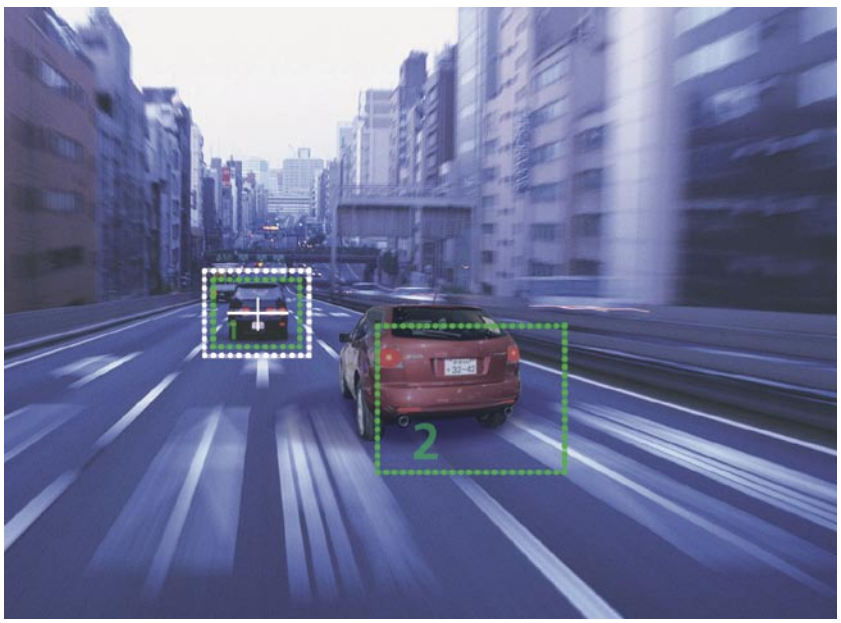
CalDesk for Driver Assistance Systems

- Driver assistance systems developed with dSPACE tools
- Measurement, calibration, and bypassing tasks in parallel
- Convenient tool environment and minimized workload

For the development of Pre-Crash and Adaptive Cruise Control, DENSO CORPORATION uses an environment with several dSPACE tools. CalDesk, the universal measurement and calibration software, is the heart of the setup and provides parallel access to ECUs and MicroAutoBox, which is used for calculating new functions in bypass mode. CalDesk also has an ASAM-MCD 3 COM interface to provide direct data exchange with DENSO's software tool for evaluating video and radar data. The tool environment enables DENSO to perform measurement, calibration, and bypassing tasks with a minimized workload.

Driver Assistance Systems

It happens every day: Traffic is congested, and when a vehicle changes lane, it encroaches into the path of another vehicle. All it takes is for one driver to have a momentary lapse of concentration, and an accident occurs. Driver assistance systems can help here, by correcting drivers' mistakes and giving them support in situations that can overtax their reactions and skills. Driver assistance systems such as Pre-Crash have had a positive impact on vehicle safety. To develop driver assistance systems, DENSO uses a tool chain in which several dSPACE tools play an important role:



▲ *The traffic as seen by the camera onboard the vehicle (reconstructed scene): The driver assistance system detects other road users (in this case there are two) and analyzes their direction and speed so that it can react in critical situations.*

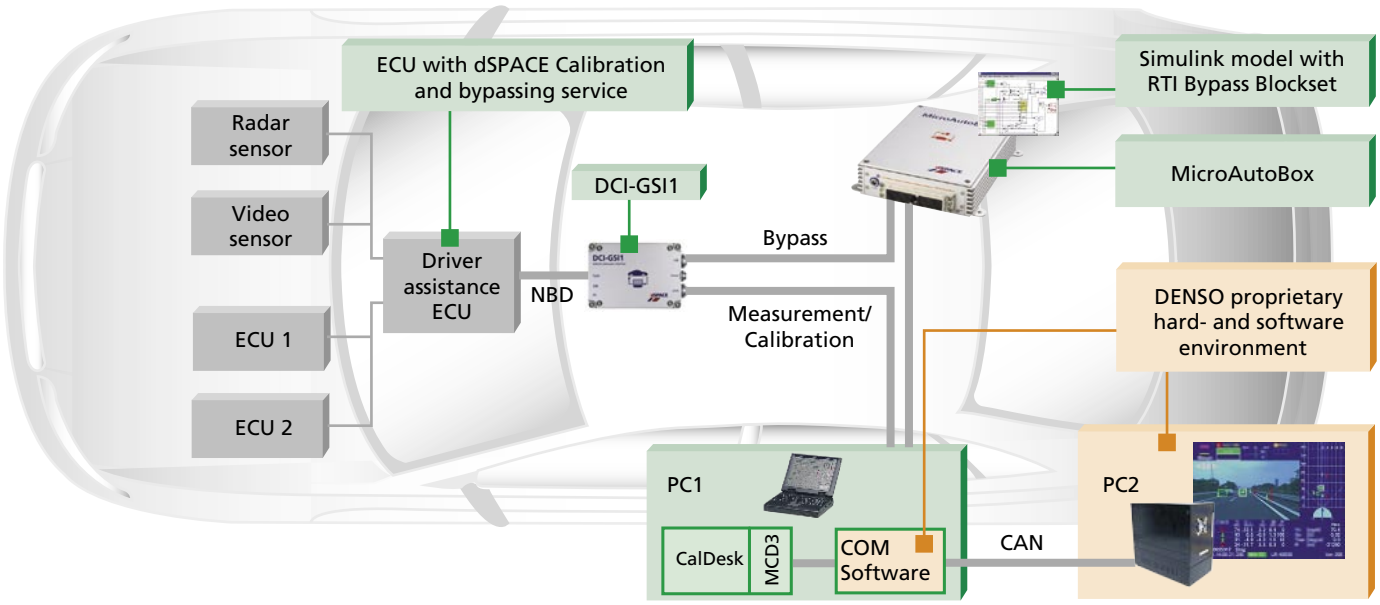
- CalDesk (universal measurement and calibration software)
- dSPACE calibration and bypassing service (additional service code in the ECU that manages communication between the ECU and the dSPACE equipment)
- RTI Bypass Blockset (dialog-based configuration of bypass applications, assignment of variable names to ECU addresses)
- MicroAutoBox (prototyping system for calculating complex bypass functions in real time)
- DCI-GSI1 (Generic Serial Interface for ECU access via various on-chip debug interfaces)

The Setup with dSPACE Equipment

A radar sensor and a video sensor are the vehicle's eyes. They observe the area in front, so that the driver assistance system can react to critical situations appropriately. An electronic control unit (the driver assistance ECU) evaluates the radar and video data to decide whether it needs to activate systems like the brake or the seatbelt tensioner.

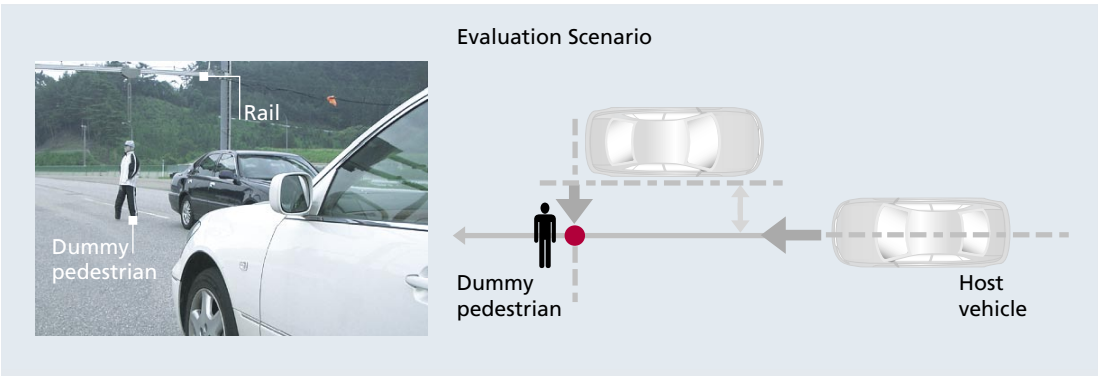
Calibration, measurement, and bypass access to the ECU runs via the microcontroller's NBD on-chip debug interface and the DCI-GSI1, which is capable of handling all three scenarios synchronously and in parallel without compromising bypass latencies.

CalDesk is used for several different purposes: first, for ECU calibration, and to capture large amounts of data from certain arrays of several kBytes in the ECU RAM; second, to control and monitor parameters of new bypass functions on the MicroAutoBox;



▲ *Schematic of the setup for developing the driver assistance system.*

and third, to feed ECU-internal data (via ASAM-MCD 3) to DENSO's dedicated software environment on a second PC (PC2). DENSO has implemented its own Windows® COM application, which is executed on the first PC (PC1) in order to transmit relevant data to PC2 via the CAN bus. CAN was used as the communication interface between the two PCs, since the DENSO software environment already supported CAN. The dSPACE Calibration and Bypassing Service is integrated in the driver assistance ECU. The service provides access to the ECU application, and communication between the ECU and the other dSPACE equipment. In combination with the Generic Serial Interface (GSI), the service feeds CalDesk with ECU-internal data, for example, from the radar and video sensors in the vehicle.



◀ *The proving ground with several cars and a dummy pedestrian reproduces typical traffic situations.*

System Evaluation

To test the driver assistance system, DENSO constructed a proving ground for reconstructing typical traffic situations. Thus, DENSO can check the reactions of the system in a defined and reproducible way, and optimize it. A typical case involves a dummy pedestrian and two vehicles, one of which is equipped with the driver assistance system. The dummy pedestrian can be moved by a motor to imitate a pedestrian suddenly running onto the road from behind a car. The radar sensor detected the pedestrian so fast that the driver assistance system activated the brake and the seatbelt tensioner before the collision.

Results and Future Steps

DENSO will complete the integration of environments for two actual-vehicle-based development processes, rapid control prototyping and measurement/calibration. The fact that dSPACE products are ASAM-compliant greatly facilitates linkage between development tools, so from now on, DENSO plans to extend the coordinated development process to cover other development tasks.

Takao Nishimura, Masao Ohoka
DENSO CORPORATION
Japan