Vehicle-in-the-Loop

Seamless testing of ADAS in a full physical vehicle

Combine the advantages of real-world test driving and simulation for the development of new functions and components with the Vehicle-in-the-loop (VIL) method. The method focuses not only on a specific individual function to be validated but on the interplay within the full vehicle. In contrast to real-world test driving, environmental elements are partly calculated within the simulation. The advantage of this approach is the ability to easily generate even complex scenarios, or reuse scenarios from earlier stages of the simulation, and run them with complete reproducibility. Nevertheless, in terms of its handling characteristics, the behavior of the vehicle corresponds to the behavior it exhibits in real-world test driving – without the need for extensive parameterization of a vehicle model. It is also possible to take the customer's driving experience into account early on. For acceptance studies of new functions, VIL enables tests with human participants to be conducted already during the model development stage.

The VIL approach can lend particular support to the further development of today's assistance systems into semi-autonomous or fully autonomous systems. The VIL method answers the question of how the interplay between a control function and the actuator technology in the vehicle can be tested holistically while maintaining full flexibility in terms of generating the scenario – even for critical situations.

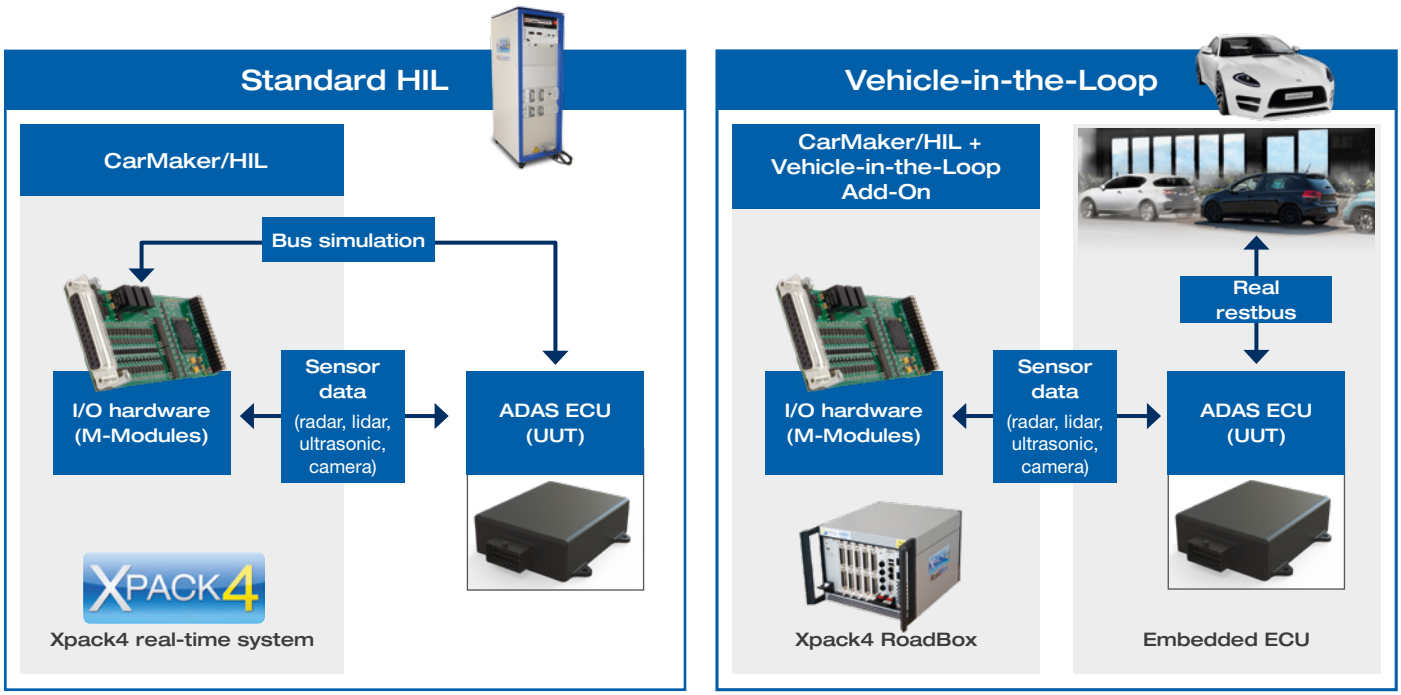
In addition, the success of highly automated driving functions substantially depends on the design of the interface between the driver and the vehicle: How does the handover of the driving task between the driver and the assistance system work? How is it ensured that the driver can be brought back into the loop at all times when the vehicle drives itself? For a comprehensive analysis of these issues, VIL offers a safe, realistic and resource-efficient test procedure.

When applying the VIL method, a physical vehicle is integrated into a virtual environment (including the traffic, signs, road markings, etc.) and tested on an open space. Fields of application for VIL include tests of park assist, lane change or emergency brake assist systems, with or without pedestrian or cyclist detection, evasive steering assist systems as well as the analysis of complex autonomous driving functions within traffic flowing in the virtual world.

This is implemented using the open integration and test platform CarMaker which enables virtual test driving in all stages of development. With the simulation solutions of the CarMaker product family, individual test scenarios can be generated including dynamic traffic objects (e.g. cars, buses, pedestrians) and static objects (e.g. parked cars, construction sites, trees). The movements of the individual traffic objects are configured based on maneuvers, making them independent from specific vehicles or routes. Autonomous traffic flowing in the virtual traffic environment can be defined as well.

Using a specially developed Vehicle-in-the-Loop Add-On for CarMaker, the physical test vehicle is integrated into the virtual traffic environment. The virtual ego-vehicle moves through virtual traffic in synchrony with the physical vehicle that is being driven around an open space. Sensor models in the virtual vehicle detect the simulated objects and transmit the signals to the ECU in real time. Depending on the stage of development, these may be the physical control units of the test vehicle (HIL) or virtual ECUs (MIL/SIL).

With the VIL method, the functionality of systems can be reproducibly tested under a variety of boundary conditions, allowing tests under real conditions to be reduced to sample checks. This way, cost-intensive iterations during the approval process can be avoided.



Your benefits at a glance

- Risk-free testing of critical maneuvers already in early stages of development
- Reproducibility during real-world test drives
- Reduction of costs and material expenses
- Augmented reality extensions
- Real vehicle dynamics
- Freely configurable scenarios
- Functional safety validation for functions including park assist, emergency brake assist, lane-keeping assist, blind spot assist, and many more
- Test system for ultrasonic, lidar, radar and camera-based functions
- Testing future driver assistance functions in connection with the driver in an augmented virtual environment

> Find more information on vehicle-in-the-loop on our website at
www.ipg-automotive.com/products-services/test-systems/vil-systems/

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