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“Constantly reliable tools”

The fast transformation of the automotive industry is creating particularly great challenges for developing and validating functions for highly automated driving. Rainer Otterbach, Director of Product Management, and André Rolfsmeier, Lead Product Manager for Advanced Applications and Technologies, at dSpace explain what tools are needed to achieve this by means of virtual validation, and how partnerships still have to adjust to this.

ATZelektronik _ Mr. Otterbach, the automotive world is changing drastically, driven by new technological challenges and new business models. Some companies are even talking about having to reinvent themselves. What is changing for you and how are your tasks changing? Will dSpace also have to reinvent itself to some degree?

OTTERBACH _ No, we don’t have to reinvent ourselves. We have long ago started to prepare for two key areas that are very important to us: electromobility and driver assistance systems, up to highly automated and autonomous driving. Our customers’ development processes in this area are changing considerably and gaining in complexity. This naturally increases the demand for appropriate development tools. And that is our core business.

Highly automated driving in particular creates enormous challenges for you. Are you tackling these with your existing staff? Or is dSpace hiring new employees? For example, digital employees?

Rainer Otterbach (born in 1962) studied electrical engineering at the University of Siegen and graduated in 1987. He did his PhD in 1995 in the field of digital image processing. From 1995 to 2000 he was responsible for software development at the dSpace GmbH in Paderborn. Since 2001 Mr. Otterbach is Head of Product Management.

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OTTERBACH _ Both. We are focusing on the new topics with our existing teams but also when hiring new employees, and we have done so for quite some time. In addition, we are building on strategic partnerships.

How has your network of partnerships evolved in the last 24 months?
OTTERBACH _ We are constantly checking how we can expand our product range through partnerships for the benefit of our customers. One example is the close cooperation we began in 2016 with the French company Intempora, an expert for high-performance sensor data pre-processing and fusion. dSpace has integrated Intempora's tool RTMaps in its own tool chain and sells this solution internationally.

Mr. Rolfsmeier, when testing driver assistance systems for highly automated and fully automated driving, it is impossible to achieve the "perfect coverage" that the industry has achieved for the traditional functions. What methods and tools do you use to reach the best possible results?
ROLFSMEIER _ We are seeing a clear trend toward virtualised test drives. In addition to hardware-in-the-loop (HiL) tests, software-in-the-loop simulation based on virtual electronic control units (ECUs) will become very important. It lets developers test a high number of traffic scenarios even without real ECUs or prototyp vehicles by varying parameters such as roads and road networks, vehicle variants, the surrounding traffic, and weather conditions. The tests can be automated and executed even faster than in real time. Due to the high number of possible tests, it is important to identify representative and critical test scenarios, for example, by evaluating accident databases. By means of an appropriate parameter variation and control, it is possible to automatically search for weaknesses and errors of the driving function. For this, dSpace offers a seamless tool chain for model-, software-, and hardware-in-the-loop simulation.

"Closer cooperation between OEM, Tier-1 and test system supplier"

What areas do you focus on?
ROLFSMEIER _ Integration tests and tests of the chain of effects during software development with dSpace Veos, the dSpace platform for PC-based simulation, and parallel execution of MIL/SiL tests on many, even several hundred, high-performance computers, which we call a PC cluster. We already set up the first PC clusters and gained valuable experience in customer projects.

And other focal points ...
... include release tests on HiL test benches and the validation of complete chains of effect, including the real sensor ECUs. One example is the new dSpace radar-in-the-loop test bench. An important factor for validation by means of virtual test drives is the quality of the simulation and sensor models. Therefore, the dSpace Automotive Simulation Models (ASM) and the 3-D animation tool ModelDesk are another core area of our work.

The volume of test data and their automated analysis is enormous already today – and the analysis is becoming even more complex and extensive. How is dSpace preparing for this? And what measures do you still have to take to master the future challenges of big data?
OTTERBACH _ Large volumes of data are generated during test drives, when the data of camera, radar and lidar sensors are recorded together with data from the vehicle buses, for example. During SiL simulation on PC clusters, a high number of simulation results is produced in an extremely short time. To store this data, manage it, and make it available to distributed work teams at different locations, dSpace and its data management software Synect build on IT solutions by partners who are experienced in working with big data. Here, we are in contact with established providers on the market.
ROLFSMEIER _ The management of simulation models and their parameterisations as well as the test management and

Andrè Rolfmeier Name (born in 1967) studied electrical engineering with focus on measurement, regulation and control system engineering at the University of Paderborn. In 1997, he began his professional career at the dSpace GmbH in Paderborn in the application area and engineering. In 2000, he was a resident engineer at DaimlerChrysler in Auburn Hills, USA. Since 2001 Mr. Rolfsmeier works as a Product Manager at the Paderborn company, responsible for various business areas. Since 2013 he is Lead Product Manager Advanced Applications and Technologies, among others responsible for the topics driver assistance systems and autonomous driving.

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sequence control of PC cluster simulations are performed in Synect, among others. We are also developing technologies for automatically analysing, evaluating, and annotating measurement signals during the running simulation. This will make the later analysis of he large volumes of measurement data much easier.

Vehicle developers have to be extremely flexible. Which of your latest innovations support your customers? And how will you allow your customers to have an even more agile development process?

OTTERBACH _ Important aspects of agile development are a continuous integration and testing of the developed ECU functions in the overall system. This can be done particularly efficiently by using virtual ECUs, prototypes that consist only of software. Developers can use the entire tool chain they already know from the HiL test bench, i.e., the same environment models, the same test scenarios, the same test automation, and the same experiment software. The only difference is that the tool chain is now available at the software developers' desks, so they can perform realistic tests in a high-quality environment. We are noticing that this additional validation step is becoming an important part of the OEMs' and suppliers' development processes, in addition to HiL tests. This allows them to detect errors at very early stages, when no hardware prototype of the ECU is available yet.

How did you prepare your MicroAutoBox for the new challenges in the field of highly automated driving?

ROLFSMEIER _ The main challenges in developing functions for highly automated driving are sensor data preprocessing and fusion. To tackle these challenges, we are extending MicroAutoBox by the Embedded Sensor Processing Unit. The new system is based on the latest Nvidia processor architecture with a six-core CPU and an integrated GPU. But the high processing power is not the only unique feature of MicroAutoBox Embedded SPU. It also includes interfaces to all common automotive bus systems and to camera, radar and lidar sensors, GNSS positioning, and wireless communication. All this is combined in a robust and compact system. Together with the graphical modeling environment RTMaps for multisensor applications, users can implement and test algorithms in fast iteration cycles in C++, Nvidia Cuda, Python, or on the basis of Simulink. Additionally, MicroAutoBox has been equipped with mechanisms for functional safety, making it easier to use it for test drives in real traffic.

"International standards would be great"

Data Security also has to be tested. But how is this possible without the necessary standards?

OTTERBACH _ Our HiL systems support the Autosar standard for secure onboard communication, so the respective ECUs can be connected to the HiL simulator to test onboard communication. We are also currently collaborating with OEMs, suppliers, and security experts to identify how we can use the infrastructure of our simulators to make security testing even more efficient.

What conditions do you think are necessary to improve industry-wide collaboration?

ROLFSMEIER _ EIn our opinion, there are no uniform criteria and regulations for the validation and approval of functions for highly automated driving. We would like to have commonly accepted methods and procedures, particularly for simulation- and test-bench-based testing. For example, realistic sensor models have to be used to validate complete chains of effect. dSpace is investing a lot of effort and time in this field. However, it would be ideal if such models were provided by the actual experts, i.e., the manufacturers of the sensor ECUs. This would require uniform sensor model inter-

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"In our opinion, there are no uniform criteria and regulations for the validation and approval of functions for highly automated driving. We would like to have commonly accepted methods and procedures, particularly for simulation- and test-bench-based testing. For example, realistic sensor models have to be used to validate complete chains of effect," emphasise André Rolfsmeier and Rainer Otterbach in discussion with Markus Schöttle, ATZelektronik

faces. Furthermore, we will need open description formats for test scenarios as well as generally accepted exchange formats for virtual ECUs ...

... and a closer cooperation between OEMs, Tier-1 suppliers, and test system providers?
ROLFSMEIER _ Exactly. Highly and fully automated vehicles will use a high number of environment sensors, such as camera, radar and lidar sensors. The release tests on the HiL test bench require concepts that integrate the different sensors in the closed loop real-time simulation synchronously and with as little latencies as possible. This means that the partners you named have to work together more closely.

Open development platforms would be desirable. As would be test scenarios that everybody can agree on. How would you assess the effort and success in this area?
OTTERBACH _ Openness is created by means of standardisation. For example, a simulation platform should support the FMU/FMI standard for exchanging simulation models. Or the Asam XIL standard for connecting test automation software. Naturally, the Autosar standard and the prospective Adaptive Autosar standard also play an important role, for example, for the creation of virtual ECUs – and of course for production code generation with TargetLink. And a data management system like Synect can be integrated in a development department's IT infrastructure via OSLC. At dSpace, we put great emphasis on supporting these standards with our tools, and we are on the relevant committees to develop them further.

What is current research focusing on, nationally and internationally?
ROLFSMEIER _ National research and funding programs are already discussing the option of uniform test catalogs and specifying open description formats for traffic scenarios (OpenScenario) and sensor model interfaces. We are welcoming these activities and are contributing to the respective work groups. In the future, it would be great to include international partners to achieve a worldwide standardisation.

Dr. Otterabch, Mr. Rolfsmeier, thank you for your answers.

INTERVIEW: Markus Schöttle