Contact
Dipl.-Ing. Frederic Christen
christen@ika.rwth-aachen.de
Phone: +49 241 8861 104

Institut für Kraftfahrzeuge
RWTH Aachen University
Steinbachstr. 7
52074 Aachen, Germany

PELOPS AS A TOOL FOR SOFT/HARDEWARE-IN-THE-LOOP SIMULATION

Advanced Driver Assistance Systems (ADAS) are under development in recent years with an upward tendency. Such systems will relieve the driver and improve safety on the road in the future. Computer-aided-simulation has already been used for the development and evaluation of such systems for a long time. So far there was only the choice between two kinds of simulation systems, which both did not meet the requirement of an easy system evaluation in a real traffic environment. The Software- and Hardware-in-the-Loop-tools (SiL/HiL) currently used in the development of ADAS are not able to compute complex and thus realistic traffic scenarios. The second kind of simulation was originally developed for traffic flow simulation, but does not contain easy manageable features to integrate and evaluate system models or hardware prototypes in the sense of Rapid Prototyping.

The newly implemented extension of the sub microscopic traffic flow simulation program PELOPS, which reproduces the main elements of traffic (driver, vehicle, environment), with techniques of SiL- and HiL- simula-tion allows system developers a fast functional check and an assessment of new ADAS.

For this purpose the new PHIL (PELOPS & HIL) – tool has three different ways for integrating external soft- and hardware models or prototypes. External software can be connected to PELOPS via Ethernet-based network communication, which has already been realised for the widely used development tool MATLAB® / SIMULINK®. With this version, models of assistance systems or complete vehicles can be integrated in the traffic flow simulation. For this purpose function blocks for trans-mission and reception of PELOPS-data are simply added to the flow scheme and connected to the actual model. The underlying routines are implemented in C/C++ and are POSIX-conform, so that these routines can in principle be integrated in other CAE tools too, as long as they allow a corresponding way of integrating modules.

PHIL gives the developer two possibilities for providing a HIL-environment. On the one hand connections to the commonly used dSpace development platform can be used. There to the PHIL-equipped PC is connected via one or more RS422-interfaces to a dSpace expansion box. Every available hardware interface of the expansion box to the real world can be accessed. Unlike the SIL-version, PHIL is running in real time, which is determined by the dSpace system. It is possible to compute traffic scenarios with hundreds of surrounding vehicles with conventional PCs.

On the other hand a direct connection between PHIL and an existing CAN data bus can be established for HIL-simulation. Thus every system of an experimental vehicle can be tested in a virtual traffic environment to receive an impression of the comfort behaviour, which

typically cannot be assessed in the simulation. The simulation data on the CAN is provided by PHIL in that conditioned form, which is required by the application, so that neither extensions nor adjustments of the vehicle's ECUs are needed. PHIL reads the data of the vehicle sensors to detect the vehicle movement (accelerations, yaw rate, velocity) and uses it to compute the vehicle position in the virtual world.

Within the development of the control algorithms of the INVENT Congestion Assistant the MATLAB® based as well as the vehicle based simulation as shown above is used. Besides the direct application in the vehicle other application fields are imaginable for the PHIL-environment. Currently a driving simulator for commercial vehicles is being composed in a cooperation between ika and the Zentrum für Lern- und Wissensmanagement (ZLW) / Informatik im Maschinenbau (IMA) of the RWTH Aachen University.

Here the PHIL-environment is used for the simulation of traffic and for the integration of the driver's cab. In this way a test person can be integrated in virtual traffic by means of real vehicle equipment. Another possibility could be the use at a drive train test bench for exposing the modules or vehicles that are going to be tested to realistic load populations.

Summarized, the PHIL-version of PELOPS provides a tool for the application developer, which he can use to analyze models and prototypes of ADAS, vehicle modules or complete vehicles in a realistic traffic environment in terms of Rapid-Prototyping. Besides the objective data a subjective impression of its (comfort) behavior can be received.