Interview with Martin Sevenich
Continental AG

„There is nothing in the field of ADAS that is inconceivable in the future“

Martin Sevenich of Continental already knows part of the future. During pre-development, vehicle functions are tested that won't be ready for series production for several years. We sat down with Mr. Sevenich to talk about different applications, the technical implementation of studies with test participants in the fields of driver assistance and automated driving, as well as the significance of these tests for the future.

Simply put, you test advanced driver assistance systems with test participants, which is important for the current trend of automated driving. We'd like to go into more detail here. What is it exactly that you do?

I'm responsible for the simulation of active safety systems in the department Advanced Technology of the division Chassis & Safety at Continental. We have set up a driving simulator to test and evaluate advanced driver assistance systems.

For those who are not familiar with driving simulators: How does this work?

Currently, we use a static version, which means that there is no movement at all in the simulator. We try to imitate reality, however. Most of the components in our driving simulator therefore correspond to those of a regular vehicle. For instance, the driver receives feedback on the driving situation via an active steering wheel as well as active accelerator and brake pedals. To enable drivers to feel as though they are in a realistic scene, we have set up a large 120-degree screen in order to create this illusion to a certain extent.

And do you believe that driving feels as realistic as in a real vehicle? Does a test drive primarily work on a visual level or are different senses involved?

The extent of realism becomes obvious, for instance, when test participants who change lanes in the simulation look over their shoulders. This shows us that immersion is able to approximate realism. All sensory channels are important for a test participant to experience a realistic sensation. Not only are a good image or good haptics of the steering wheel required but also the adjustment of the individual components, that is, the latencies are crucial. We have invested considerable energy into a good driving perception in order to continue increasing the realism of the driving experience. Compared to a dynamic simulator, a static simulator lacks the sensation of movement. As a result, not all of a driver's senses are stimulated in a static simulator.

How did you realize the simulation and which technical implementation did you choose?

The driving simulator is coupled with the simulation software CarMaker since this software is also used for real-world tests in later stages of the development process. CarMaker enables us to drive reproducible scenarios. In contrast to regular traffic on roads, this opens up the possibility of separating the lateral and longitudinal control. For example, in the case of an ACC system, we test different aspects of the longitudinal control of our system while leaving the lateral control to the driver model IPGDriver of CarMaker. This allows us to examine whether the driver understands the reaction of the vehicle and how the function works on different routes.

Are there significant differences between test participants in simulator tests? How about a function such as ACC, for instance, in terms of the subjectively comfortable distance to other vehicles?

That always depends on the driving situation and therefore on the object of investigation. There certainly are differences between the individual drivers – that is the human factor. Taking the ACC as an example, the difference in driving perception in terms of distance can be observed and evaluated based on objective data.

How long have you been using a driving simulator?

I have been part of the department Advanced Technology since 2012 and started out with a simple static simulator, a seating buck, which we have gradually expanded since then. In 2014/2015, we set up the driving simulator and we continue to develop and improve it further. The control computer and the relevant components are under the hood. The modular setup of the components enables a flexible adaptation to the respective issue of the assistance function.

How did you implement the driving simulator on a technical level?

By means of projectors, we found a way to display a realistic image by merging three images into one visualization on a curved screen. The size of the projection is not necessarily crucial; it is the required seating distance. In order to achieve a realistic sensation of driving, the minimum distance to the screen should be 3.5 meters. Only then is it acceptable for the test participant since the accommodation of the eye is comparable to a realistic driving situation. An estimation of distance is then possible based on the size of objects.

Is the original solution still in use?

Yes and no. It currently sits in my office, waiting to be deployed again. A possible test scenario would involve initial tests on cooperative driving with two drivers who directly interact with each other.

I assume that test participants need to be familiar with the system to be able to give a good assessment of the driving function.

On the contrary, to evaluate the assessment of new systems, studies with representative test participants (age, gender, etc.) without knowledge of the function are preferable. However, a basic orientation and a training run in the simulator are always completed beforehand.

In addition, we use the simulator for the objective assessment of functions. This differs from one project to the next and these tests are conducted by test engineers. When collaborating with a software developer, the test is focused on the debug function.

Do the tests with test participants run without any problems?

Usually, the tests with participants mostly run without a problem due to the robust setup. A small number of test participants (about 10 %), however, may suffer from the so-called simulator sickness (nausea).

Quick question for a better understanding: The functions and the systems are exclusively developed by Continental?

That is correct, the systems are developed here in the department Advanced Technology. We focus on proof of concept in simulation and subsequently in the test vehicle. Following this, the systems including the documentation are passed on to product development after they reach a defined maturity to be developed in the context of customer projects until they reach series production maturity.

What is the advantage of virtual testing on the computer?

It offers us the chance to test different functions in a safe environment and validate the function code with ideal sensors in an ideal environment as a first step. Here, we can quickly switch from A to B in various scenarios with the vehicle. Thanks to different map materials, we can switch from a two-lane to a three-lane highway which would be impossible in reality. An on-the-fly change from winter to summer testing is also possible in the simulator. To sum up the biggest advantage: It is possible to reproducibly repeat different scenarios several times without any problem.

How will the share of tests of simple advanced driver assistance systems up to complex systems evolve in your opinion?

The test effort will rise significantly along with the increase in functions. Especially with regard to complex systems, there will be a considerable rise. A shift of test activities from the test bench and the vehicle to the simulation is evident and will continue to increase. Here, the interaction between the driver and the assistance function is steadily gaining in importance with the result that driving simulators have made a significant contribution to this in recent years.

What happens to the systems that you test? Do they all find their way into a real prototype?

Selective preliminary studies are already conducted during the model-in-the-loop stage. Following this, the promising functions are implemented in software modules and software-in-the-loop tests are carried out within the simulation environment. Possible solutions are gradually refined during this stage. In the next phase of development, the software functions are transferred to the hardware. Parallel to the implementation in vehicle prototypes, hardware-in-the-loop tests are conducted.

We concentrate the development of automated driving functions in one project house. Within the project house, we develop new functionalities every day. Since we are no longer able to test the scope of functions in a real vehicle on a daily basis, we have made our development agile and test the algorithms in simulation. Daily modifications of the functions within the software are thus tested using a variety of scenarios in the simulator, leading to continuous additions to the test catalog.

Do the results gained in your projects have a global influence on development activities at Continental?

We are simultaneously in charge of many projects and test scenarios that are used throughout the corporation. In 2012, for example, we were the first automotive supplier on a global scale that obtained a license for highly automated driving on public roads in the state of Nevada, USA. For these purposes, it is important to supply our engineers on-site with regionally adapted test scenarios. A software code developed here is correspondingly rolled out to the different locations.

Is there a routine to this or is every test different?

There are simple tests that we conduct on a daily basis in order to verify whether the function still works. If it does not, the result is directly forwarded to our software developers who work in the relevant modifications. It is much more efficient to realize this in a simulator than by conducting daily test drives.

Which other tools are used in connection with the simulator and CarMaker and which functionalities are made possible by this?

In addition to CarMaker, we also draw on other tools. For instance, we require digital street maps such as those provided by ADAS RP in order to test functions in real environments in the simulator. The advantage of this is the fact that the maps in CarMaker are identical to those maps that we download from ADAS RP. We also use digitized routes such as those from 3D Mapping. To give you an example: In order to test a camera-based advanced driver assistance system, a traffic sign must be positioned in the same spot in reality and in the virtual world, otherwise we won't be able to identify it.

Do you often use the same or different virtual test tracks?

The test scenarios are defined according to each project. In addition, we regularly use three to four real tracks at the present time that we also have available as high-resolution virtual test tracks. On these tracks, real-world test drives are carried out and the results are compared to the simulation.

In your opinion, how will the number of tests (and of test cases) conducted in the simulator rise with regard to the entire development chain?

It is already rising significantly. Compared to 2012, we now increasingly rely on simulation. It is difficult to predict how this will develop but I anticipate a rapid growth.

In terms of release processes, the car is still the one that needs to prove itself in real traffic. The last release will continue to take place in the vehicle in the future; however, the findings gained through simulation will be taken into account.

Coupling the simulation software CarMaker with the driving simulator enables realistic test drives with test subjects in reproducible scenarios.

Speaking of simulators, which specific range of functions of the software do you use for this?

In particular, we use the sensor data, the driver, and of course the corresponding vehicle dynamics interface of the closed-loop vehicle dynamics simulation program. Additionally, we use the Test Manager and IPGMovie for the visualization. For tests of automated driving functions, the development of the Scenario Editor was especially important for us – it would have been great to have it sooner but I'm glad it's here now. (laughs)

With regard to automated driving, do you think that a driver model might become obsolete?

Especially for handover scenarios between automation and driver, driver models are of particular interest. Maybe it is important for these precise cases. A driver model is necessary to compare how an ideal driver would drive in comparison to an artificial driver.

What big challenges do you see for simulation?

The ability to simulate complex scenarios in real time must be given. Both sensor models and graphics must simultaneously deliver speed as well as performance in order to continue increasing the level of realism. A specific example: An ideal line marking for measuring distance on the highway is applied every 6 meters in theory, which would be easy to test. However, in reality the distance is 6 ± x meters. There are certain deviations and this is precisely what tools such as CarMaker need to be able to model. New bus protocols should be mentioned here as well since they present new challenges to the architecture of a HIL system. The now common CAN protocol is already close to being outdated. In this field, automotive Ethernet is the future.

How far into the future do you look in general?

In the case of a feasibility study from a prototype up to a customer project, we're talking about four to five years. In my opinion, it is impossible for anyone to anticipate a period longer than five years; those are strategies and visions. However, in terms of advanced driver assistance systems, I'd say that there is nothing in this field that is inconceivable in the future.

Much has happened in the development of advanced driver assistance systems in recent years, and the software used must keep up. Which specific features do you consider to be particularly important and which potential do you still see?

New challenges definitely lie ahead for us. It will be exciting to include the entire complexity of natural surrounding traffic into the simulation. Covering only one scenario with three vehicles in all variations is a complex task. One specific issue is this, for instance: What does an emergency braking maneuver of a fully automated vehicle look like? Those are future applications. For now, we must invest considerable energy into finding how such test scenarios can be generalized and simplified.

What challenges do you see in terms of test drives for automated driving?

Essentially, everything has become much more complex. Previously, you had one control unit with one function. Nowadays, there is a large number of control units with different functions that interact with each other as well. For the evaluation of the systems, different, highly detailed and more complex test technology is also required. Due to this, not all tests of automated driving functions can be conducted in vehicle tests any longer.

The challenges arising from this cannot be fully estimated yet. There will be changes to the evaluation methodology toward simulation and possibly sooner than we expect.

Thank you very much for the interview, Mr. Sevenich, and good luck with your work.