

focus

S P E C I A L

AVL

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INNOVATIONS FOR SAFE AND INSPIRING MOBILITY SOLUTIONS



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A STRATEGIC FOUNDATION FOR THE FUTURE

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Mobility is changing. As technologies such as ADAS and automated concepts gain focus, we face a paradigm shift in the way vehicles are designed, built and used. This means new challenges and opportunities in almost every aspect of the vehicle. From a societal perspective, these are mainly in terms of road safety. For the end user it is also about comfort, safety and convenience. For OEMs, suppliers and many start-ups, the focus is on bringing innovation to market, monetizing it and exploring new business models. This requires new approaches in development, system testing, as well as validation and certification.

The future is, of course, unwritten, but there are many influences shaping the road ahead. Whether it's the demands of the markets, regional and international legislation, or the driving force of innovation itself, the industry is finding its footing and confidence in this new landscape.

At AVL we have been working on these exciting challenges for quite some time. Virtualization – blending the simulated with the real world – along with Model-Based Systems Engineering (MBSE) and proving ground plus real world testing for the development and validation of AD and ADAS systems, are cornerstones of our business. The resulting data-driven development ecosystem enables us to combine our solid and professional software know-how and our application expertise. These are all crucial ingredients for developing and building the next generation of safe, reliable and inspiring mobility solutions.

By combining our vision, our focus on R&D and new technologies, as laid out in our ADAS/AD strategy towards 2025, we find ourselves in a unique position to be able to support our customers in this new and challenging era of mobility. We've seen what's coming next and we have shaped our strategic direction accordingly. With our know-how, our portfolio of tools and solutions and our deep understanding of our customers' needs, it makes us the perfect, professional and reliable partner for high demanding technology solutions within ADAS/AD system development.

DRIVERS OF INNOVATION

Innovation is creating a new automotive landscape, but what is the driving force behind it?

— The race to market in the new era of mobility is being fueled by a variety of factors, all of which are accelerating innovation. Even innovation itself plays a role as consumers, hungry to be early adopters of the newest technologies, demand that OEMs step up and deliver.

Some brands are eager to be first to introduce Automated Driving (AD) systems. But with being first also comes the risk of failing first – and the damage that can do to a brand's reputation. So, where brands are unable or unwilling to lead, it is driving them to be different, better or more affordable. With updates, features and different performance characteristics potentially available over the air, new business models present themselves. But it's legislation and the creation of value that will really shape the road ahead.

A FRAMEWORK FOR PROGRESS

Despite exhaustive testing in the simulation, on the testbed, the proving ground, and on the road, it is incredibly difficult to be 100 % certain how an AD system will behave in every possible scenario. Ultimately, in most countries it will be standards, legislation or certification that will lay the foundation for what can or cannot be done on the road.



Once this framework is in place, it provides a basis that OEMs and Tiers can work upon. Additionally, it can also be a motivator to OEMs to find new methods and locations for development. For example, Automated H2H (Hub-to-Hub) transportation requires commercial vehicles to be driven over long distances autonomously. Legislation is in preparation in many markets, but it is not ready to be rolled out yet. However, in some states in the US, not only are the longer highways more suitable with lower traffic densities, but state legislation also permits comprehensive testing of autonomous pilot fleets.

International standards and legislation also influence development in areas such as vehicle-to-vehicle and vehicle-to-infrastructure. Differing privacy laws and government poli-

cies all have a big impact on what can be done across the EU, in North America, China and South-East Asia, for example.

DELIVERING VALUE

As brands seek differentiation, the focus moves to delivering value, and how this translates into revenue streams. For some end users this means on-demand features, systems upgrades, and new in-vehicle entertainment. For others – particularly commercial operators – it's technologies that positively impact TCO, such as platooning or ADAS comfort functions that attract new drivers to hard-to-fill roles, or which support driver substitution. Driver substitution is the ultimate goal of AD in the commercial vehicle sector, as it eliminates staffing



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INTERVIEW

Stephan Tarnutzer
President AVL Mobility
Technologies Inc., USA

focus: Which differences do you see in the market drivers and requirements between US and others in ADAS/AD?

Tarnutzer: The main drivers in North

America are competition and technology, in contrast to the legal drivers in regions such as Europe. In America companies are trying to differentiate with technological leadership, with innovation, and by being first to market. They are focusing on which comfort functions are more important for end customers rather than safety, which is important in Europe.

focus: Which companies push the development of ADAS/AD the most and why?

Tarnutzer: The companies bringing up most new things are mainly start-ups taking higher risks to bring new AD technologies to market. And established OEMs are following with new ADAS functions, such as highway pilot.

focus: What role do tech companies in Silicon Valley play?

Tarnutzer: Software development like perception, AI, cloud computing or other services leads to a new mindset to aggressively (and not conservatively) develop new fields of application for vehicles. They also help the mobility industry to speed up, by demonstrating shorter development cycles and intervals, and “outside the box thinking”. OEMs are redefining themselves and are now talking about software-defined mobility (instead of seeing the vehicle as a mechanical product).

costs and enables 24/7 operation.

Value can also be societal. Highly automated people movers are already in service in large pilot fleets around the world. Other applications like harbour trucks, refuse collection trucks and agricultural machinery are also already being tested at large scale.

For some new entrants, the focus is on innovation. OEMs would agree that their greatest focus is on safety. For others it is affordability. With our years of industry experience, our technological know-how, and our understanding of the needs of the customer, we can bring development excellence, application expertise, and smart testing systems to create the right balance for any vision in this new space. ———

FEATURES ON DEMAND IN A SOFTWARE-DEFINED VEHICLE



The AVL approach to software and controls raises the bar for increased development efficiency

— The vehicle is becoming defined by software more than ever. Not simply within the development process, where tools such as simulation and data management are a necessity, but within the vehicle itself. Every sensor, every function, and almost every physical component has some sort of software connected to it, monitoring it or operating it, leading to an ecosystem of software in and around the vehicle. And this raises challenges for OEMs and Tiers.

Just as in the physical vehicle, where hardware components must be designed with cross-system influence in mind, similar considerations must be taken when building the vehicle's software and E/E architecture. Furthermore, to reduce complexity, time and cost, this must be done as efficiently as possible. Throw in factors such as functional safety, SOTIF, and cybersecurity, and it adds an additional layer of complexity to the development of the vehicle. Complexity that our software experts at AVL help our customers manage.

MODULAR, SCALABLE, AGILE AND RE-USEABLE

As the physical vehicle increasingly becomes a platform for software functions, including over-the-air downloads and upgrades, a holistic overview is needed when developing the complete software architecture.

To support this, we use different building blocks. The essential ones are a modular software architecture, and an integrated development and test platform. These support agile development processes that are compliant to automotive standards. Linking these building blocks enables the re-use of already-developed software components.

The complete software development process is supported by our AVL MAESTRA® tool. In addition to component development, it offers continuous integration and continuous deployment into different test environments. After testing the software components, the software system is tested in a virtual ECU. MAESTRA provides a seamless connection between modelling and simulation.

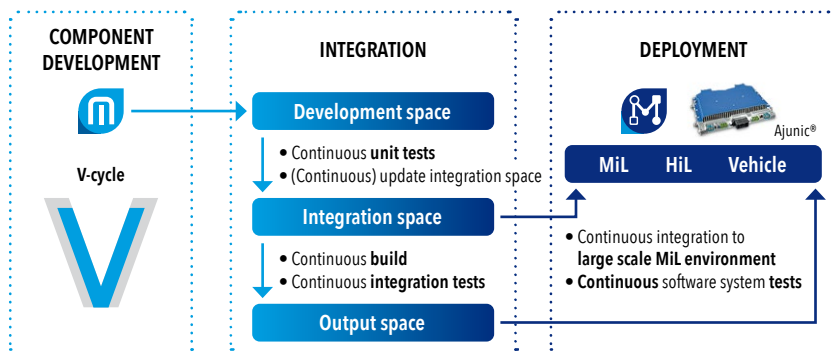
This open and flexible approach allows us to tailor our solutions to our customers' goals. At the same time, we increase efficiency by combining functions in a single control device instead of multiple

devices. Considering everything from functional safety to e-drive functions, data analytics and AI, this approach is comprehensive and puts an emphasis on safety and standards.

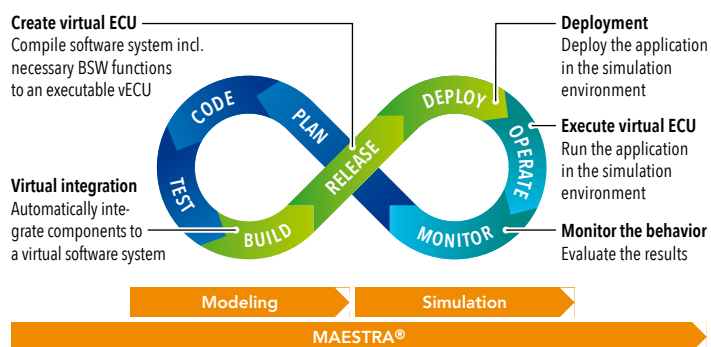
SIMULATION, SAFETY AND SECURITY

Our approach allows us to create a model of our software and test it in the simulation or XiL environment. We consider cybersecurity, SOTIF and overall safety, recommending redundancies and back-up systems where required.

We also pay close attention to standards, ensuring compliance with Automotive SPICE, the latest ISO and automotive standards, as well as OEM group standards. Whether we're working directly as a partner with our customers or simply providing them with the tools they need to realise their software and controls goals, they know that they have everything they need to meet the highest standards of quality, safety, and security. _____



▲ The AVL solution



▲ Maestra provides a seamless connection between modeling and simulation

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INTERVIEW

Klaus Fuchs

Senior Product Manager
ADAS/AD, Software and
Controls

focus: What are the market drivers for software development?

Fuchs: In addition to the ongoing driver – software-defined vehicles – the main future trend is features on demand.

focus: What are the challenges for your customers?

Fuchs: The biggest challenge to all our customers is the transition towards being a software company in general. This, in combination with a lack of resources, makes it more difficult to meet the market needs in a timely manner.

focus: What can AVL offer to support their customers to face these challenges?

Fuchs: AVL can offer support in processes and methods consulting. We have tools like MAESTRA for component development, continuous integration, and continuous deployment, that are available for our customers too. And we can implement the customer's brand-specific solutions.

Harnessing the Power of Data

Our Data Management solutions support the industry in an exciting new era of automotive development

From the simulation to the test-bed, the proving ground and real-world test drives, up to the in-use phase, every aspect of vehicle development is alive with vast amounts of data.

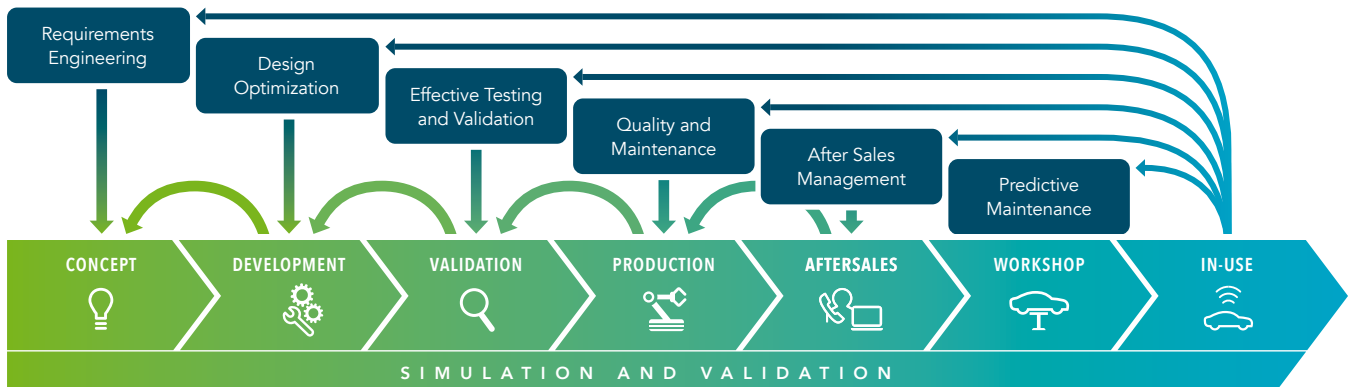
In a new era of mobility in which ADAS and AD technologies play a crucial role, the higher the level of automation the more complex the systems become. To ensure the safe and correct functioning of these systems it is vital that data is generated and harnessed optimally throughout development. With more than seven decades of experience in the automotive industry and working with data, as well as developing the tools, systems and services for handling and managing it, at AVL we provide a single point of contact for our customers' data requirements.

DELIVERING VALUE AND CONFIDENCE

Data is the lifeblood of the development process. It is gathered in a



DATA-DRIVEN DEVELOPMENT



▲ AVL's data-driven development approach – from concept to the in-use phase

precise manner with our Ground Truth Measurement Device during exhaustive development and testing of ADAS/AD systems on the road and proving ground. The collected data can then be used for activities such as comprehensive resimulation, to fully expose the system under test to the maximum number of realistic scenarios and ensure proper functionality under all defined conditions.



▲ The AVL Ground Truth System collects a highly precise reference of the traffic environment.

Optimizing the value of data means designing test activities that deliver the best results in the shortest time with minimal effort. To support this, data must also be recorded, stored, processed and analyzed as quickly and simply as possible. All for the purpose of delivering the best insights and enabling faster and more robust decision making. With such vast quantities of data it's impossible to do this manually, so we employ automated processes to extract the most value possible from your data.

Our data-as-a-service business model includes all necessary development activities – from start to end – beginning with specifying the data acquisition requirements, followed by configuring and mounting the system. From there, we identify the best test route and execute the measurement campaign wherever the vehicle needs to be

driven, supported by our global tech center network. Finally, we transfer the data to the data center for further preparation and analysis with our Big Data and Analytics Platform. In this way, we ensure high degrees of automation, delivering the most value in the minimum time to optimize both costs and quality.

We conduct these services as engineering projects with our experts, or provide the tools, software and training on our customer's sites to enable them to carry out projects by themselves.

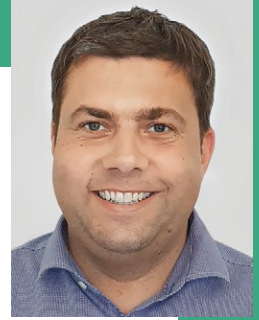
SUPPORTING A FLEDGLING INDUSTRY

With ADAS and AD the automotive industry is in the process of being reborn and this transformation brings both obstacles and challenges. Very few players in the market have the full toolchain or domain know-how necessary to bring their products to market unsupported. With AVL's data management offerings and trusted industry know-how, we are empowering established OEMs and new entrants alike with the tools and the capability they need to compete confidently in a new automotive landscape, regardless of their own experience or capabilities. _____



◀ The Big Data and Analytics Platform's scenario viewer provides a synchronized view of video, object, time-series and map data for a clear visual interpretation of the test drive.

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INTERVIEW

Georg Teichtmeister
Chief Engineer for Service
Engineering AD, E/E,
Connectivity at AVL

focus: Can you describe the use case of the customer project you are working on?

Teichtmeister: The main aspect is to provide both raw data and associated tags to support ADAS function development. We provide the integrated measurement equipment, the global raw data collection, and the manual and automatic labelling of the data.

Then we apply the data logistics process from the road to the data center, ensuring data quality and integrity. Finally, a data management tool (AAP) is provided to allow the customer to search for relevant data based on tags or vehicle bus data.

focus: What is the added value for the customer when working with AVL?

Teichtmeister: We support the customer in the road-to-lab transition with SiL validation instead of comprehensive road testing. This allows a significant saving of development time and cost.

At AVL safety, SOTIF and cybersecurity are not an addition to development, but integral to it

Safety and Security, from Start to Finish

— New vehicle technologies bring new vulnerabilities and challenges relating to safety and security, and this is particularly true of AD, ADAS and connected functions. In part these challenges come from the complexity of the technologies. It is vital that these technologies work as intended and, in the event of a failure, that redundancies and fail-safe systems protect the passengers and other road users until the vehicle can be brought to a safe halt.

In relation to connected technologies there are issues of cybersecurity, in particular preventing the vehicle from being subject to malicious intrusion. Also, there are a variety of other issues including privacy and ensuring that over-the-air system updates or function downloads don't affect the integrity and safe operation the vehicle. Moreover, developers need to ensure that other functions – both within and outside the vehicle – do not cause conflicts with vital vehicle systems.

There are few industry partners with the experience, toolset, or service offerings that AVL can deliver. And even though we are experts in all aspects of vehicle development, including the next generation of technologies, thanks to our broad R&D activities, there are still unknowns that cannot be predicted. It is essential, therefore, that from a safety and security perspective, all system design processes must be robust enough to provide

reassurance under both known and unknown scenarios.

Given the complexity of both developing the current and next generations of vehicle concepts, and the vehicles themselves, it's clear that Functional Safety, Safety of the Intended Functionality (SOTIF), and Cybersecurity cannot be an afterthought. Instead, it must be an integral part of the development process, from vehicle and system level right down to the individual component, and from the concept phase throughout the complete vehicle lifecycle.

A HOLISTIC, COMPREHENSIVE APPROACH

At AVL, our approach is holistic and comprehensive, considering the entire vehicle in everything we do. As the industry and its drivers have evolved, we've made it our job to evolve alongside them, and to research and develop new technologies before they reach widespread acceptance across the market.

This allows us to anticipate the impact of new technologies. In the case of SOTIF and cybersecurity in relation to AD, ADAS and connected systems, we have many years of experience developing the tools and processes to help our customers comprehensively tackle the issues and challenges that they present. Combined with the close industry relationships that enable us to fully understand our customers' exact needs and difficulties, we are able to bring our unique expertise to bear on these issues.

This includes the tools, such as system design, simulation, and the relevant test environments, to support development, verification and validation of the vehicle and its systems. And we can also provide the engineering support to either enable our customers to tackle these challenges themselves or take over that function entirely on their behalf. —

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INTERVIEW

Dirk Geyer

Head of Safety and Security, AVL Software and Functions



Gerhard Griessnig

Corporate Functional Safety and Cybersecurity Coordinator, AVL List GmbH



focus: Will taking responsibilities away from the driver and automating it make vehicles safer?

Geyer: Increased operational safety is definitely the most important target of automated cars. All-seeing sensors and reliably performant algorithms will ultimately save lives. Tiredness and dangerous mistakes must be avoided.

focus: What is the single biggest challenge to safety of the automated vehicle?

Griessnig: This is without any doubt the combination of infinite number of possible environmental scenarios and the need to prove safe behaviour in practically all of them.

focus: How can we best prepare for the unknowns of automated mobility?

Geyer: We have to prepare methods and solutions that are capable of turning unknowns to knowns by fast and safe learning. A key for this is the implementation of connected and cooperative automation.

A Roadmap for Development

The AVL systems engineering approach ensures goals are met from the start

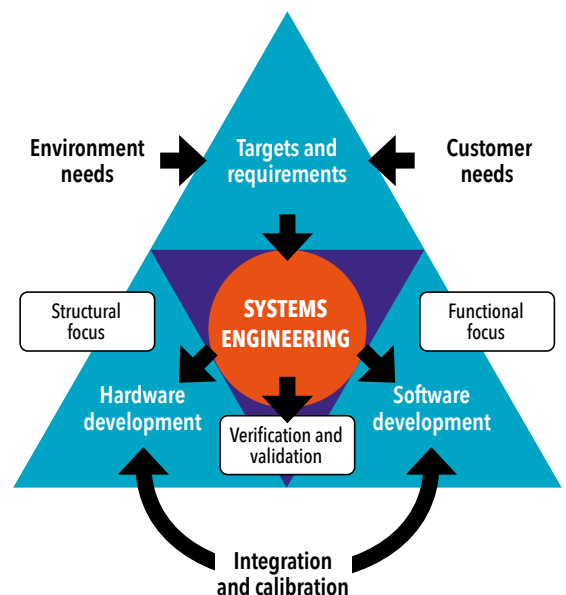
— With the arrival of connected and autonomous driving concepts comes a new level of complexity demand in vehicle development. Through the fast pace of interlinked technologies, highly diversified markets and customer profiles, as well as frequent regulative updates, there is little room for error. If one system or function has an unexpected impact on the performance or function of other systems, the outcomes can be costly, hazardous, can delay time-to-market or even damage a brand's reputation.

At AVL we have defined Systems Engineering (SE), and in particular Model-Based Systems Engineering (MBSE), as a base methodology for all product development workstreams and the key to structuring the complexity of vehicle functions, systems, software and hardware. It enables us to understand their interdependencies and to cover the needs of established OEMs or new entrants in the automotive markets alike.

These new functions or even complete new mobility concepts are introduced in the first loop of the system model to analyse their impact on the rest of the system, in order to define any required

► AVL Systems Engineering is supporting organizations on their transformation journey with outstanding application expertise and proven methodology.

AVL SYSTEMS ENGINEERING





changes. The related simulation model allows these changes to be tested virtually, within a very short time and with minimum additional effort. Even the relevant use cases, as well as already complete test procedures, are defined using the information and data collected within the system description. Further tests are generated by the AVL Scenario Manager where test and calibration tasks are focused on the changes and the potential impact on affected systems, and therefore reduce the development time, effort and the required resources for testing.

In our MBSE practices the well-known frontloading approach is extended and improved in combination with advanced simulation techniques. A so-called digital twin (multi-domain simulation model) is used alongside scenario-based test definition and road simulation as a virtual base for engineering. The system model, the digital twin and the real system are representations of the same product and typically synchronized with respect to maturity.

Pressure is on the industry to do more than ever before, with less than ever before. More complexity, competitiveness, and less time-to-market, demand that processes are more efficient, with fewer mistakes, and that the highest standards are met from the start. Our model-based systems engineering approach embraces the complexity of the vehicle, its environment and the development architecture, and abstracts it so that it becomes manageable, clearly defined, and highly efficient. This is why we are seen as the expert partner in the uncertain landscape of this new era of mobility.

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INTERVIEW

Rudolf Freidekind

Head of AVL Vehicle Functions & Systems – ADAS/AD, Vehicle Networks, Connectivity and Mobility Services



focus: How is systems engineering accelerating innovation?

Freidekind: (MB)SE, to our very talented and creative AVL engineers is like the paint brush to the artist. It enables the first concept sketching of their ideas for new solutions right up to the full development of most innovative products in partnership with our customers.

focus: What are the industry-wide challenges facing the systems engineering approach in this new era of mobility?

Freidekind: The challenge of any new era begins with adapting our mindset and being open to new ways of collaboration. This is a continued practice at AVL. We are already seeing the positive impact of (MB)SE methodology in the increase of efficiency and performance in development within our interdisciplinary teams and especially with our customers for the future of mobility.

focus: Can systems engineering unite a disparate industry to create focused change for a better world?

Freidekind: No. It is up to every one of us to create a better world for the next generation to come. Nevertheless, AVL with its innovative products, solutions and methodologies like (MB)SE embraces the changes to the industry today to constantly shape a better future.

ADAS/AD TESTING SOLUTIONS



— In the development of ADAS and AD functions, one of the biggest challenges is ensuring that the equipped vehicles can perform as intended, safely and reliably in any road situation and under any condition. That means a potentially infinite number of different scenarios that a vehicle might encounter day or night. And it includes conditions such as rain, shine, fog, or snow, busy or quiet streets, highways, hills or lanes, in different countries with different road layouts, traffic rules, driving styles and a plethora of other known and unknown situations.

To ensure that the assisted or automated vehicle can safely tackle an acceptable percentage of scenarios to meet international regulations and public expectations of safety would take an estimated 11 billion miles of road driving. In other words, it is impossible to manually

test highly automated vehicles on the road to these standards. So, the burden of testing naturally falls to the simulation.

But this isn't simply a matter of driving a virtual vehicle down a virtual road. The vehicle must be a true representation of the actual vehicle, its sensors and systems, the environment must be a true representation of the environment and its actors, and a credible methodology must be adopted for creating and running the vast number of relevant scenarios and meta-scenarios required

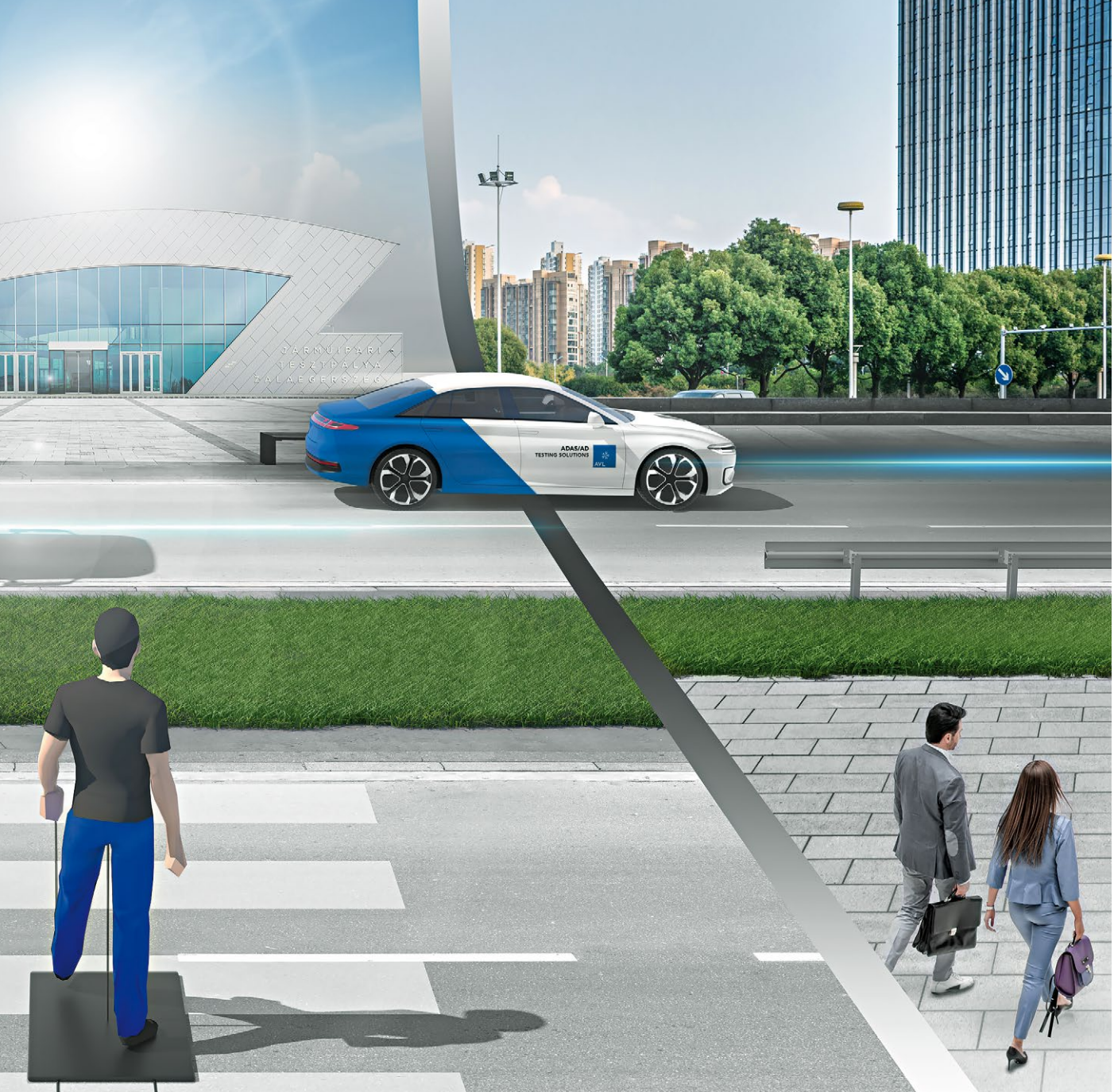
for testing and validation. Add to the mix the requirements for Model/Software-in-the-Loop, Driver/Human-, Hardware-, and Vehicle-in-the-Loop testing environments, as well as proving ground, public road and in-use testing, and the whole process becomes complex and unwieldy. So, a seamless toolchain of various methodologies and solutions is required to manage the testing and validation effort, and make the most of open data formats for reuse, exchangeability and future-proofing. At AVL, this is what we aim to provide.

A TRUE IMAGE OF REALITY

The AVL SCENIUS™ suite includes our Scenario Designer, Scenario Data Manager, and our Test Case Manager. It gives the developers of highly automated vehicles everything they need to plan, execute and manage their scenario-based testing on a professional level. Based on an open architecture, it can be used with a large variety of testing tools, such as AVL or third-party testbeds, simulation tools, and on the proving ground. It offers seamless integration into almost any testing environment.

At AVL our approach to scenario-based testing leaves nothing to chance





SETTING THE SCENE FOR SUCCESS



▲ The AVL Scenario Designer supports easy traffic scenario design, editing, parametrization and verification.

Furthermore, it includes a flexible catalogue of actors, maneuvers, scenarios and data, which can be updated to accommodate new data and testing activities from both testing prior to start of production and later in-use phases. As the testing catalogue grows, it reduces effort by enabling scenarios to be created by simply adding different elements from the catalogue, saving vast amounts of time. When combined with cloud-computing it allows over a million scenarios to be executed in a day, and the huge amounts of data are then automatically processed so that the maximum value and insights can be gained from all activities.

For any test that involves simulation of the system under test and/or a virtual environment, proof must also be provided that the virtualized parts represent the real world with sufficient accuracy. Our suite of solutions supports the correlation of the data gained in the real world

with the data generated through simulation, by using mobile testing tools or ground-truth measurement systems. And to make things easier, it also includes test and data management functionality to ensure that test planning effort is reduced, result analysis according to KPIs is simple, and the resulting data delivers the maximum value.

OPEN TO THE UNKNOWN

With conventional vehicles there have always been earlier technologies upon which to set the new standards, both in terms of technological innovation and global legislation. But with assistance and automated technologies the industry is stepping into a new automotive era, much of which is still unknown. Development, therefore, must embrace a rigorous philosophy of openness that can tackle the things we know, the known unknowns, and the unknown unknowns.

◀ The AVL DRIVINGCUBE™ combines both simulation and ready-to-drive vehicles on a chassis dynamometer or powertrain testbed.

We do have, after all, a century of data about the behavior of conventional vehicles on the road which we can draw upon. But we are still gaining knowledge about the behavior of assisted and automated vehicles, and there are some scenarios that the automotive industry has absolutely no knowledge about. So, we must ensure that when those scenarios happen which, ultimately, they will, we are well placed to be able to deal with them in the safest way possible.

We also need to be open about what is realistically achievable within the industry. With the development of any new technology comes great complexity and cost. To ensure that this is manageable for both our customers and the end users, it is vital that a dialogue consisting of open standards and agreed methodologies is adopted right across the industry. Following this open ideology, our scenario-based testing solutions are integrable with our customer's existing toolchain and methodology.

COMBINING THE REAL AND THE VIRTUAL

To boost credibility and safety, SCENIUS not only supports in generating scenarios virtually, it also draws on a variety of data sources and databases, including the testbed, the proving ground, the public road test and the in-use phase. Working closely with our partner network and other organizations across the industry, we ensure that our methods are reliable, our processes can withstand the toughest scrutiny, and our products comprehensively solve the problem they were designed to solve.

Because every use case is different, we combine multiple approaches, such as ontology-based methods, game-based testing to challenge the system under test (SUT) to failure, route optimization for real-world testing and the comparison of raw data against ground truth-captured data to validate system perception. When integrated into your existing testing and validation toolchain, this collection of tools and methodologies provides a seamless, robust and reliable scenario-based approach to the testing of ADAS systems and AD functions that can help you move forward confidently in an evolving automotive landscape. _____



INTERVIEW

Sebastian Siegl

Product Owner of the Verification and Validation Team in the Development of Automated Driving Functions at Cariad

The testing effort on the road is immense and time-consuming. Hence we are striving for new technologies as well as methods to reduce those real-road maneuver testing efforts drastically.

Based on the Vehicle-in-the-Loop solution, AVL DRIVINGCUBE™, we have identified the clear potential to not only reduce real maneuver testing but also to bridge the virtual and real worlds in the most effective and efficient way. By scrutinizing corner cases, critical traffic as well as environmental conditions in a risk-free Vehicle-in-the-Loop environment we constantly improve our ADAS and HAD development and test strategy.



INTERVIEW

Roland Lang

Program Manager Business Development ADAS/AD at AVL

focus: What is the biggest added value of AVL SCENIUS™ for OEMs?

Lang: OEMs are shifting testing to virtual environments to reduce effort and time-to-market. SCENIUS enables them to organize vast numbers of scenarios, even across multiple vehicle projects. It helps to define and optimize test granularity for each phase of development, while adapting for new optimization methods or legislation.

focus: How do you plan to collaborate with scenario initiatives in countries around the world?

Lang: Those initiatives bring in the local aspects of testing an automated vehicle for a specific market. However, it poses the risk of having too many individual tools and redundant content that OEMs have difficulties dealing with. With SCENIUS we strive to develop a widely accepted solution, for example, by using open ASAM standards for exchange formats, or by contributing in global exchange as fostered by IAMTS.

Delivering Real-World Efficiency

When the time comes to move ADAS development into vehicle testing on the road, AVL aims to make it as efficient as possible.



— The proving ground plays a vital role in vehicle development, in tasks such as the verification of functional targets, active safety, and legislative compliance. The simulation complements the road tests in terms of higher test coverage and verification of so-called corner cases. With the widespread adoption of ADAS functions up to level 3, and advances in AD systems, the number of test cases that must be conducted both on the proving ground

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INTERVIEW

Rico Barth

Head of Connected and Automated Driving, Future Mobility Solutions at TÜV Rheinland

focus: Why is testing on the proving ground with a real vehicle so important?

Barth: This is the only way to carry out reproducible tests of automated driving vehicles in a safe environment. This includes safety-critical maneuvers, and maneuvers that transfer the vehicle to a state of minimal risk for the occupants and other road users. Moreover, we can evaluate a vast number of different scenarios by mixing simulation with a real vehicle on the proving ground, thus validating test methods.

focus: What will be the biggest challenges in the future of automated driving?

Barth: At TÜV Rheinland, we see some of the biggest challenges in the lifecycle of automated systems. We are developing standards for periodic inspection of these systems, which is vital to guarantee fault-free functionality throughout the entire vehicle life.



INTERVIEW

Natalie Roberts
Managing Director
at ABMARC

focus: How did you learn about AVL's solution offering with regards to ADAS/AD?

Roberts: We were looking at procuring ADAS test equipment with an integrated data analysis/validation solution. One vendor fulfilled this request with some software called the AVL Smart ADAS Analyzer™. Using AVL's PEMS system we knew AVL's approach to manage and validate data. This gave us confidence in the purchase.

focus: How does our solution support you in your daily activities?

Roberts: While on the test track, the

analyzer provides us with an instant pass/fail test result in accordance with the ANCAP/Euro NCAP protocols. This allows us to confirm the test validity and move quickly on to the next one. With failed tests, the tool identifies the issue and accelerates resolution finding.

focus: What is your vision of our collaboration for the upcoming year?

Roberts: We see ABMARC working closely with AVL to assess newly released protocols and increase the functionality of its data analysis tool to provide even more benefit to us and our clients.

and on the road is growing exponentially. At the same time, budgets and time-to-market constraints are getting tighter. This means that effective and efficient methods and tools must be put into practice, to ensure that proving ground verification, and the public road testing that complements it, have the highest coverage and diversity.

FEWER MILES, GREATER VALUE

We have created a range of solutions and methodologies that ensure that every driven mile delivers the maximum contribution to the testing targets of our customers. From test planning through to the installation of equipment on the vehicle, nothing is left to chance. Our portfolio even supports execution with either

a robot or human driver depending on accuracy requirements and test case need, and then the collection, management and analysis of the data.

Automated maneuver detection, driver guidance and performance KPI evaluation tools monitor test activities, and if they don't meet requirements prompts are delivered to repeat the scenario until it is complete. This improves accuracy, reduces the need for test rescheduling, and accelerates the fulfilment of test targets. For customer acceptance evaluation, we employ automated scenario detection technology and measure objective evaluation of perceived safety and comfort. As well as significant effort reduction for test engineers, our approach supports OEMs to deliver the best quality products to market.

To further aid road testing efforts, our 265-hectare AVL ZalaZONE proving ground has been built specifically for the development and testing of AD, ADAS and V2X systems. Featuring the largest smart city of any proving ground in Europe, the site includes 5G testing capabilities, an ADAS platform for NCAP and GSR compliance, and also highway, urban and rural road environments. Roundabouts, crossings, special low speed areas, and nearby engineering resources provide a comprehensive array of opportunities for test activities.

THE INDUSTRY'S PARTNER FOR EXCELLENCE

We fully understand testing demands and the effort involved with verification and validation both in the real world and other applied environments. That's why we've set up a variety of tools that optimize efficiency, without compromising testing targets. This portfolio of cutting-edge solutions complements our know-how and execution expertise, and are all brought together with the single aim of being a reliable industry partner in every aspect of automotive development.

AVL



Reimagining Motion

For a greener, safer, better world of mobility.

We are driven by a passion to examine the science, mechanics and philosophy of movement. By using all our imagination, creativity and pioneering spirit, we create a world that is carbon neutral and one that makes safe, comfortable, green mobility a reality for everyone.

As a technology partner, we provide concepts, solutions and methodologies to shape future mobility trends. From vehicle development and integration to e-mobility, autonomous driving and software-defined vehicles, we support customers with our engineering, testing and simulation know-how.

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