mobility scenarios.

However, the path to this goal is far from straightforward. Investments in research and development are massive, technological paths are diverse, competitors from the USA and China are aggressively entering into the automotive markets, and, not least, the social and political landscape is evolving rapidly. These are demanding conditions for an industry in the midst of transformation, one that has shaped Germany's industrial landscape like few others.

Connected and automated driving (CAD) holds immense strategic significance for the automotive industry. It contributes to qualified jobs, high added value, vast innovation potential, and ensures international competitiveness and connectivity, making CAD a cornerstone for the future of mobility.

The VDA Flagship Initiative Relies on Industry-wide Cooperation

In Germany, the response to these challenges is the VDA Flagship Initiative for connected and automated driving (VDA LI). Guided by the belief that the industry can only address CAD's cross-sector research challenges through collaboration, committed vehicle manufacturers and suppliers joined forces in 2016 under the umbrella of the German Association of the Automotive Industry in the VDA LI. The goal of its members is to identify and advance key CAD research and development priorities that affect the entire industry within a pre-competitive framework. The Flagship Initiative serves as a coordinating body for initiating and managing large consortium projects. These are open to other stakeholders from industry, technology and science. The initiative's activities focus on cross-cutting topics such as artificial intelligence (AI), safety, and standardization across various application areas (use cases).

LEVERAGING EXPERTISE

Successful Applied Automotive Research

To maintain and strengthen its leadership in connected and automated driving (CAD), the German automotive industry must advance key technologies, master their application, and ensure their broad accessibility. Additionally, an ecosystem is needed that fosters an open framework while ensuring scalability.

Through highly networked large-scale projects and the transfer of knowledge and results across project boundaries, the VDA Flagship Initiative supports the comprehensive development of competencies in connected and automated driving within Germany. The focus is on new technologies and their practical applicability, particularly in relation to innovative driving functions, development processes, and the industry-wide adoption of new methods.

Key Focus Areas of the VDA LI

» **New Technologies:**
AI, generative methods, software, quantum algorithms

» **In the Vehicle:**
Future CAD functionalities

» **Vehicle and Environment:**
Backend connectivity and infrastructure communication

» **Validation:**
Validation methods and toolchain

» **Data:**
Generation, processing, maintenance, management

» **Development Methods:**
Data-driven development, AI, and validation in the development process

AVF Technology Development: Strategic Positioning of the Industry

Driver assistance systems and automated driving functions at Levels 1 and 2, commonly referred to as ADAS (Advanced Driver Assistance Systems), are already commonplace in many vehicles today. Higher levels of automation (Levels 3 and 4) require mastering exponentially increasing complexity. Considering vehicle categories such as passenger cars, trucks, buses, and shuttles in applications like individual transport, public transportation, and logistics, technology development focuses on expanding the Operational Design Domain (ODD) with respect to time of day/season, weather conditions, surroundings, traffic situations, road types, and higher speeds. Safe driving at higher levels of automation is expected to be available in many vehicles by 2030.

2020:

USE CASE AUTOMATED VALET PARKING

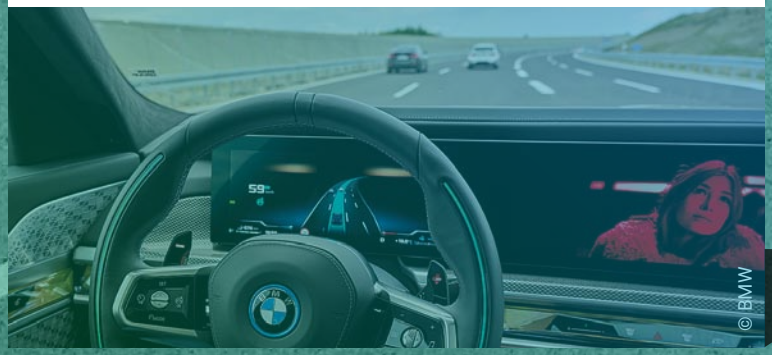
Searching for a parking spot in a garage is time-consuming. Automated Valet Parking adresses this by allowing passengers to exit the vehicle in a designated area outside a parking garage, after which the car parks itself at the push of a button. Retrieval is also fully automated. In 2020, Bosch and Mercedes-Benz introduced the world's first infrastructure-supported Level 4 automated valet parking service, operating in mixed real-world conditions. Standardized interfaces and protocols enable smooth communication between vehicles and infrastructure technology.

© Mercedes Benz

2023:

USE CASE HIGHWAY 60 KM/H CERTIFIED

With international regulations enabling automated lane-keeping systems, these systems have been permitted in Germany and Europe since 2021. The first Level 3 system allows for automated lane-keeping at speeds of up to 60 km/h on highways, particularly useful in traffic jams. Early in 2023, regulations were updated to allow highly automated lane-keeping systems to operate at speeds of up to 130 km/h on highways, along with automated lane changes. Mercedes-Benz has offered such a system in its luxury models since 2022, and BMW since 2023, in both Europe and the U.S. In the coming years, Level 3 systems and vehicles are expected to operate in broader conditions and at higher speeds.


© BMW

Starting 2025:

Use Case Truck Hub2Hub Certified

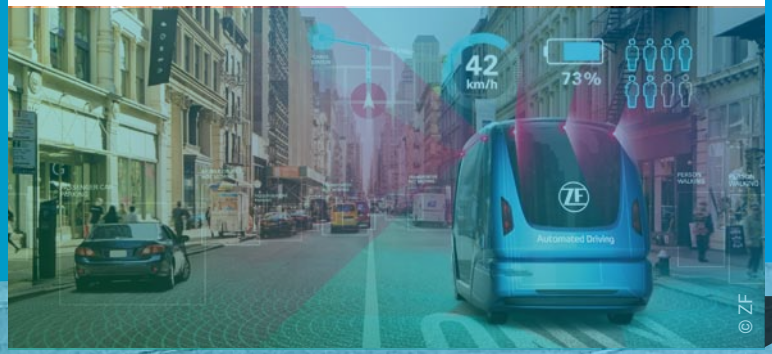
Automated driving offers a wide range of applications in freight transport. In logistics, autonomous vehicles are expected to independently drive to and from loading and unloading hubs. In the Hub2Hub use case, driver-operated trucks will deliver goods to transfer stations near highways. There, highly automated Level 4 trucks will take over, transporting the cargo independently to the destination hub. Upon arrival, the “last mile” will again be covered by driver-operated trucks. Various commercial vehicle manufacturers are already testing this use case in different pilot project configurations.

© Daimler

After 2030:

USE CASE URBAN SHUTTLE IN PUBLIC TRANSPORTATION

Self-driving shuttles in public transportation offer expanded mobility options for both urban and rural areas. These shuttles can efficiently transport passengers while reducing car traffic and associated emissions in metropolitan areas. Additionally, they improve rural connectivity to urban centers and help address the shortage of drivers in public transportation.



© ZF

We invented the car, and now we are reinventing it: clean, safe, and digital. Germany is a pioneer in developing automated driving technologies and is the first country worldwide to pass a law on this topic – an important step towards real-world implementation.

VDA

Since the 1990s, the BMW Group has supported research into modern mobility with increasingly automated systems that allow driver and vehicle to operate independently. Through partnerships and funding, the BMW Group aims to make automated driving a central component of future mobility.

BMW

Self-driving cars are ushering in a new era on our roads. As innovation leader, we laid the foundation early for all levels of automation with driver assistance systems and the corresponding environmental sensors. Thanks to intelligent software and powerful hardware, future vehicles will be able to transport passengers safely and comfortably without driver intervention.

Bosch

ZF is one of the leading technology providers for autonomous driving. Automated and autonomous functions contribute significantly to greater safety, efficiency, and comfort across all vehicle categories. ZF offers a strong portfolio of sensors, high-performance computers, specialized software solutions, and intelligent actuators, providing customers with valuable and in-demand development services.

ZF

Valeo is a pioneer and global leader in automated driving technology. These technologies play a key role in making mobility cleaner, safer, and smarter. A core element of automated driving is perceiving the increasingly complex vehicle environment through sensors combined with intelligent software and artificial intelligence.

Valeo

Automated and connected mobility has been an integral part of our corporate strategy for many years. We see ourselves as the link between IT and automotive development, as we know what it takes to bring applications into the vehicle. We support our customers in all aspects of assisted and automated driving.

AVL

Autonomous driving will play a central role in the future, fundamentally revolutionizing the automobile, with the support of artificial intelligence. A range of Mercedes-Benz concept vehicles and prototypes have already demonstrated that the technical prerequisites are in place and function as intended.

Mercedes-Benz

The technological foundations for autonomous driving are high-performance sensors and robust connectivity between vehicles and infrastructure. HELLA develops highly sensitive sensors and lighting systems for autonomous vehicles, supporting the promising path to full autonomy with both hardware and software.

FORVIA HELLA

Automated and autonomous driving brings a new dimension to all forms of transportation. For autonomous driving to work, sensor data must be fused, and vast amounts of data must be processed. Software and hardware in the vehicle must be seamlessly connected. Continental has identified multiple approaches to advancing this field.

Continental

DENSO remains committed to developing technology for advanced driver assistance and realizing safe and flexible mobility for all people around the world, including drivers and pedestrians. Advanced driver assistance technologies are essential to helping drivers safely operate vehicles in driving scenarios.

DENSO


MAKING AN IMPACT
Advancing Progress Together

The VDA Flagship Initiative Lives up to its Claim – Safe Autonomous Driving Originates from Germany

Given the highly complex, demanding, and resource-intensive nature of technology development, the solution is clear: cooperation.

Within the VDA Flagship Initiative, participating industry partners discuss and develop a unified stance on research and development needs. Policymakers can rely on this coordinated industry position to align funding priorities accordingly. Through close collaboration with relevant federal ministries, the VDA Flagship Initiative has strengthened alignment in national funding policy for CAD and enhanced convergence in technology development across programs and projects.

The German industry continues its ambitious path, prioritizing consistency and a safety-focused approach. While this strategy has occasionally appeared cautious compared to the activities and announcements from the U.S. and China, its success has validated Germany's strategic direction. The first and so far only internationally approved Level 3 system comes from Germany. In contrast, many announcements regarding autonomous driving from providers in the U.S. and China have yet to be realized.

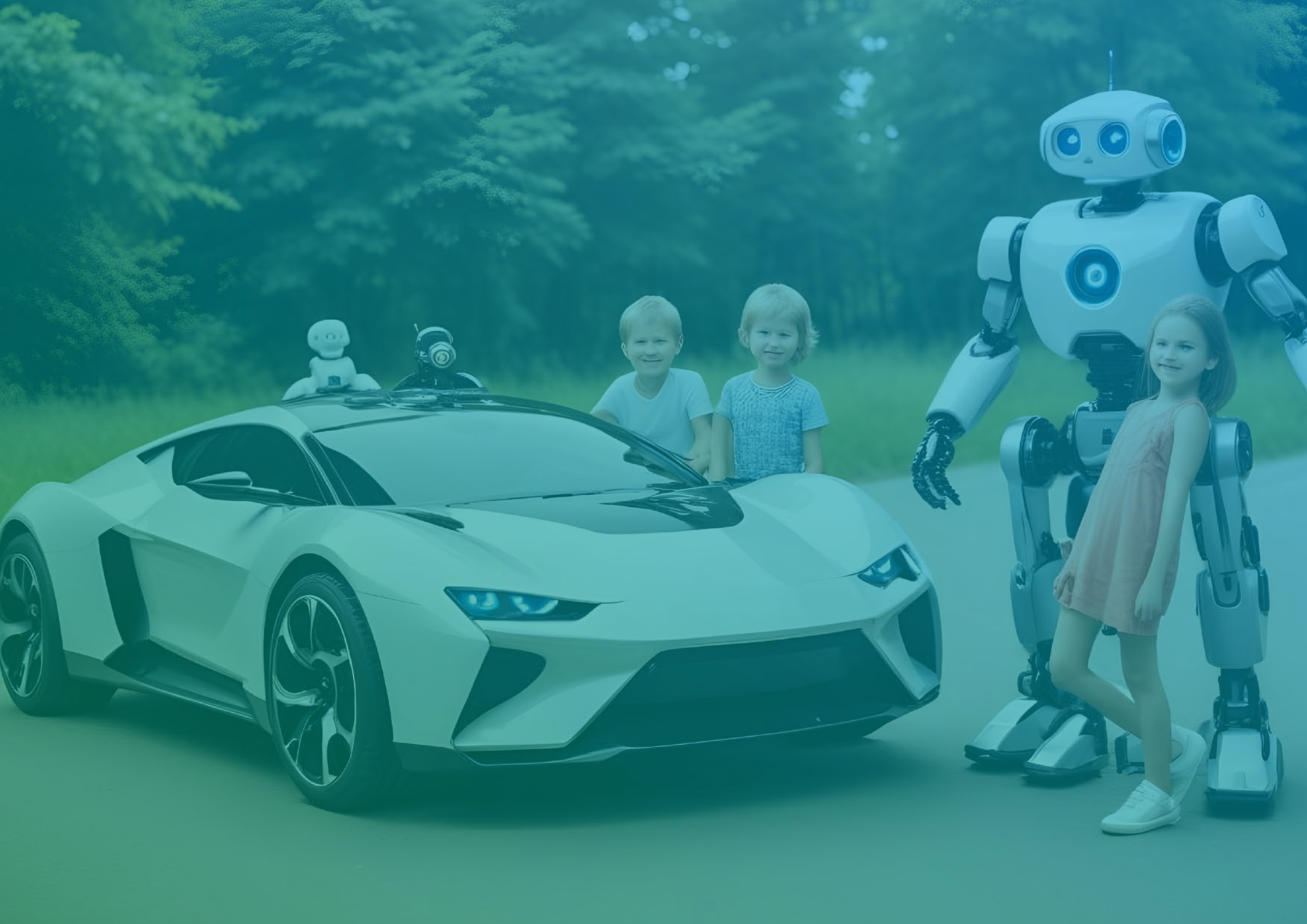
Challenges for the German Automotive Industry Remain

Despite successes and ongoing technological advances, the challenges in achieving driverless mobility across all modes of transport remain substantial.

Recent developments in artificial intelligence offer hope that significant progress will be made in the coming years on complex issues surrounding data, as well as on scenario and environment expansion, simulation, testing, validation, verification, and safety assurance.

The need for innovation remains high, with many critical aspects that require pre-competitive, cross-industry discussion, research, and solutions.

Cooperation Continues to be the Essential Tool for the Future.



PROJECT FAMILIES

Pegasus, AI, @City

The VDA LI-developed project families Pegasus, AI, and @City focus on critical research and development areas for connected and automated driving that are essential for maintaining competitiveness. These projects tackle various research fields that complement one another effectively.

Within these project families, research and development resources are used efficiently, leveraging synergies and sharing outcomes across projects when requirements and research topics overlap.

VDA LI ensures knowledge transfer between sister projects and facilitates information exchange across project families. This concept of a “sharing community” is central to all VDA LI-initiated research initiatives.
New projects deliberately build on the findings of ongoing and completed projects, and wherever possible, share project infrastructure and data.
This approach minimizes redundancy, prevents misinvestment, and enables high adaptability and practical application of project results.

PEGASUS FAMILY

PEGASUS FAMILY IN BRIEF
Worldwide establishment of scenario-based development and validation
Standardization of simulation-based development and testing tools (architectures, scenarios, traffic environments, models, and interfaces)
Further development of the Pegasus 6-Level Model for urban use cases
OpenDrive, OpenScenario, OpenSimulation Interface, Open ODD (ASAM)
ISO CD/TS 5083 Safety for automated driving systems — Design, verification and validation

Methodology: Standards for Testing and Safety Argumentation

Driver assistance systems, including automated driving functions, must demonstrably be safe. Establishing a broadly accepted understanding of the behavior quality and reliability of automated vehicles is essential. The Pegasus Family of projects serves as the bridge between safety argumentation and the development process for driver assistance systems.

In Pegasus Family projects – such as Pegasus, SetLevel, and VVMethoden – efforts have focused on creating a standardized, cross-industry approach to simulation-based development and testing tools for connected and automated driving (CAD). These projects have also elevated the international visibility of Europe's approach to safe autonomous driving.

Research Areas and Impact

Within the Pegasus project family, a Credible Simulation Framework has been developed to support robust development and validation of CAD. Additionally, a transparent safety argumentation framework was established as a central component for safety assurance, meeting legal requirements through reliable behavioral derivation. The projects analyzed various operational design domains (ODDs) and identified relevant and critical scenarios. Key outcomes, such as the Pegasus 6-Level Model and the Omega Data Format, are now widely used globally in CAD development. Pegasus projects have made significant contributions to ISO 5083 standards for the development, verification, and validation of assisted driving. The project partners have built methodological expertise to incorporate safety objectives and safety argumentation into the development process. The Pegasus Family has pioneered the scenario-based approach to safety assurance, now the prevailing method in the industry. Scenario datasets for re-simulating real-world drives (digital twin) were also created, enabling the shift of substantial testing portions to simulation through the effective use of scenario-based release methods.

KI FAMILIE

AI FAMILY IN BRIEF
World's first industry consensus on methods and measures for securing AI functions
Knowledge advantage in AI methods in the automotive context built within a few years
Combined datasets for extended reuse
Definition of strategies to counteract manipulation and adversarial attacks on AI systems
Contributions to the development of generative AI and the success of Stable Diffusion
ISO/AWI PAS 8800 Safety and Artificial Intelligence

Safe AI Technologies and Data Generation

Traditional automotive challenges take on new dimensions with the advent of artificial intelligence (AI). Expertise in AI and the secure integration of this technology into modern vehicles will determine future leadership in mobility markets. Through the projects in the KI Familie (AI Family), the participating partners jointly address the challenge of making AI safe and effective for autonomous driving. The first generation of AI family projects – KI Absicherung (AI Assurance), KI Delta Learning, KI Data Tooling, and KI Wissen (AI Knowledge) – develops comprehensive AI expertise across the automotive application spectrum with thematic complexity and an interconnected structure. With the second generation of projects – just better DATA and nxtAIM – the focus has shifted towards data generation and the use of generative AI in CAD, highlighting key areas in cross-industry research collaborations.

Research Areas and Impact

For the first time in research, the AI family projects introduced and implemented fully coordinated projects, involving a wide array of academic experts alongside industry partners to advance the broad industrial use of AI. These efforts established the world's first industry consensus on methods and standards for securing AI functions.

The AI family projects laid the groundwork for data-driven development processes incorporating safety argumentation (AI Life Cycle; Data Life Cycle) and essential function development to handle everyday traffic situations. Sustainable and robust machine learning (ML) methods and development processes have also been created.

The KI Familie contributed foundational concepts to the ISO/PAS 8800 Safety for AI standard, building application-specific expertise for the German automotive industry. These projects not only introduced an ML life-cycle architecture with methods and workflows for data and ML application, but they also developed large, combined datasets using real and synthetic data. Advanced perception algorithms were also created for future driving functions, and it was demonstrated that adapting AI systems to the automotive context and vehicle resources is feasible.

Expanding Automation to Urban Traffic

In the projects of the @City family – @CITY, @ CITY-AF, DEKOR-X, and STADT:up – the partners pool their expertise to develop groundbreaking technologies for automated and connected urban driving and create functional prototypes for urban autonomous driving. For automated vehicles to navigate city traffic safely, they must reliably perceive the complex traffic environment and manage challenging traffic situations. Additionally, urban driving requires seamless communication and interaction between the vehicle and other road users.

Research Areas and Impact

The @City Family focuses on concept and technology development along with the realization of demonstrable functional prototypes for urban automated driving. AI-based methods play a key role, such as in sensor-based environmental perception, which must provide detailed traffic information even under adverse conditions, or in sensor data fusion, where AI combines data from multiple sensors to create an accurate, comprehensive view of the vehicle's surroundings. AI methods are also crucial in predicting the actions of other road users and planning the vehicle's responses accordingly, enabling it to move safely and efficiently in urban traffic.

Another core area is developing innovative interaction concepts between humans and automated vehicles. This includes external and dynamic human-machine interfaces that allow automated vehicles to clearly communicate their intentions and maneuvers to others in a naturally understandable way.

Building on these concepts and technologies, the @City Family research projects are creating demonstrable driving functions tested and showcased in challenging urban traffic scenarios. The ultimate goal is to demonstrate that advanced automated driving functions are capable of meeting the complex demands of urban mobility.

@CITY FAMILIE

@CITY FAMILY IN BRIEF
AI models for perception, sensor fusion, prediction, and behavior planning
Advanced interaction concepts between humans and automated vehicles
Functional prototypes for automated urban driving in test vehicles
Demonstration in challenging urban scenarios such as intersections and interactions with vulnerable road users
Intermodal mobility concepts for urban environments

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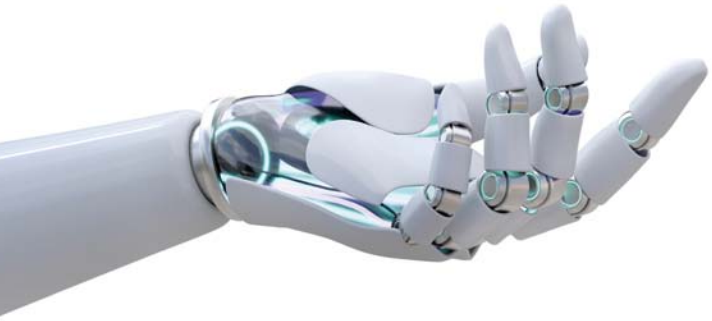

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