
# PEGASUS-Project

## Faster Validation of Functions for Autonomous Driving with Simulation-Based Tests

Get in the car, choose your destination, sit back, and relax. This is what many drivers want. Yet, how can we be sure that the driving function also makes the right decisions? How do you prove that an autonomous vehicle is safe? The collaborative PEGASUS project, funded by the Federal Ministry of Economics and Energy (BMWi), took on this task.

In mid-May 2019, 17 project partners from industry and science presented the results of three and a half years of practical research and development that focused on validating functions for autonomous driving at the Volkswagen test site in Ehra-Lessien, Lower Saxony. dSPACE was an associated partner and provided expertise for the testing subproject.

During the PEGASUS project, the researchers developed a procedure that ensures a uniform evaluation and validation of the driving functions in the most efficient manner possible. "We discussed the findings with experts nationally and internationally through the course of the project to ensure that the results are also viable in practice," said Prof. Karsten Lemmer, DLR Executive Director for Transport and Energy and one of the two PEGASUS coordinators. Professor Thomas Form, responsible for vehicle technology and mobility experience at Volkswagen AG and also a project coordinator, added: "PEGASUS makes an important contribution to the future approval of autonomous vehicles by developing requirements, processes,

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metrics, and tools that in combination lead to a consistent overall method for the approval of the driving function."

### Presentation of Results on VW Test Site

At the final presentation, the project partners demonstrated the tool chain developed during the project at the Volkswagen test site in Ehra-Lessien. They clearly demonstrated the individual steps involved in validating and approving functions for autonomous driving using digital posters, exhibits, and (driving) simulators as well as outdoor driving tests.

In 2016, the project partners decided on a tangible application case, the Highway-Chauffeur to test the universal PEGASUS approach for validating a driving function. The Highway-Chauffeur controls the vehicle on highways and expressways at a speed range from 0 to 130 kilometers per hour. It can also independently change lanes.

The PEGASUS overall method enables a continuous test sequence through a collection of all requirements for the driving function and a collection of relevant traffic situations. The data collection is based on field test, simulator and accident data. The data is processed uniformly and made available via a central database for applications in simulation, on the test site and in real traffic. This results in a release recommendation for the driving function, which is supported by process recommendations and the final safety evaluation.

### dSPACE Support by Means of a Scenario-Based Tool Chain

The large number of simulation-based tests makes the tests in PEGASUS particularly efficient. Uniform interfaces are used, which also enables integration into existing environments. The simulation results are validated by means of tests on the test site. The simulation approaches in particular are also suitable for the early phases of the development processes of autonomous vehicles. PEGASUS therefore transfers the previously manufacturer-specific procedure for testing and validating assistance functions to a new, universal procedure for which all developers can apply the same criteria and dimensions.

dSPACE supported the project in setting up an exemplary scenario-based tool chain in which standard formats such as FMI (models), OSI (sensors), OpenSCENARIO, and OpenDRIVE (scenarios) were implemented and used by BMW as prototypes. With dSPACE VEOS, all these interfaces were integrated into a single simulation platform and combined with the ASM environment models. The result was a powerful software environment for validating and verifying ADAS and AD functions.

Test tools from the other project partners were easily connected via standard interfaces as shown by the prototype from TraceTronic. Therefore, it was possible to implement the PEGASUS idea of intelligent, scenario-based SIL tests with comprehensive as well as various practical scenarios. "In combination with the VEOS ability to simulate virtual ECUs based on the Classic or Adaptive AUTOSAR standard, the project partners have come much closer to their goal of performing tests in a realistic, reproducible, and highly scalable manner," says Dr. Karsten Krügel, Senior Product Manager Virtual Validation at dSPACE. As a result, the requirement of expensive real test drives will be greatly reduced. ■

> "PEGASUS makes an important contribution to the later approval of autonomous vehicles."

*For more information, go to:*
*www.dspace.com/go/pegasos*


**FMI:** The Functional Mock-up Interface defines a standardized interface that supports the connection of simulation software.

**OSI:** The Open Simulation Interface is the standard for connecting the development of functions for automated driving with a variety of frameworks for driving simulation.

**OpenSCENARIO** defines a file format for the description of dynamic traffic maneuvers (scenarios) for use in driving simulators.

**OpenDRIVE** defines a data model for the highly accurate, logical description of road networks.

**ASM** is a dSPACE tool suite for simulating combustion engines, vehicle dynamics, electric components, and the traffic environment.