How can I test everything from complex networked functions up to complete vehicles as early and flexibly as possible? How can I save costs by reusing test artifacts from one process step in the next one? dSPACE test systems support you in all of your current and future challenges.

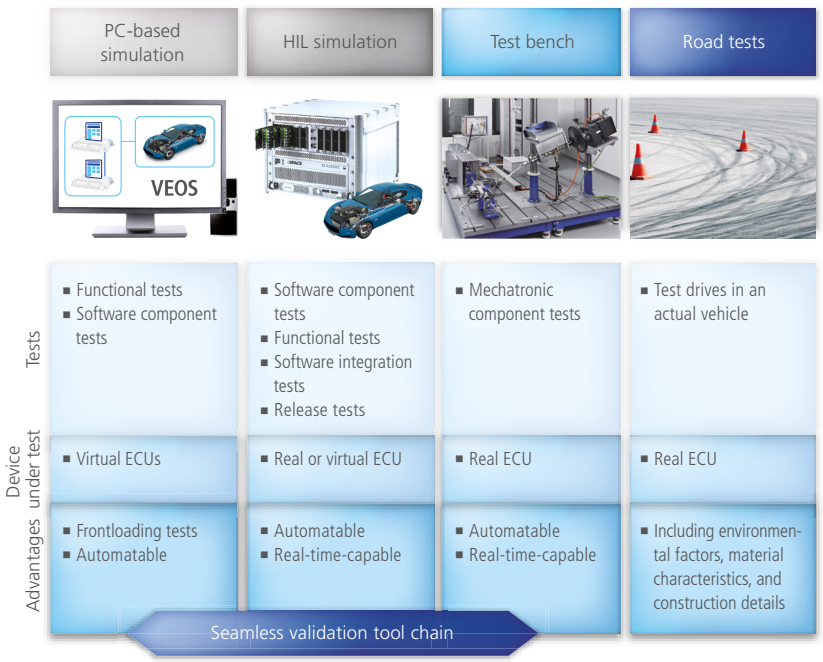
No one can exactly predict how vehicles will develop in the long term, but if the innovations of recent years do show a general direction, the path is leading to more, and more complex electrics/electronics (E/E) functions in the vehicles. In today's vehicles, 100 million lines of code for an entire ECU network are already a reality in many places, and the complexity is continuing to grow due to factors such as driver assistance systems. The challenges on validation and test systems to validate this complexity are also increasing.

Enormous Challenges

There are several factors that affect future test processes and test systems:

- *Networked functions*
  The new driver assistance functions require networked sensors and actuators that give them information about the environment and other road users. This requires detailed simulation models of the vehicles, the sensors, and the environments. The numerous electronic control units (ECUs) interact tightly with each other. Besides the classic vehicle bus systems, new communication networks such as CAN FD and Ethernet are also being used. Their behavior must also be validated in the tests.
- *Vehicle and model variants*
  The increasing level of networking between functions and ECUs is accompanied by a wide range of variants and models and also new drive concepts such as electric and hybrid vehicles. This increases the diversity of the ECUs and embedded software to be validated, because ECUs are used across several vehicle variants. More and more, the decisive factor for the test system is an intelligent data management which provides process reliability.
- *Special requirements for combustion engines and electric motors*
  New technologies in the field of battery management and electric motors are changing the validation process because, in comparison to conventional drives, significantly higher currents and faster control algorithms have to be considered. For internal combustion engines, new emissions laws are causing an increased use of exhaust gas treatment systems and more precise injection systems which, in turn, need to be included in validation tests.
- *Standards and norms*
  Test systems are increasingly influenced by binding standards and norms, such as ISO 26262 for the development of safety-relevant E/E systems in motor vehicles. >>

Figure 1: The dSPACE tool chain is used seamlessly throughout several test phases.



Quo Vadis, Test?

Single-source test solutions

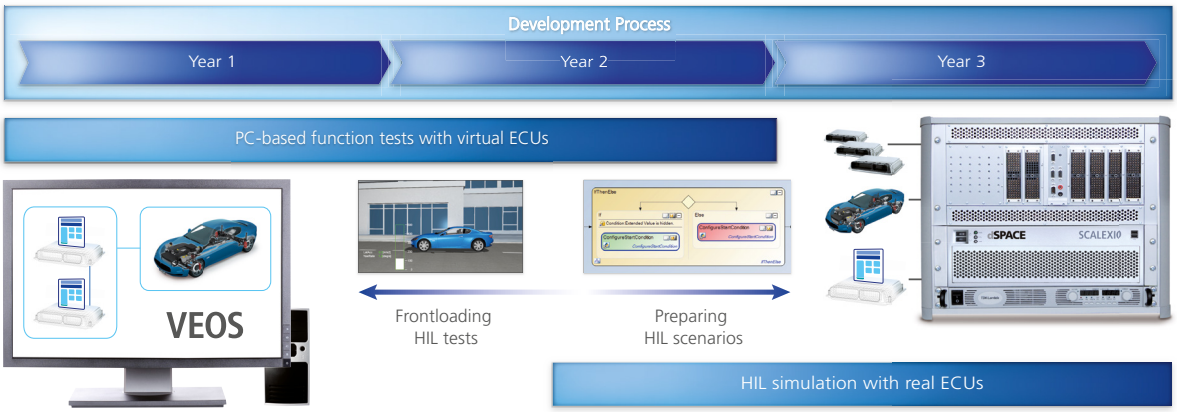


Figure 2: The combination of PC-based simulation and HIL tests enables early function validation and test scenario preparation throughout the entire development process.

Seamless Test Systems

To make the complex challenges manageable, dSPACE offers seamless test system solutions from a single source. In these solutions, hardware-in-the-loop (HIL) tests and driving tests play an important role, complemented by pure software simulation with virtual ECUs (figure 1).

Early Validation on the PC

The increasing number of model variants, high variety of functions, and shorter development cycles are making it more difficult, even impossible, to use prototype vehicles to perform all the tests. Beside HIL simulation, validation on a PC makes earlier tests possible, as functional tests are frontloaded to the earlier development stages. dSPACE provides the PC-based simulation platform VEOS® for this task. This gives function developers their own test platforms to perform function tests with virtual ECUs. They can verify the development steps at any time and cost-effectively.

Reliable Real-time Tests on HIL Simulators

With the HIL simulator SCALEXIO®, HIL tests follow directly after PC-based simulation. HIL simulation is a well-established, efficient process step for automatically validating the ECUs that are built into the vehicles later on. In particular, bus communication via CAN/CAN FD, LIN, and Ethernet SOME/IP, for example, can be validated with a dSPACE HIL system reliably and reproducibly in a simulated vehicle environment. dSPACE offers tailored hardware for applications with special requirements. For example, to test electric drives, which require short control cycles and high currents, the dSPACE Automotive Simulation Models (ASM) and FPGA-based hardware are available. For driver assistance applications, dSPACE provides simulations for the vehicle environment and sensors so that the HIL simulator can be used to test the wide variety of traffic scenarios in the virtual world.

Mechatronic Tests on the Test Bench

In some HIL test cases, it is not possible to access the ECU through its electric interfaces alone. As a result, mechanical access is essential for setting up mechanical loads on electric drives, stimulating the integrated sensors for mechatronic ECUs, or stimulating human-machine interfaces, for example. For these tasks, dSPACE provides highly dynamic test benches for mechatronic components and systems in connection with the real-time simulation. For more information, read the interview on page 66.

Process-Reliable Tool Chain

Standards and norms are becoming more important for test systems. For example, ISO 26262 explicitly names HIL tests as a validation step. For process-reliable test environments, dSPACE offers not only appropriate test systems, but also software that meets the standards. The test automation software AutomationDesk has been certified by TÜV SÜD for testing safety-related systems according to ISO 26262 and IEC 61508. This certificate confirms that this software tool is suitable for developing and testing safety-relevant systems in the automobile industry, commercial vehicles, aerospace and many other fields. AutomationDesk is the first test automation software in the area of HIL simulation that has been granted such a certificate.

Openness Through Standards

Test systems often need to be integrated into existing software environments. With its products, dSPACE

supports several standards such as AUTOSAR, the Functional Mock-up Interface (FMI), and ASAM XIL API. Standardized interfaces to the dSPACE test systems make it easier to exchange simulation models, for example, between the OEM and supplier (figure 3).

Convenient Data Management with SYNECT

The complexity of the test tasks and test systems generates a huge amount of data. To make the testing process as efficient as possible, the test scenarios, test variants, models and test results must be managed, versioned and stored for easy retrieval. dSPACE SYNECT® is the data management software tool that is designed exactly for these tasks, focusing on the model-based development and ECU tests. SYNECT manages both the data throughout the development process (e.g., models, signals, parameters, tests, test results) and the data dependencies, versions, and variants, including links to the underlying requirements. ■

All Solutions from One Source

From PC-based simulation, to HIL test systems, up to mechatronic test benches, dSPACE offers a harmonious hardware and software tool chain. Together with its decades of accumulated experience in setting up systems with many thousands of applications, dSPACE helps customers design effective testing processes, today and in the future.

For further information, visit the dSPACE website at: www.dspace.com/go/dMag_20153_HILE

Figure 3: The seamless tool chain and support of various standards enables the early exchange of test scenarios, models and configurations.