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Furthermore, the conference is specifically dedicated to addressing the challenges and opportunities of developing AI and software platforms for autonomous and self-driving vehicles. Experts will present their research on deep learning and how to validate algorithms, as well as explaining their take on AI/programming best practice, fusion challenges and cybersecurity, plus how to understand, utilize and manage big data.

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Tim Sandford
Conference director
tim.sandford@ukimediaevents.com

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Enabling virtual test and validation: creating a virtual proof of validation in the ENVITED ecosystem

New forms of cooperation are necessary to turn the vision of autonomous driving and fully connected mobility systems into a reality. Virtual validation is an essential part of the development process. Standards for model and system interchange are vital for cross-company and cross-domain virtual integration and simulation of HAD functions. Standards like FMI, SSP and the OpenX at ASAM eV showcase current possibilities, challenges and future directions, as well as a vision of future collaborations. The foundations for the future ecosystem have been laid by the ENVITED ecosystem: standardized data for virtual test and validation; open and modular simulation architecture; traceability of standardized data and test results for a virtual proof of validation.

Carlo van Driesten, systems architect for virtual test and validation, BMW Group, Germany

Why the safety of autonomous vehicles must be a collaborative affair

The AV industry now has a key opportunity to formalize safety standards, give guidance to regulators, and get AVs off the test track and into the real world. For years, Intel and Mobileye have advocated for industry and regulatory consensus on AV safety, culminating in a forthcoming standard – IEEE 2846 – that will establish a model for AV decision making that will be formally and mathematically verifiable, technology-neutral and regionally customizable. This session will provide an overview of the safety standards landscape, how this IEEE standard initiative plays a unique role, and why it is imperative for the industry to adopt a more open, transparent and collaborative approach to deliver on the AV promise.

Jack Weast, senior principal engineer, Intel & VP autonomous vehicle standards, Mobileye – Intel Corporation, USA

HEADSTART project: Harmonized European Solutions for the Testing of Automated Road Transport

HEADSTART is an H2020 EU-funded project that aims to define testing and validation procedures of connected and automated driving functions including key technologies such as communications, cybersecurity and positioning. The tests will be in the simulation and real-world fields to validate safety and security performance according to the key users’ needs. The expected impact of the HEADSTART project is to establish a model for AV decision making, including testing and validation procedures, open and modular simulation architecture, traceability of standardized data and test results for a virtual proof of validation.

Álvaro Arróo, project manager connected and automated driving, Applus IDIADA, Spain

Bridging ADAS to AD in mass production

The presentation will discuss the gap between current ADAS and expected ADAS and AD systems. It will also outline technologies to enable 3D sensing using low-cost sensors by available ADAS ECU, and examine advanced sensor fusion to compensate for the deficiencies of one by the abilities of others.

Dr Duong-Van Nguyen, ADAS department manager, Panasonic Automotive Europe, Germany

Autonomous driving and open-source technology – does it fit?

Automated driving solutions introduce a new complexity into the development of embedded systems in cars. This complexity rises with each level of control and autonomy. The toolchain for such challenges is also complex, and the integration of all the tools requires considerable effort without a real competitive advantage for the automated driving solution. Instead of solving these challenges alone, wasting lots of money along the way, Bosch’s automated driving division has started an open-source community known as OpenADx. This talk will present the open-source approach, the current state of the community and the currently available solutions.

Andreas Riesinger, product manager, Robert Bosch GmbH, Germany

Functional safety and security – partners or independent contributors

As the complexity of systems increases, so does the need for functional safety and security. Quite often these goals are meant to be fulfilled by the same component. But how are they analyzed and designed so that instead of being two independent areas, they contribute together toward the achievement of the system goals? The presentation will show the similarities and differences in terms of goals, processes, concepts and mechanisms when it comes to functional safety and security. It will also discuss the analysis that can be done to bring them together on the same page.

Anamaria Hutuleac, functional safety software assessor, NXP Semiconductors GmbH, Germany
Achieving safe autonomous driving through collaborative test and development, harmonization and standards

Why the safety of autonomous vehicles must be a collaborative affair
Jack Weast, senior principal engineer, Intel & VP autonomous vehicle standards, Mobileye, Intel Corporation, USA
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ASAM simulation standards – past, present and future
Benjamin Engel, global technology manager, ASAM eV, Germany
In 2018 ASAM acquired its first simulation standards in the form of the OpenX portfolio (openDRIVE, openCRS and openSCENARIO), with the addition of the Open Simulation Interface in 2019. Since then, simulation experts worldwide have been working hard on the first official ASAM revisions, the first of which are to be released in Q1 of 2020. This presentation will give an overview of the ASAM activities to date, and provide some insight into where we see the road leading in 2020 and beyond. Our goal is standardization to facilitate the development of safe, regulated autonomous driving.

Humanizing autonomy: setting a global standard for how autonomous systems interact with people
Raunaq Bose, co-founder and CTO, Humanising Autonomy, UK
By building a human intent prediction software, we are able to increase VRU safety while also improving public acceptance of AVs.

From absolute safety to informed safety: the role of operational design
Dr Siddartha Khastgir, head of verification and validation, intelligent vehicles, WMG, University of Warwick, UK
To prove that automated driving systems (ADS) are safer than human drivers, it is suggested that they need to be driven for over 11 billion miles. A number of miles is not an appropriate metric and doesn’t guarantee absolute safety. This highlights the question: “How safe is safe enough?” To answer, we suggest a departure from the world of absolute safety to informed safety. A key aspect of informed safety includes an accurate and standardized definition of the operational design domain for an ADS, including conveying it to users, regulators and other stakeholders. The first step in all safety standards: ODD definition.

Homologation of automated driving functions: worldwide overview, customer acceptance and strategic aspects
Christian Gnandt, vice president automated driving, TÜV Süd Auto Service GmbH, Germany
Homologation of automated driving functions presents a huge challenge for their market introduction. Existing regulatory safety frameworks applicable to conventional vehicles and their components are insufficient to fully assess the operational characteristics of current and future automated vehicle technologies. With increasing automation, vehicles transform into cyber-physical systems that no longer require a human driver; therefore, new safety challenges will have to be considered. This presentation discusses those challenges, provides an overview of the current regulatory and standardization work in progress and explains the possibilities for how to approve automated vehicles for public roads today.
Assurance cases for automated driving
Rasmus Adler, program manager, Fraunhofer IESE, Germany
This presentation covers challenges, solutions and standards for arguing the safety of automated driving. In the V&V Methoden project, Fraunhofer IESE is working on a safety argument that can be based on evidence from testing and simulation. The talk will summarize the current results of this project. It will also discuss UL 4600 and the upcoming application guide of the AK DKE/AK 801.0.8 Spezifikation und Entwurf automoner/kognitiver Systeme (specification and design of autonomous/cognitive systems).

Enabling scenario-based verification for autonomous driving
Alexandre Mugnai, business development manager, Esteco, Italy
Siddhant Gupta, research engineer, verification and validation, autonomous driving/ADAS, Volvo Cars Corporation, Sweden
This paper proposes a methodology to enable scenario-based verification for autonomous driving by creating a scenario and test database using a suitable design of experiments. Consequently, an optimization strategy is developed to evaluate the criticality of the aforementioned test cases to segregate the test cases to be simulated in a software-in-the-loop (SIL) environment and the critical test cases in the vehicle-in-the-loop (VIL) environment to ensure the coverage using SIL and VIL platforms. The toolchain to create the design of experiments and optimization strategy is the Simulation Platform Active Safety (SPAS) virtual platform enabling SIL verification developed at Volvo Cars, which is co-simulated with the multi-domain optimization tool modeFrontier.

Simulation, scenarios, verification and validation

Enabling virtual test and validation: creating a virtual proof of validation in the ENVITED ecosystem
Carlo van Driesten, systems architect for virtual test and validation, BMW Group, Germany
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Validating ADS toward an industrial scenarios database
Marc Pajon, expert leader - testing and measurement technologies, Renault Group, France
Validating AV safety is a crucial part of ongoing research. The approach of separately track-testing sensors and driving algorithms is hardly sufficient to demonstrate AV safety. Scenario-based simulation approaches are necessary complements to the traditional approach, allowing computation of a controlled diversity of key variables in many iterations in a safe, fast and documented way. French car manufacturers Renault and PSA, together with academic researchers (VEDECOM, SystemX, Lab and Ceesar) and other partners ( Valeo, AVS and Expleo), propose to address the challenge of demonstrating AV safety by taking an array of ‘in-the-field’ situations into account.

Autonomous vehicle engineering simulation tools for appropriate driver acceptance and comfort
Dr Andras Kemeng, expert leader immersive simulation, Renault, France
The challenge of autonomous vehicle validation relies on massive simulation, due to the vast number of kilometers to run in various road, traffic and weather conditions. Nevertheless, acceptance of the proposed automation system will have a heavy impact on the use of the system and the efficiency of handling it when sharing or taking back vehicle control. Driver-in-the-loop simulation will play an essential role, using high-performance driving simulators or dedicated configurations, including virtual reality and web-based online solutions. These simulation tools will be essential to complete efficient autonomous vehicle engineering design for driver acceptance and comfort.

Large-scale simulation supporting HARA for ISO 26262, SOTIF and STPA
Dr Edward Schwaltb, lead data scientist, MSC Software, USA
We will review a Bayesian approach to hazard analysis and risk assessment, which gives rise to ‘smart hazardous miles’. We describe a generic hazard control loop that enables active avoidance of accidents, and illustrate how it can be applied to classify hazards as potential or developing, consistent with the UK theoretical driving test administered to human drivers. This approach further guides our development of tools enabling accelerated development and testing. We discuss the implied hazard specification extensions to the PEGASUS approach. An integrated workflow will be presented, which is consistent with ISO 26262, SOTIF and STPA.
Developing a future-proof scenario database in a world of emergent standards
Mike Freeman, project engineer, Warwick Manufacturing Group, UK
Testing is fundamental to the safety of automated driving software, but driving billions of miles to achieve sufficient scenario coverage is unfeasible and requires a better approach. Scenario sharing across the industry is gaining support as being the solution. With this aim, the standardization of scenario description is being worked on but we are still some way from a universal standard. This puts the system architect in a difficult position: how to design a scenario database that will support today’s standards as well as those of tomorrow? As part of the UK’s Midlands Future Mobility project, we answer this question.

Panthera driving simulation framework with high-quality content for human-in-the-loop testing
Jelle van Doornik, product manager ADAS and AD, Cruden, Netherlands
Although the industry seems to be focused on full autonomous driving (L5), Cruden believes that partial automation (L1-L4) is going to be around for decades to come. The increasing number of automated driving functions causes the interaction between driver and vehicle to change. The most time-effective way to test and validate this property is with an open-architecture simulation framework that allows easy integration of the customer’s engineering tools while displaying high-quality content for the human driver. The Panthera driving simulation framework provides a safe and cost-efficient way to add human-in-the-loop simulation to the existing development, test and validation toolchain.

Edge-case hunting in scenario-based virtual validation of AVs
Dr Henning Lategahn, CEO, Atlatec GmbH, Germany
Validating ADAS and AV stacks in large parts in virtual environments using simulators is a given nowadays. The industry largely agrees on a quality over mere quantity view on things. But what is the quality of a scenario set that is tested against? It essentially boils down to the ability to identify edge cases that show the exact limits of the system under test. In this talk, we present how one can use real-world scenarios, translate these into their digital-twin counterparts for simulation and finally modify these to identify the crucial edge cases.

OmniCAV: hybrid simulation for AV stack verification
Dr Gavin Jackman, managing director, Aimsun, UK
OmniCAV is a consortium project that is partly funded by the UK Government. It aims to deliver a highly realistic simulation environment for AV stack verification that considers all road users and road types. A unique environment that covers all road types and eventualities is being created and validated with real AV testing within the OmniCAV project. Our consortium is applying cutting-edge technology in creating this environment, with high-fidelity lidar mapping, mixed-traffic simulated environments with motorized and non-motorized vehicles (bicycles) and pedestrians, advanced driving simulators and more. The solution will cover the urban environment, the strategic road network and the rural road network, allowing all conditions to be simulated and evaluated. This is being delivered in combination with a UK local government and a Zensic/CCAV-funded testbed location.

Automated validation toolchain for autonomous driving functions
Thorsten Drogge, system architect, Elektrobit Automotive GmbH, Germany
Handling huge amounts of raw sensor and vehicle bus data in the hundreds of petabytes range, as well as maintaining a precise and comprehensive sensor model tightly coupled to a restbus simulation, poses a major challenge for sufficiently testing and validating automated and autonomous driving functions. Providing a high-performance web portal to ingest, track and reprocess such data in the cloud or from locally attached mass storage of hardware- or software-in-the-loop simulation solutions and driving scene catalogs enables the task of data orchestration to be mastered. In addition, suitable tooling provides hardware support for maintaining a precise sensor model and bus simulation to emulate a full automotive restbus to the device under test.

Generation of safety-critical scenarios for validation of autonomous vehicles
Julien Niol, research engineer, Apsys, France
Autonomous vehicles are introducing a new challenge to secure them by relying on algorithms to analyze their environment and take decisions accordingly without any human supervision. This paradigm requires the consideration of not only functional safety but also the safety of the intended functionality (SOTIF). We present how we have experimented with a model-based safety assessment methodology to generate classes of safety-critical scenarios for the validation of autonomous vehicles. This approach is based on a high abstraction level behavioral model integrating the system architecture and its immediate environment, developed to address key concepts introduced in ISO 21448.

Managing the test and development process – best practices for accelerating development and achieving safe autonomy

Scaling a simulation toolchain for higher levels of autonomy
Dr Sandeep Sovani, global director, automotive industry, Ansys Inc, USA
Driving automation software for ADAS Levels 1-2 is now routinely validated by software-in-the-loop (SIL) simulations. Moving up to Level 3 greatly increases the complexity of the

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automated driving system, thus increasing validation needs exponentially. This talk presents the ANSYS Autonomy toolchain for virtual validation and sign-off of automated driving features at Levels 3-4. For these levels, beyond SIL simulation the toolchain includes software solutions for scenario collection via drive data analytics, scenario curation, scenario variation, test plan management, robustness testing of perception software, simulation result analytics for coverage analysis and building statistical validation cases, simulation data management and toolchain validation.

Product management for autonomous vehicles
Todd Medema, product manager, Uber ATG, USA
Most product management resources are focused on B2C or even B2B. But what does it take to design and build internal tooling to accelerate autonomy development? In this talk, we’ll cover some of the unique challenges in products built by engineers for engineers, capable of handling immense datasets and complexity, in an unsolved and ever-changing solution set.

Building a toolchain and an ecosystem — the strategy behind creating a new company for autonomous solutions
Magnus Liljeqvist, global technology manager - infrastructure, Volvo Autonomous Solutions, Sweden
Synopsis to follow.

Vision, lidar and sensor test and development

Synthetic data utilization for AD/ADAS sensing functions performance evaluation – challenges and opportunities
Farid Kondori, verification tools lead, Aptiv, Sweden
To tackle the problem of verification and validation of autonomous vehicles, synthetic data generated in virtual environments can be employed to complement field testing, due to the fact that these environments are highly scalable and inexpensive. Although in recent years virtual environments have been employed by the community to develop and test ADAS/AD functionalities, such as AEB or ACC, there has been limited possibility to utilize synthetic data for sensing functions performance evaluation. This presentation will address the challenges and opportunities of virtual environments for test and validation of camera-based sensing algorithms.

Modular solid-state lidar to find the best fit for automotive applications and car integration
Filip Geuens, CEO, XenomatiX – True Solid State Lidar, Belgium
XenomatiX and Marelli have elaborated a modular solid-state lidar approach. Based on compact modules, different lidar systems can be composed to find the right fit between lidar performance, application requirements and vehicle integration restrictions. A number of system configurations will be explained and detection capabilities will be shown. As Level 3 ADAS is the next target for automotive mass-production vehicles, a high-resolution front-view solid-state lidar configuration will be presented.

See the unseen: the future of driving
Tim LeBeau, chief business development officer, Seek Thermal, USA
The best vehicles on the market are hyper-aware and able to detect challenges in their path more quickly than occupants. As autonomous vehicles begin to hit the road, it is imperative that ADAS are optimized to safely avoid hazards with speed and accuracy. The presentation will explore concerns around autonomous vehicles and share the impact of thermal sensors on minimizing human control in driving with real-time insights. It will discuss how data collected from thermal sensors can be leveraged to identify impending dangers before they occur, sharing how temperature values create visual images, accurately distinguishing living from non-living objects.

New consumer-friendly ADAS rating system including innovative lidar solutions
Dr Mircea Gradu, senior vice president quality and validation, Velodyne Lidar, USA
Rapid developments in the field of driver assistance technologies require clear communication from the industry. Customers need crystal-clear information about what their vehicles can do. Simply naming ADAS functions such as LKA or ACC as a feature is not enough. A clear, general nomenclature is needed to understand and accept new
functions. Service descriptions must be refined, and test protocols must be adapted to the use cases. More security through new sensor technologies requires common, transparent standards that must be clearly communicated in order to enable responsible implementation. The presentation gives an overview of identified shortcomings in the current ADAS sensor taxonomy, testing and validation and proposes a standardized approach leading to a new ADAS feature rating system.

**Physics-based sensor simulation – essential for developing the safest autonomous vehicles**

Serge Laverdure, connected and automated unit director, ESI, France

The certification of autonomous vehicles will require more and more virtual testing as a consequence of a new level of complexity that the automotive industry has never faced before. Nevertheless, real testing should evolve accordingly and should be supported by interoperable software tools. ESI is providing an interoperable solution relying on high-fidelity physics-based sensor models to tackle the harsh weather conditions in which autonomous vehicles will operate in the field (fog, rain, snow, dust and sand). The aim of this presentation is to evaluate the effect of harsh weather conditions on lidar performance.

**LWIR thermal sensing is a must in the autonomous suite**

Raz Peleg, sales director, AdaSky, Israel

The current trio sensing suite of CMOS, radar and lidar fails to address certain corner cases. Adding LWIR thermal sensing to this suite will allow all-weather detection and classification, VRU classification even through fences, VRU classification when only partial body is exposed (between parked vehicles), a solution for blinding situations and faster AV shuttles. The sensor is passive and cost-effective and can support the shift from prototypes to mass autonomous production.

**Real-world and open-road test and development**

**Robopilot – Level 4 autonomous driving on mixed roads**

Nicholas Clay, head of homologation and quality, Arrival, UK

The presentation will outline the challenges, lessons and successes of Robopilot – a UK CCAV-funded project delivering a demonstration of Level 4 autonomous driving on mixed roads in the UK. It will focus on the testing and validation journey from research and simulation to on-road testing and live demos. Robopilot is a £12m consortium project based in the UK. Partners include UPS, Thales, Bristol Robotics Lab, Loughborough University, TVS and South Gloucestershire Council.

**Automated driving grows out of the niche**

Dr Eric Sax, head of Institute of Information Processing Technology, Karlsruhe Institute of Technology (KIT), Germany

The motivation for the introduction of autonomous driving differs between road users. For passenger cars, safety and comfort are driving forces. For commercial vehicles, economic reasons are most promising. Raising service times of trucks and buses by supporting drivers or even substituting them with advanced driver assistance systems is a huge business case. The idea is to start in areas that are closed to ordinary traffic: on depots. This application domain is followed by bus rapid transport in special lanes, highways and situations that promise a controllable environment. A stepwise approach is most promising and the innovation will be derived from the niche. The idea is to learn and experiment there and, step by step, enhance the field of use.

**Deploying autonomous buses in mixed traffic**

Jorgen Kjaer, business development manager - autonomous buses, Vy Group, Norway

Vy Group is a leading bus operator in the Nordics, operating over 3,000 buses. We are taking a leading role in the deployment of autonomous buses in public traffic. In a successful project in Kongsberg (Norway), two autonomous buses have replaced a regular diesel bus in operation (mixed traffic). This winter, we will test driving without a safety host on some parts of the route in Kongsberg. We will also test operation without a safety driver in an industry park, with traffic lights. We also have a project for bigger AV buses.

**CAV testing on public roads – crucial learning or unnecessary risk?**

John Fox, program director – Midlands Future Mobility, WMG - University of Warwick, UK

Testing of CAVs on public roads is a hot topic. Does it expose the public to unnecessary risk, or is it essential for profound safety improvement on the world’s roads? Can we have the best of both worlds: on-road learning with enhanced safety? The presentation addresses these questions, using the £35m Midlands Future Mobility test and trialling ecosystem as a case study. There are exciting times ahead!
Level 4 AV testing for urban environments: challenges and opportunities
Mohamed Azhar Halikul Zaman, research engineer, CETRAN, Singapore

As autonomous vehicles (AVs) increase in maturity, the complexity in ensuring they are safe increases as well. The traditional automotive testing methodologies need to evolve to suit the ever-changing nature of AVs. This will bridge the gap between regulators and AV developers, and eventually lead to safe and effective implementation of AVs. In this presentation, CETRAN will present the key challenges it faces when testing Level 4 AVs, and will share its approach and the ongoing research/projects to tackle these challenges. The focus will be on the current unresolved issues in virtual and physical testing.

Practical implications of steward-less autonomous vehicle testing and operation
Tom Jansen, global domain leader connected and automated vehicles, Ricardo plc, Netherlands

We are seeing the deployment of many ‘novel’ pilots with self-driving vehicles around the world. Looking more closely, we see that often these vehicles feature a steward or safety driver on board, who is legally in control of the vehicle at all times. With new legislation slowly allowing testing without stewards on board, it is essential that we understand the practical implications for autonomous vehicles operating without safety drivers. In this session we will explain the implications for CAV design and testing from recent (truly driverless) CAV projects.

Data management, storage and cloud technologies

Have we collected enough traffic data?
Sytze Kalisvaart, project manager StreetWise, integrated vehicle safety department, TNO, Netherlands

Many OEMs and other automated driving companies are collecting massive amounts of driving data to identify what scenarios the automated vehicle might have to deal with. Through scenario extraction, repeated driving patterns are categorized and turned into statistics essential for effective safety assessment. But when is the data collection enough? The TNO StreetWise scenario database includes completeness indicators at various steps in the scenario mining pipeline. We will introduce the meaning and application of these completeness indicators. In this way, OEMs can compare coverage of their data collection and quantify the completeness of the collected data.

The road to cloud-based validation for autonomous vehicles
Janek Jochheim, product manager cloud and SaaS, dSPACE GmbH, Germany

It is common knowledge in the automotive industry that simulation and software-in-the-loop are key elements for the validation of autonomous vehicles. These simulations will usually be executed in the cloud. But how can a user get to a scalable cloud simulation and – even more importantly – how can they choose and execute the right test cases? And is this “just” a technical challenge? This presentation discusses the different topics that have to be addressed in order to get to simulation and validation in the cloud, and points out the major challenges on the way.

Introducing data center technologies to simplify data harvesting in test drives
Johannes Zangerle, technical business developer, b-plus GmbH, Germany

Sensor bandwidths and the complexity of automated vehicle setups are the main challenges for harvesting data during test drives. Measurement tasks are moving toward multi-gigabit data rates with many raw data and metadata streams. Intelligent data distribution and time correlation are crucial for exact data acquisition. In the end, data integrity and time correlation are key for further analysis and AI lessons. This presentation shows how data center technologies such as RDMA over Converged Ethernet and Ethernet switching fulfill the requirements of Level 4 or Level 5 systems, and how an intelligent data recording infrastructure reduces data management complexity.

Mapping, positioning and connectivity

The challenges in testing connected vehicles
Stoan Nikolov, test analyst, McLaren Applied Technologies, UK

The complexity of connected and autonomous vehicles increases significantly with the introduction of multiple connectivity channels and sensors. The requirements for robust and uninterrupted connection provoke the need for multiple modems fixed to multiple network operators, being able to switch among various wireless networks (such as 3G, 4G and 5G). The introduction of geofence-triggered software features requires GPS/GNSS connectivity in addition to the mobile network. Testing the connectivity is a challenging task that requires realistic simulation of the mobile network conditions and GPS/GNSS. This presentation will cover the challenges of testing the connectivity channels for connected vehicles, the simulation scenarios to be considered and the challenges of simulating a fleet.

Bridging the gap between AV navigation software and hardware
Greg Drew, CEO, Polysync Technologies, USA

Currently there is a gap between autonomous vehicle (AV) navigation software and physical operation. This presentation will discuss the current status, challenges, pitfalls and best practices for integrating AI and physical navigation systems and ensuring autonomous vehicle safety. The business results of achieving the ability to write once, run anywhere include efficiency, safety, fastest time-to-market, normalization and best-practice optimization. A universal safety standard for integrating software and hardware navigation systems will streamline and normalize the development and optimization of AV navigation systems, accelerate market entry and achieve the promise of AVs to dramatically improve safety.
The collaborative way forward: open data for an autonomous future
Emil Dautovic, vice president automotive, Mapillary, Sweden
For autonomous vehicles to safely navigate our roads, they need meticulously detailed and accurate information about the world around them. No single actor is capable of collecting all the data necessary for these vehicles to operate in all locations and situations, so the only way forward is to open and share data. This collaborative approach has driven the growth of roughly one billion street-level images on the Mapillary platform – all used to create data sets for training machines to see and understand the world, and to build and maintain the high-definition maps required for autonomous vehicles to be deployed globally.

Automated public road testing based on digital twins
Patrick Luley, R&D manager - automated driving, Joanneum Research - Digital, Austria
To pave the ground for salable and cost-efficient test and validation of AD functions by real testing on public roads, Joanneum Research is producing Ultra High Definition Maps (UHDmaps) based on mobile mapping data in a salable automated workflow. UHDmaps contain a digital copy of reality, which sets the benchmark for the digital assessment of automated driving functions. The depicted solution is already utilized by the Austrian Light Vehicle Proving Region for Automated Driving (ALP.Lab GmbH) and its partners. The presentation will give an overview of the technical solution and certain test use cases.

Pedestrian protection through automated driving
Hartmut Runge, project manager DriveMark, DLR, Germany
A new concept for an autonomous driving system is presented, which in particular protects other road users such as pedestrians and cyclists. Furthermore, the system automatically ensures compliance with traffic regulations in a smart city equipped with it. It goes far beyond what we have seen so far with lane-keeping or automatic braking systems. The concept of geofencing will be further developed with unprecedented granularity. Detailed maps of the traffic areas of a city with 4in resolution will be used.

On-track testing of connected vehicles: methodology, challenges and results
Annie Saleh, head of automated and connected driving, PMG Technologies, Canada
PMG Technologies has completed closed-circuit track testing for Transport Canada to evaluate the performance and effectiveness of crash avoidance technologies, specifically connected vehicle technology. Tests were performed using two DSRC-equipped vehicles to reproduce maneuvers that would trigger targeted V2V features (hard braking, slippery road and disabled vehicle). The test results are used to describe and quantify the timing of visual and audible alerts sent to the driver after the reception of basic safety messages. This presentation discusses the testing methodology and challenges of physical testing on tracks. It highlights the analysis of test results and demonstrates the importance of track testing.

Companies represented include:
Bridging ADAS to AD in mass production
Dr Duong-Van Nguyen, ADAS department manager, Panasonic Automotive Europe, Germany
The presentation will discuss the gap between current ADAS and expected ADAS and AD systems. It will also outline technologies to enable 3D sensing using low-cost sensors by available ADAS ECU, and examine advanced sensor fusion to compensate for the deficiencies of one by the abilities of others.

Functional safety and security – partners or independent contributors
Anamaria Hutuleac, functional safety software assessor, NXP Semiconductors GmbH, Germany
As the complexity of systems increases, so does the need for functional safety and security. Quite often these goals are meant to be fulfilled by the same component. But how are they analyzed and designed so that instead of being two independent areas, they contribute together toward the achievement of the system goals? The presentation will show the similarities and differences in terms of goals, processes, concepts and mechanisms when it comes to functional safety and security. It will also discuss the analysis that can be done to bring them together on the same page.

Autonomous driving and open-source technology – does it fit?
Andreas Riexinger, product manager, Robert Bosch GmbH, Germany
Automated driving solutions introduce a new complexity into the development of embedded systems in cars. This complexity rises with each level of control and autonomy. The toolchain for such challenges is also complex and the integration of all the tools requires considerable effort without a real competitive advantage for the automated driving solution. Instead of solving these challenges alone, wasting lots of money along the way, Bosch’s automated driving division has started an open-source community known as OpenADx. This talk will present the open-source approach, the current state of the community and the currently available solutions.

Bridging ADAS to AD in mass production
Dr Duong-Van Nguyen, ADAS department manager, Panasonic Automotive Europe, Germany
The presentation will discuss the gap between current ADAS systems and expected ADAS and AD systems. It will also outline technologies to enable 3D sensing using low-cost sensors by available ADAS ECU, and examine advanced sensor fusion to compensate for the deficiencies of one by the abilities of others.

Migrating autonomous software from prototype to production
Robert Day, director automotive solutions and platforms embedded and automotive division, Arm, USA
This session discusses the challenges in moving autonomous vehicles from prototype to deployment, starting with the general requirements for the compute platform and then looking in more detail at the huge task of migrating the enormous software stack into a commercially deployable platform. The presentation will cover software platforms from an open-source and a commercial perspective, including the use of operating systems and hypervisors, middleware and application stacks. There will also be discussion around functional safety and how mixed-criticality systems can be deployed effectively.

Building an ADAS test and development environment in the cloud
Gabriel Sallah, EMEA HPC and big data architect, autonomous driving platform solutions, Microsoft, United Arab Emirates
This session will focus on the key Azure Cloud services needed to meet the demanding end-to-end requirements of testing and validating autonomous driving vehicles: from large-scale data ingestion (PB), to large-scale simulations (60,000+ cores) using high-performance computing (HPC), to scalable machine learning model creation, deployment and management. The presentation will share real-world experience of successfully building this platform for major OEMs and tier suppliers.

ADAS development and validation workflow and methodology
Dr Florian Baumann, CTO automotive and AI, Dell Technologies, Germany
IT and AI are key components of your development toward autonomous driving and the next generation of ADAS. Using an efficient workflow, you can make your engineers extremely productive and happy. This session will introduce you to the complete workflow of AI-enabled ADAS/AD product development.
Combined model-based and AI architectures for safety and comfortable driving
Dr Son Tong, senior research engineer, Siemens Digital Industries Software, Belgium
This talk presents our autonomous vehicle (AV) algorithm developments exploiting combination architectures of model-based and artificial intelligence (AI) toward safety and comfortable driving objectives. Recently, AI has been investigated in AV control; however, the disadvantage is a lack of rigorous results on explainability and safety. We discuss several strategies that incorporate data learning in control developments dealing with these challenges while enhancing performance: imitation learning of human-like driving in lane-keeping; Gaussian process control for snowy driving; reinforcement learning control. Finally, our experience in applying AI in robust sensor fusion is also highlighted.

AI and big data management for autonomous driving (AD)
Frank Kraemer, systems architect, IBM, Germany
Advanced driver assistance systems (ADAS) are already becoming part of all vehicles today, and fully autonomous driving (AD) is in the development phase right now. To win this race, applied artificial intelligence (AI) is the key component. All major OEM and Tier 1 auto manufacturers are implementing and testing AD facilities. Developing and testing AD systems requires the storage and analysis of more data now than ever before. Researchers and developers who can deliver insights faster while managing rapid infrastructure growth will be poised to be industry leaders.

AI-in-the-loop optimization of Ford’s Predictive Dynamic Bending Light
Aleksander Spychala, software engineer, Ford, Germany
Automotive lighting technologies have a challenging task to offer functionalities that provide a recognizable benefit to drivers. Engineering such technologies is even more difficult. Having successfully implemented artificial intelligence to quantify drivers’ subjective impressions of the performance of Predictive Dynamic Bending Light in real time, as well as in simulations, Ford has employed it for AI-assisted automated feature tuning by conducting AI-in-the-loop tests in addition to driver-in-the-loop tests. Using experimental design and multi-dimensional optimization techniques, various parameter sets are tested and gradually optimized with the aid of genetic algorithms to present a feature calibration offering the best performance determined by the AI.

The future of driving behavior in autonomous vehicles
Davor Andric, CTO AI and analytics North and Central Europe, DXC Technology, Germany
The vision for fully autonomous vehicles has yet to be realized. How realistic is it? Despite the increase in commercially available autonomous features up to SAE Level 3, achieving Level 5 autonomy will require a very different development approach. We will review current approaches and challenges for autonomous driving development, including human driver behavior, and examine what is needed to develop autonomous driving technologies for intelligent and safe real-time driving.

Paving the way for autonomous driving
Massimo Cavazzini, head of automotive business development - EMEA, Amazon Web Services, Italy
Connected, autonomous, shared and electric vehicle trends are converging to revolutionize the automotive industry. In this unprecedented age of innovation, automotive companies rely on Amazon Web Services (AWS) to fuel their digital transformation efforts and get their products to market more quickly, while retaining ownership and control of their data and brand experience. Learn what challenges autonomous driving is posing for developers, and how the main players in the industry are addressing those challenges.

Real-time trajectory planning for automated driving and some related applications
Dr Joshué Pérez Rastelli, principal investigator, Tecnalia, Spain
Automated driving has increased the functionalities for semi, highly and fully automated vehicles in recent years. Most of the applications receive onboard sensors and communication inputs from the infrastructure and other vehicles. Some motion planning and control techniques have been implemented for complex environments; however, most of them spend a lot of time in the execution. This presentation describes the techniques used by different research teams, their contributions to motion planning and comparison among these techniques. Furthermore, an approach based on a

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test methodology for validation of path planning and control algorithms for current and future automated vehicles is presented. A high degree of modularity, adaptability and real-time generation has been considered in the design of the proposed method. It shows good results for real applications in some complex environments.

Protecting mobility: Tesla’s vulnerability can exist in all vehicles

Yonatan Zur, CEO and co-founder, Regulus Cyber, Israel

Researchers from Regulus Cyber recently initiated remote spoofing attacks on the Tesla GNSS (GPS) receiver, exploiting security vulnerabilities in mission-critical telematics, sensor fusion and navigation capabilities. With Tesla as a backdrop, the presentation will explore the security requirements for safe autonomous driving. Using a wide variety of data, researchers have leveraged the major advantages of cyber defense for sensors’ anti-jamming, anti-interference, anti-spoofing systems that exist, and best practices for implementation. It will also discuss recent technological developments creating new threats, and will highlight the rapid growth of real-world attacks happening across these multiple sectors and how they are expected to grow as GNSS-dependent systems become more connected and autonomous.

Functional safety and security – partners or independent contributors?

Anamaria Hutuleac, functional safety software assessor, NXP Semiconductors GmbH, Germany

As the complexity of systems increases, so does the need for functional safety and security. Quite often these goals are meant to be fulfilled by the same component. But how are they analyzed and designed so that instead of being two independent areas, they can be analyzed and designed together? The presentation will show how efforts are being made to bring them together on the same page.

UAVs for safety validation and development of highly automated driving

Julian Bock, manager artificial intelligence, fka GmbH, Germany

Automated driving relies heavily on data-driven methods. Large datasets of real-world measurement data in the form of road user trajectories are crucial for several tasks. Using a drone has the major advantage of recording naturalistic behavior. Due to the ideal viewing angle, an entire scenario can be measured with significantly less occlusion than with sensors at ground level. Both the class and the trajectory of each road user can be extracted from the video recordings with high precision using state-of-the-art deep neural networks. Using this method, we are creating large-scale datasets with naturalistic road user behavior using camera-equipped drones.

Establishing trust with in-vehicle software management

Roger Ordman, executive vice president, Aurora Labs, Israel

Mass-market adoption of new technologies requires trust. Trust that the software underpinning the technology will be safe, secure and will constantly work as advertised. This presentation will look into the challenges faced by the vehicle manufacturers and their Tier 1 suppliers in ensuring that software faults and hacks can be detected before they cause a system failure. The regulatory landscape for cybersecurity and OTA will also be addressed (UNECE WP29 GRVA).

End-to-end AI – autonomous vehicle development and V&V

Sercan Arslan, director of automotive, Nvidia EMEA, Germany

Synopsis to follow.

Multi-sensor AI considerations

Mohammad Musa, founder and CEO, Deepen AI Inc, USA

Accurate classification and segmentation across multiple sensors is required for developing critical ADAS and autonomous vehicle components. Having redundant sensors is important to avoid safety risks in perception, tracking and path/motion planning algorithms. This talk will cover best practices for how to leverage and benchmark your AV/ADAS AI models for fused sensor configurations. It will include data validation aspects, early versus late fusion, and data taxonomy implications for your model.

Over-the-air updates for the entire vehicle

Reiner Duwe, regional manager, EMEA, Real-Time Innovations (RTI), Germany

Traditional over-the-air updates are known for delivering updates to the system software alone. This presentation will introduce a secure methodology to now also update the functionality of the system hardware controllers. The demo will show how hardware updates can instantaneously be processed in all nodes in today’s connected vehicle. The demo will show integrated technologies from the RTI Connext Drive framework, Xilinx adaptable technology and a secure cloud-based system from Bosch Software Innovations.

Tackle the challenges of AD algorithm development with versatile software tools

Nicolas du Lac, CEO, Intempora, France

Software has become an essential milestone for autonomous vehicles; at the same time, the number of software tasks is increasing rapidly with new sensor technologies. Automated driving development is becoming more complex, expensive and time-consuming. It is critical for developers to find reliable, versatile, powerful software tools that enable them to collaborate, face all these challenges by reducing the workload, and handle most automotive use cases from R&D to production. This presentation will focus on software development concepts for automated driving and will show how some OEMs and Tier 1 suppliers succeed, with algorithm demonstrations in multi-threaded and distributed architecture.
Design and implementation of a novel lane-departure detection algorithm
Dr Imran Hayee, professor, University of Minnesota Duluth, USA
The existing lane-departure detection systems use either some kind of image processing or advanced differential GPS technology. We have designed a novel algorithm that can detect an unintentional lane departure using standard GPS technology without any need for a camera or lane-level resolution maps. We have successfully implemented such an algorithm in a proof-of-concept system and published our results in TRB 2019. Our algorithm success rate is almost 100%. We have filed a US patent application and have secured funding to develop a smartphone app to make this feature widely available to the public.

Lessons learned and mistakes that can be prevented in cybersecurity
Miguel Bañón, vice president business line cybersecurity, Dekra, Spain
The autonomous vehicle is an exciting technological beast that will disrupt transportation. Other technological advances have had much longer development cycles, from the proper IT building blocks, like operating systems, to space and aviation systems. From the perspective of an IT security evaluation facility, we observe a number of repeating flaws and mistakes that can be prevented, providing a sound basis for lessons that need to be learned and applied for secure take-off and success of the autonomous vehicle.

Challenges of large-scale sensor data processing for autonomous driving
Dr Jan Wiegelmann, CEO, Autovia GmbH, Germany
During the development and validation of autonomous driving systems, engineers must collect and store a huge amount of sensor data for analysis, deep learning and safety validation. In the presentation, we will show insights from using frameworks for large-scale data processing and distributed applications running in on-premises clusters and in the cloud. We will share our experiences and lessons learned on accelerating the end-to-end engineering process from data ingest and cataloging to analysis, development and safety validation.

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