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dSPACE NEWS

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Model-based Development Tool Chain at Volvo Cars

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dSPACE NEWS

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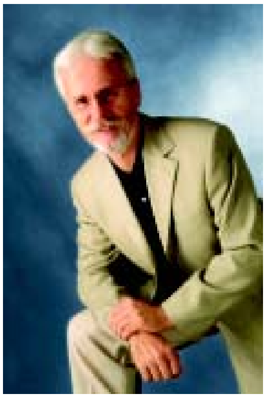
4 *For the development of shift strategies for automatic transmission, Volvo Cars successfully uses the model-based tool chain: Simulink, MicroAutoBox, and TargetLink.*

17 *Kevin Kott is President of dSPACE Inc., Novi, MI. Read the interview he gave to dSPACE NEWS, which reveals background information about his professional life and his goals for the US office.*



Don't be misled by the number of HIL simulation articles you see in our current and recent newsletters. We have a lot of non-HIL business, too. But HIL applications are maybe not as tightly guarded by our customers as their new product developments (using dSPACE) often are. Quantifiable information about the actual success of those HIL projects, like the number of errors found in the ECUs, is however quite tightly guarded for obvious reasons. Without violating confidentiality, I can say we have seen customers getting a 100% return on their investment in three months and even less, by finding errors effectively, in large numbers, and very early on, and not needing extra prototype cars.

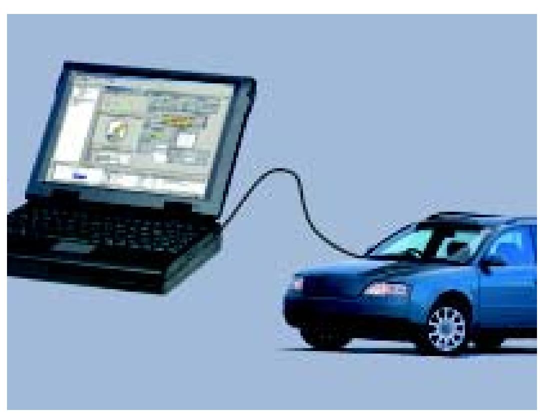
Customers using dSPACE Prototyper or TargetLink also have their secrets to hide from the competition. These often include the gains in development speed and quality they achieve by using the right tools. Sometimes we hear about reductions in development time in the order of 40-50%, for developments that would take a year or so without the tools and with several engineers involved. Preparation time included. Also a nice return on investment.

Because our tools and services bring excellent returns for our customers and really solve problems, we are not seeing any slowdown of growth on a worldwide basis. Just the opposite. To support the growing business and be able to continue our heavy investment in product development, we have hired at a high rate despite the extremely tight job market. At the beginning of 2002, we have well over 300 people in Germany alone, an increase of about 30% over the year before. The worldwide economy may sputter, and some of our customers may have to cut production temporarily: investing in improving development processes is still a must. dSPACE will continue to put the pedal-to-the-metal to keep up with the challenges in our market.

Herbert Hanselmann
President and CEO

P.S.: Do you feel something has changed with the Newsletter? You are right. We hope you like the new design.

15 *Visualizing the dynamic behavior of vehicles during hardware-in-the-loop simulation is performed by MotionDesk, the new 3-D online animation tool.*



16 *In cooperation with automotive customers, dSPACE Calibration System is currently being developed. This powerful tool will help you perform all calibration and measuring tasks on ECUs.*

Model-based Development Tool Chain at Volvo Cars

- Tool chain for function design, prototyping and automatic code generation
- MicroAutoBox as the proven in-vehicle solution for prototyping
- TargetLink as a reliable code generator for gearshift strategies

In the development of electronic control units (ECUs) for automatic transmission, Volvo Cars has for the first time used a model-based development concept to develop gearshift strategies, and interlinked the subsequent development steps.

The Challenge: Linking Development Steps

After an ECU's functions have been described as either a written specification or a block diagram, they have to be put into executable code as fast as possible. One important objective is to connect the development steps seamlessly. For example, it is very helpful to developers if they can transfer specification data from the model design straight to the prototyping process or to production code generation. Development tools that guarantee the rapid transfer of ECU functions to other abstract levels are therefore growing in importance.

So when we at Volvo Cars were planning the development of gearshift strategies for automatic transmission, it was important to find a model-based concept from which offline simulation, prototyping and production code generation could be performed primarily automatically and with as few technical obstacles as possible. The solution was a combination of several development tools, forming a tool chain that fits the overall development process perfectly:

- MATLAB/Simulink from The MathWorks for model design and VSIM for offline simulation (this is a tool developed by Volvo for offline simulation based on Simulink)
- dSPACE Prototyper with MicroAutoBox for rapid control prototyping
- TargetLink from dSPACE for production code generation

The main objectives in creating a model-based tool chain were as follows:

- To reduce the number of test vehicles by using more offline simulation
- To reduce the time needed for development by making optimum use of in-house knowledge for ECU design (modeling) and software development
- To allow fast and simple testing of new gearshift strategies
- To avoid communication problems and the ambiguity of function specifications between development steps
- To ensure that specifications are consistent, by running the ECU specification in the form of a model through all the subsequent development steps – offline simulation, prototyping and production code generation

Shift Strategies for Intelligent Shifting at the Right Time

At Volvo Cars, transmission control software is divided into a number of different categories. These include shift strategies, shift quality (for example, adjustment to the specific clutch used), diagnostics, failsafe features, operating system, and a signal database.

The new model-based development process will initially cover the development of shift strategies only. These involve functions that "decide" when the transmission should perform a gearshift. Such functions could include:

- Cruise control: Gearshifts during constant speed driving
- Geartronic: Manual shifting with the automatic transmission gearbox
- Winter: Prevents wheelslip in slippery conditions
- HOT (Hot Oil Temperature): Prevents hardware damage due to overheating
- Quickstep: Detects 'sporty' driving and adjusts shift points to support this

The Development Process

First a model was developed for each function, and then it was verified in offline simulation with VSIM. We then successfully carried out rapid control prototyping with MicroAutoBox from dSPACE. The next step was to convert the model into a TargetLink model. TargetLink was then used to generate the production code and all the calibration information (ASAP file) automatically. In the final step, the production code and all of the handcoded functions were compiled together and loaded to the transmission control module (TCM).

Successful New Strategy

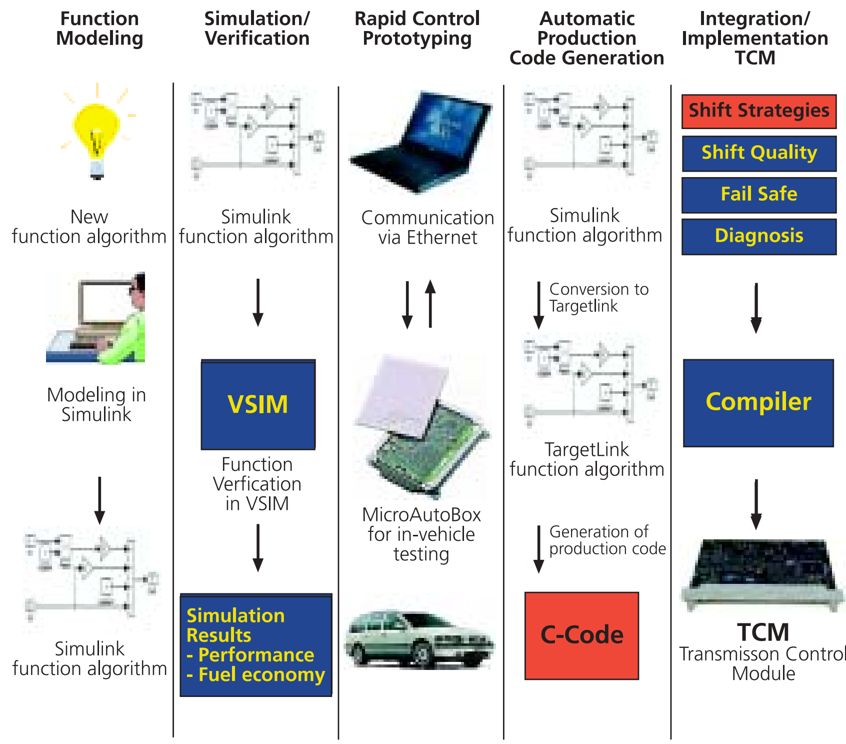
The new development process enabled Volvo Cars to make the following improvements:

- Better control of functionality; modeling gives better overview and structure
- Shorter process from function idea to implemented software
- Fewer logical errors in implemented functionality, better conditions for calibration
- Fewer communication problems and less ambiguity of function specifications; shift strategies are now developed in-house
- Flexibility: Function changes are performed quickly and easily

Tools Must Interlink

The challenge involved in this project was the new model-based workflow in the development of gearshift strategies. The work involved in introducing a new process is often underestimated, as a large number of personnel have to familiarize themselves with new development tools within a brief period of time. The precondition for this is that all the tools used mesh with one another optimally. The interlinking of Simulink, MicroAutoBox and TargetLink was very satisfactory, and the only point at which a little more time was needed in the start-up phase was in converting the Simulink models to TargetLink models in order to generate the corresponding production code.

Model-Based Function Development at Volvo Cars



On the Way to Completely Automatic Code Generation

Thus, our goal in the future will be to extend the model-based development of functions. Another objective is complete automation of code generation. We intend to make more intensive use of rapid control prototyping to achieve faster and simpler testing of new functions. In addition, we will produce test scripts, including different driving situations, automating the testing process.

MSc Mikael Lygner
Automatic Transmissions
Volvo Car Corporation, Sweden

C Code Reaches New Heights at Nord-Micro

- Code generation twice as fast with TargetLink
- Easy code verification
- Reliable C code production for airborne systems

Nord-Micro develops and manufactures cabin pressure control systems (CPCS) for aircraft manufacturers worldwide. This system includes software that has to meet the highest requirements regarding safety and comfort. With TargetLink, the dSPACE production code generation software, Nord-Micro successfully generated C code for all demanding control tasks. From releasing the software requirements to the first running prototype, the team needed only 9 months in comparison to 18 months for former projects that were conducted without TargetLink.

For the safety and comfort of the passengers and crew in an aircraft, the air pressure has to be suitably controlled. Nord-Micro develops and produces digital cabin pressure control systems (CPCS) that do not require any crew intervention. The CPCS consists of a redundant pressure controller, sensors and valves, both electromechanical and pneumatic. The CPCS ensures that all of the safety and comfort requirements of cabin pressure are fulfilled.

These include:

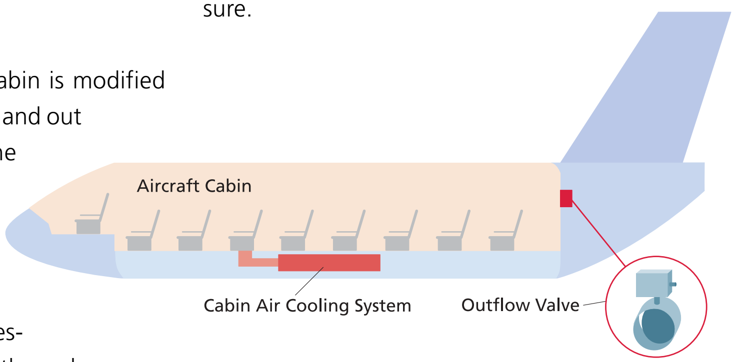
- Maintaining the cabin pressure within the required limits
- Slow change of pressure rate in the cabin
- Adaptation of cabin pressure to the altitude of take-off and landing sites
- Protection against damage to the aircraft structure caused by excessive pressure differences

The pressure level in the aircraft cabin is modified with the amount of air that flows in and out of the cabin. Fresh air enters the cabin continuously through the air-conditioning system, and the corresponding amount of air is let out through outflow valves, thus maintaining a certain cabin pressure. The valves change their flow-through diameter if necessary and determine the amount of air mass that exits the cabin.

Determining the Set Value for Cabin Pressure

The pressure controller measures several parameters and controls the outflow valves accordingly. These parameters include the actual cabin pressure and the outside pressure. The Flight Management System (FMS) calculates other relevant parameters, like take-off and landing sites, entered by the pilot before departure. There are also aircraft specific parameters that determine the maximum difference between the cabin and the outside pressure, so that the structure of the aircraft is not damaged.

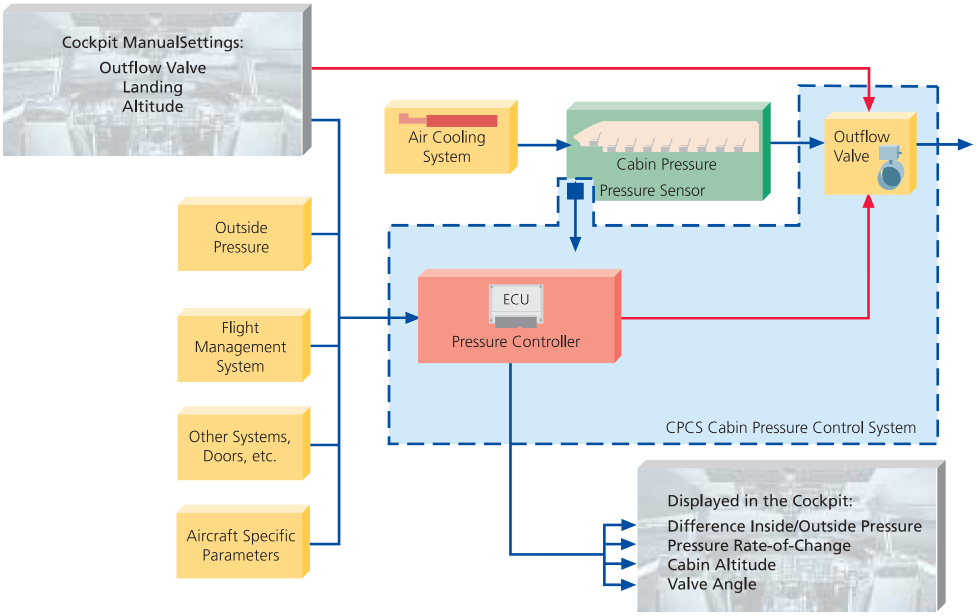
With these parameters, the pressure controller calculates the set-value for the cabin pressure. The difference between the set value and the actual cabin pressure is fed to the control unit as the actuating signal. The control unit calculates the respective adjustment signal for the outflow valve, which modifies its flow diameter accordingly, thus influencing the outflow airflow and the cabin pressure.



Cooling system and outflow valve regulate the amount of air that enters and exits the cabin.

Coding – Easy with TargetLink

The high requirements for airborne software are laid down by the European Organisation for Civil Aviation Equipment. "Level A" software was developed for this control system. Therefore, the functionality of every single source code module had to be tested and its structure had to be analyzed. According to the system requirements agreed on with the aircraft manufacturer, we designed the cabin pressure control functions in a MATLAB/Simulink model. We then tested and corrected this model with floating-point simulation and converted it to a TargetLink model. We divided the TargetLink model into sensible function blocks and single files, so that each individual software module could be tested.



Sensitive cabin pressure control in an aircraft.

Early Function Test Results

The results of the fixed-point simulations on the evaluation board, like storage efficiency and execution time, could immediately be used in the software design in order to increase code efficiency. Formerly, these results were not available before the production hardware was ready, and testing could be done on the plant. Now with TargetLink we performed this step at an early stage in an integrated testing environment. A further advantage was that source code was 100% reproducible up to object level code, with which we could then generate former versions of the Simulink model and modify them. TargetLink also enabled us to trace TargetLink model modifications down to C code. This was easily done as TargetLink's C code is always consistent to the model. All relevant requirements were met except the fact that the date and time were generated into the sources, which meant that the model was modified even if the source code itself had not changed. This made the configuration test slightly difficult but it is something that can be solved.

Finally we designed access functions in the handwritten code as our design rules require that access to variables is executed via accessor functions. These accessor functions have to be manually written and are easily included in TargetLink via the external variable class.

Exceptional dSPACE Support

We would like to emphasize the exceptional consulting offered by dSPACE. Due to the strict aviation requirements, we sometimes had to adapt the standard TargetLink configuration. But thanks to the cooperation with dSPACE's technical support, we always found a suitable solution. Due to our success we plan to use TargetLink in all future projects whenever code generation is required.

Trusting TargetLink Code for Aviation Applications

From releasing the features of this completely new software, to the first running prototype, we needed only 6 months. Furthermore, we came to the conclusion that the generated code fulfills the high aviation requirements. We plan to make the first test flight with TargetLink generated code soon.

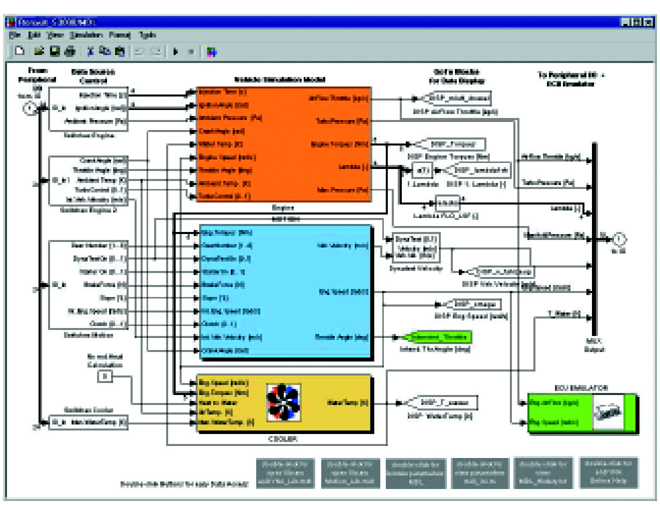
Andreas Alaoui
Nord-Micro
Germany

Renault: Validation of Powertrain ECUs

- **Test automation for gasoline and diesel engines**
- **dSPACE Simulator as an essential tool for developing power-train control**
- **Simulation with TESIS DYNAware models**

The increasing complexity of embedded software for electronic control units (ECUs) means that Renault needs a convenient and flexible environment for system testing. Since the company employs ECUs from different suppliers, the decision to switch to the independent system partner dSPACE was an easy one. The first turn-key Simulator was delivered to Renault in early 2001. The good results achieved with this, together with positive experiences with the flexible dSPACE concept in other projects, prompted Renault to acquire additional dSPACE Simulators shortly afterwards.

As engines become increasingly sophisticated, engine control software is forced to handle more and more demanding functions. Compliance with the growing constraints on all automotive systems, such as safety and environmental aspects, time-to-market engineering, etc., is also essential. The complexity of the new controllers makes extensive tests on hardware and software indispensable. As the ECUs contain complex control algorithms with sensitive fault recognition, they cannot be operated realistically without a hardware-in-the-loop (HIL) environment.
To meet all these demands, José Amorim, head of Powertrain Control Software Tools, chose dSPACE Simulator Full-Size as a turn-key solution for the software development of engine ECUs at Renault. A key objective was to automate test runs, in order to reduce delays in software validation and at the same time enlarge the test range.



Simulink engine model from TESIS.

ECU Development at Renault

Renault gives its engine ECU suppliers not only the written software specifications, but also some controller strategies and functions. These are produced by Renault's development teams using specification tools such as MATLAB/Simulink/StateFlow from The MathWorks.
The ECU suppliers then implement the controller functions.
By the time Renault receives the first prototype of an ECU, the hardware has already been tested in open-loop tests.

dSPACE Simulator

In spring 2001, a turn-key dSPACE Simulator Full-Size was delivered to Renault. This had been adapted to the company's needs and was ready to use in all kinds of applications.
The Simulator's modular hardware architecture is based on a PowerPC processor board. There are components for realistic sensor signal simulation, simulation of electric faults and signal conditioning. This modularity will enable Renault to add other components later on, and even to test networked ECUs. An ASAM-MCD 3MC interface allows the remote control of external calibration tools.
The Simulink-based real-time engine model en-DYNA from TESIS (adjustable to various engines, such as diesel, gasoline) was already fully integrated and parameterized for Renault's engine.

ControlDesk is used to change parameters and monitor the test results during real-time simulation. Here, initial layouts were also provided. As Renault wanted to start by using dSPACE Simulator as a platform for software validation, the enhanced ControlDesk Test Automation options were very useful. With the test algorithms prepared by dSPACE as a reference, it was easy for Renault to develop further test sequences step-by-step, and set up an extensive test database.

Function Development at Renault

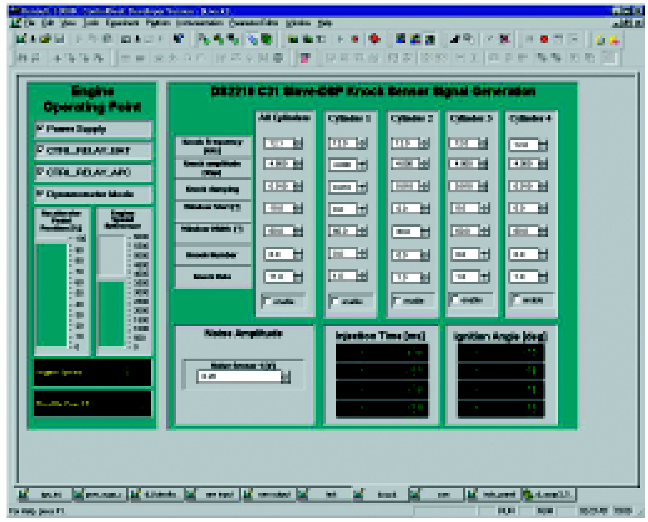
With en-DYNA, each engine model can be modified to simulate a different engine (VVT, turbocharger, etc.). This allows Renault to test newly implemented functions on the ECU before the real engine actually exists. Once the functions have been sufficiently validated on the Simulator, they are passed to Renault's supplier for implementation.
On the other hand, if an engine is already physically available at Renault, its ECU functionality also undergoes thorough testing with the HIL system before final tests are run on a test bench, followed by test drives.
The two approaches significantly reduce test and validation runs on real-engine test benches, and even more importantly: They allow wider test ranges with no risk.

ECU Software Validation – Status Quo

dSPACE Simulator's first task at Renault is software validation. The team has already developed a series of engine-specific tests and run them as lights-out tests overnight and on weekends. Several common and specific test series had been produced in an impressively short time. This made it possible to find and understand hardware-related bugs that had previously been impossible to locate even for the supplier. Renault's choice of such a comprehensive hardware-in-the-loop Simulator had proved to be a good one.
During test drives (test bench or road), external data measured by the ECU is collected by a calibration tool and can be reproduced in the lab with the help of ControlDesk's Test Automation Library (TALib). The advantage lies in repeatability and in the ability to run large numbers of tests with different parameter settings.

Renault's Further Plans

José Amorim's team will continue setting up a detailed test database covering all imaginable scenarios. Renault has already employed standard Rapid Control Prototyping systems (MicroAutoBox,



ControlDesk layout for knock sensor simulation.

modular dSPACE Prototyper systems) to develop and prototype new control functions for existing engines. Now the dSPACE Simulator will be used to develop new strategies for new engines and new controllers. Renault has already acquired more Simulators and intends to make intensive use of them in the management of complex gasoline and diesel engines, such as common rail.

They plan to perform on-board diagnostics (OBD) tests, plus functionality and RAMS (Reliability Availability Maintainability Safety) tests. Suppliers will also be expected to eliminate hardware and software problems at an early stage using comprehensive HIL Simulators. Moreover, Renault plans to simulate new engines and test prototyping ECUs with dSPACE Simulator even before the specifications go to its manufacturers, and is also about to test networked ECUs (such as gearboxes, ABS, ESP). HIL is an essential element in Renault's strategy for developing powertrain control systems.

Contact:
José Amorim, jose.amorim@renault.com,
François Seprey, francois.seprey@renault.com,
Powertrain Control Software Tools
France

Opel Vectra Heading for its World Premiere

- dSPACE Simulator for testing car interior electronics
- 15 networked ECUs
- Extensive CAN bus and I/O requirements

In January, the new Opel Vectra went into production in one of the world's most modern automobile plants in Rüsselsheim, Germany. Equipped with a variety of new features, the new model will have its world premiere at the Geneva Motor Show in March. The Vectra will feature a completely new, driver-oriented design with pioneering technology for a high level of safety and comfort. Thanks to positive experience made with former dSPACE systems, Opel decided to rely on dSPACE Simulator for running the hardware-in-the-loop tests on the Vectra's new electronics systems.

High Goals with Comfort and Safety Systems

Our new Vectra's ambitions are above all reflected in the variety of equipment aimed for improving the comfort and safety of the driver and passengers. For example, the Vectra features new safety and comfort systems, intelligent Electronic Climate Control with an air quality sensor, a wide range of communication and entertainment systems, eight-way adjustable front seats, a rain sensor and park pilot. The passive safety equipment includes standard front and side airbags and full-size curtain head airbags, Opel's patented Pedal Release System, and further improved active head restraints for protection from whiplash injuries.

Much of the new Opel Vectra's functionality is provided by a new integrated electronics system, which provides features like body control, info modules, instrument panel control, a parking assistance, and interfaces to other electronic car components. In total, there are 15 electronic control units (ECUs) connected via the CAN bus, controlling the interior comfort and safety system. The communication between the ECUs is enormous. Thus, a big challenge for us is to check the functionality of the ECUs when connected, especially considering that the ECUs are from different suppliers. Therefore, we were not looking for a system to test the single ECUs, but for a system to test the networked ECUs and their interfaces to the driver and to the powertrain and chassis electronics.

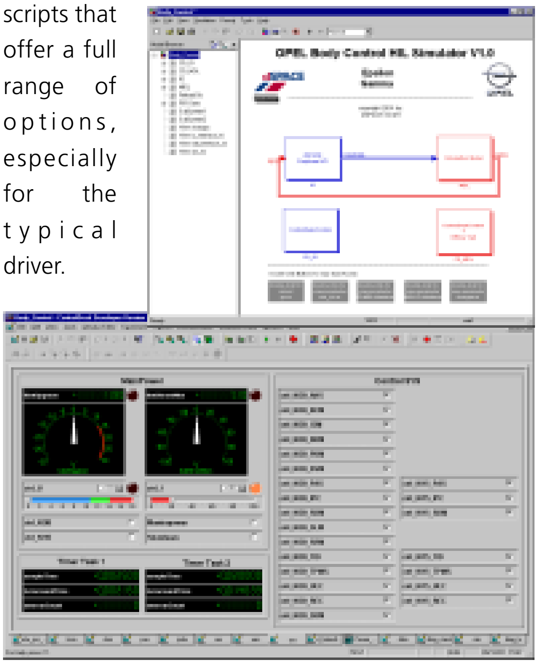
CAN and I/O: Huge Communication Requirements

After evaluating different HIL solutions, our decision to deploy a dSPACE Simulator was based on dSPACE's good reputation at Opel and the clear hardware architecture of dSPACE Simulator. This guarantees high reusability for all hardware and software components when the architecture of future HIL test stands is changed. It also allows us to execute reproducible functional tests with different ECU variants very systematically.

dSPACE Simulator was tailored to our challenging requirements. The complexity is mainly related to I/O and CAN: the I/O of our dSPACE Simulator comprises 192 digital outputs, 16 analog outputs, 4 resistance simulation outputs, 104 digital inputs, 32 analog inputs, 8 PWM channels, equipped with signal conditioning, load and electrical fault simulation, where required, and 199 CAN messages with a total of more than 1200 signals. The CAN messages had to be read, written, and falsified for failure simulation – all in real time. Thus, there were high requirements on the calculating hardware. However, dSPACE Simulator – equipped with the powerful DS1005 PPC Board – mastered the real-time calculation easily.

Simulation of Driver Operation

The tests were executed in two modes: fully automatic and partly automatic. For the partly automatic tests, the aim is to check ECU operation after failure. The operator manually generates hardware errors via ControlDesk, and the ECU has to react correctly. For the fully automatic tests, we have constructed small yet powerful test automation scripts that offer a full range of options, especially for the typical driver.

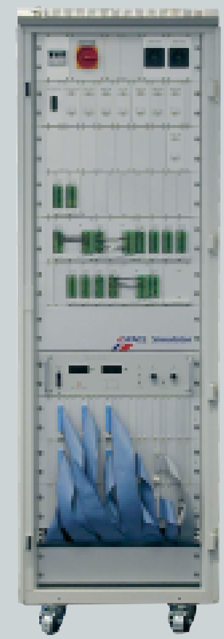


Ready-to-use Simulink models and layouts for automated tests in ControlDesk.

New comfort and safety systems controlled by 15 car interior ECUs.

The Car Interior ECUs

- Auxiliary Heating System (for engine start-up)
- Body Control Module
- Column Integrated Module
- Driver Door Module
- Driver Seat Module
- Instrumental Panel Cluster
- Parking Assistant (ultrasonic sensors)
- Passenger Door Module
- Rear Electrical Center (for example, rear light control)
- Sensing and Diagnostic Module (crash detection and reaction)
- Shift Lever Module (gear selection for automatic transmission)
- Sunroof Module
- Triple Info Display (for example, radio and navigation system)
- Tire Pressure Monitoring System
- Underhood Electrical Center (for example, front light)



Complete list of the car interior ECUs – the test environment is simulated by dSPACE Simulator.

A typical test sequence is as follows: Test start – simulation of driver action – check of system reaction – diagnostics scan – reset – change of variables – restart.

Even though the dSPACE Simulator has been in use since only September, we are seeing a significant saving in time and effort needed for executing our standard tests. The Vectra will initially be available as a four-door sedan with a four-cylinder engine, but the model range will soon be extended with the introduction of additional innovative body styles, engines and gearboxes. We are sure that we will run successful HIL tests for all the new model variants, and later for the Opel Astra's successor, with our dSPACE Simulator.

Dr. Daniel Lemp
Adam Opel AG
Germany

The Relativity Mission at Stanford University

- Hardware-in-the-loop set up for general relativity experiment
- Simulation of gyroscopes that orbit the Earth 400 miles away

While Albert Einstein's theory of General Relativity has been around for nearly a century, tests confirming its ideas are few and far from conclusive. Gravity Probe B is an experiment developed by NASA and Stanford University that will measure how space and time are influenced by the presence of Earth. dSPACE enables a hardware-in-the-loop set-up to test the highly sensitive electronic system of the most stringent and precise test of general relativity ever done.

American scientists calculated that according to Einstein's theory about space-time curvature, a rotating massive body should slowly drag space and time around with it – an effect called frame dragging. This force was supposed to push a gyroscope's axis out of alignment as it orbits the Earth. Gravity Probe B (GP-B) will use four gyroscopes to prove this prediction and measure the frame-dragging effect to a precision of 1% or better. It will also measure the geodetic effect, a result of the warping of space-time, with an accuracy of 0.01%.

The Physics of Gyroscopes

Gyroscopes are not only common traditional toys, today they are used as high-tech gyroscopes in gyrocompasses, like in advanced navigation systems on the Space Shuttle. There is one feature that makes them so interesting for that purpose: Fast rotating gyroscopes tend to keep a stable spin axis. If a force acts perpendicular to the rotation axis, the gyroscope's angular momentum (generated by its own perpendicular movement) presents a strong counterforce.

The behavior and properties of common traditional gyroscopes are used in the GP-B experiment.

Axis Movement by a Hair's Width

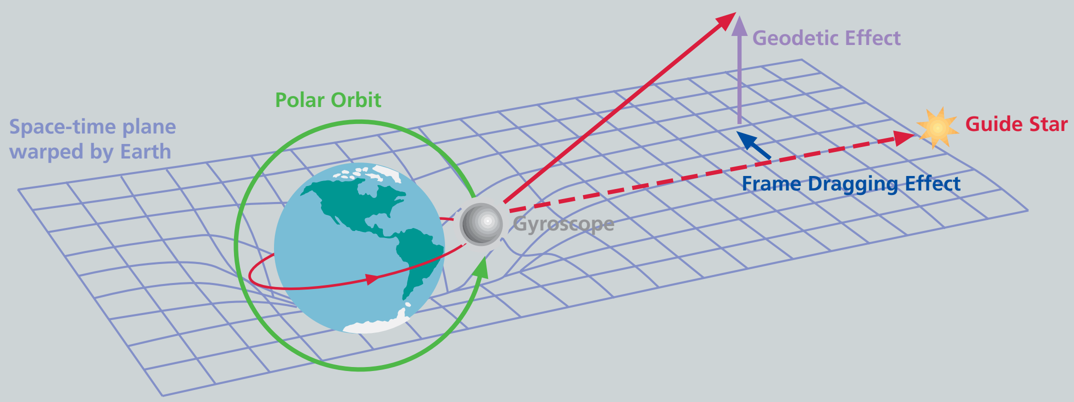
GP-B will place the incredibly precise gyroscopes in polar Earth orbit at 400 miles. Each gyroscope spin axis will be aligned with the inertial axis of the rotating satellite. The satellite and its four gyroscopes will point toward a distant star, which will be used as the inertial reference. During the year, General Relativity predicts that the gyroscopes will turn in two directions. The geodetic effect will tend to push the gyro axes in a direction perpendicular to the frame-dragging effect, which allow it to be measured separately. GP-B will keep the telescope continuously pointed at the original guide star. After a year, Einstein's General Theory predicts that the axis of the gyroscope will have moved six arcseconds due to the curvature of space-time and 42 milliarc-seconds (the width of a human hair, seen from a quarter mile away) due to the frame-dragging effect.

The Gyroscope Suspension System

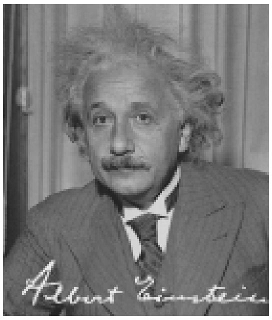
The gyroscope quartz rotors are the roundest objects ever machined. They are each about the size of a ping-pong ball and will spin at about 10,000 rpm. We have a Gyroscope Suspension System (GSS) that electrostatically suspends the spherical gyroscope.

The gap between the rotor and the six suspension electrodes is less than 20 micrometers.

The GSS suspends the rotor by measuring the capacitance between the rotor surface and 3 pairs of electrodes, and if the rotor is centered, the rotor/electrode capacitance of a pair will be equal. If not, the GSS capacitance bridge will output an error voltage. This voltage (and the voltage of the other 2 bridges) will be used to determine the necessary correction voltages needed to force



Scientists often compare the fabric of space to a rubber sheet, with the Earth denting the surface, thus curving the paths of passing objects, known as geodetic effect. This is caused by the Earth's physical presence. The rotation of our planet twists the sheet and distorts time a little, an effect called frame dragging. So Earth's own gravity and rotation should drag space and time just a little and thus pull the gyroscope spin axes slightly out of position. As both effects are so small they require incredibly precise instruments for the Gravity Probe B experiment.



the rotor toward the capacitive center, and an appropriate voltage will be applied by the GSS to each of the electrodes.

The Gyroscope Simulator

The GSS must undergo serious testing before it can suspend flight gyroscopes. Therefore, we needed a gyroscope simulator for GSS inputs and outputs and that's where dSPACE comes in.

We have a mechanical representation of a gyroscope consisting of 6 parallel plate capacitors. Their capacitances are controlled using a Simulink model compiled and downloaded to the DS1005 PPC Board. The separation of the parallel plates is measured using a capacitance bridge. This measurement is read into a Simulink model via the DS4002 Timing and Digital I/O Board. The gyroscope model determines the next position and sends it to the controller Simulink block, where it converts the request into a voltage command communicated again via the DS4002 to a piezo actuator, which moves one plate on each of the parallel plates such that the appropriate set of capacitances is presented to the GSS bridge. While this is going on, the GSS is commanding voltages to control the position of what it thinks is a gyroscope. These 6 voltages are read into the Simulink model using the DS2003 Multi-Channel A/D Board. They enter the gyro model and are converted to forces providing the dynamics introduced by the suspension system.

In the end we can present the dynamic equivalent of a gyroscope orbiting 400 miles above the surface of the Earth to the Gravity Probe B Gyroscope Suspension System.

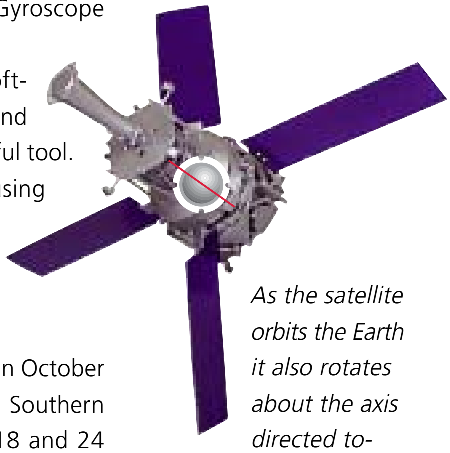
We also use ControlDesk experiment software to monitor variables, acquire data and adjust parameters. It has been a very useful tool. With the easy learning curve involved using the Simulink interface, we had our simulation up and running in two days.

GP-B is to be Launched this Year

The GP-B satellite is scheduled to launch in October 2002 from Vandenberg Air Force Base in Southern California with a mission life between 18 and 24 months. By then, not only will GP-B have faced the challenges of inventing basic new technologies to create this experiment, but it will also have combined the efforts of scientists from numerous fields. GP-B is the most thoroughly researched program ever undertaken by NASA.

For further details please see "The story of GP-B" at http://einstein.stanford.edu.

David Hipkins
Jennifer Mullins
Stanford University
USA



As the satellite orbits the Earth it also rotates about the axis directed toward the guide star, the inertial reference. The GSS suspension system controls the rotor position to within 1 nanometer of this rotational axis.

Magnetic Wave Moves Railway Shuttle

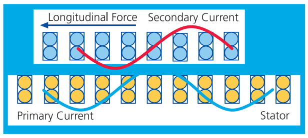
- A German University is developing a magnetic railway system
- Testing and optimizing with dSPACE Prototyper

Researchers at the University of Paderborn are developing a new mechatronic, modular railway system, known as NeueBahntechnikPaderborn (NBP). The system combines comfortable individual transportation with the advantages of linear drive technology, while using the existing railway tracks. With dSPACE Prototyper the team of NBP tested and optimized the control strategies on the test bench at an early development stage in preparation for further tests at an outdoor test site.

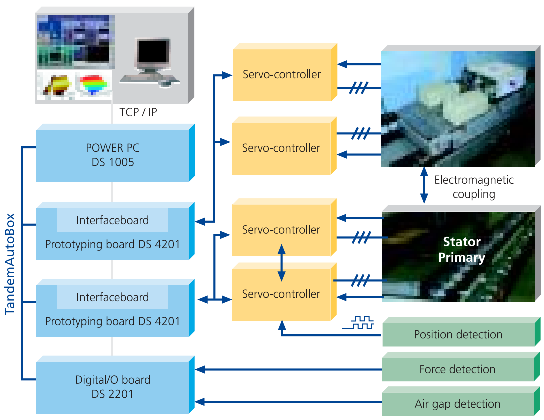
The new railway system is based on magnetic drive technology, providing contact-free power transmission with a frictionless, lightweight drive and low maintenance costs. Another feature is also impressive: Small autonomous shuttles will take passengers and loads to their destinations without having to change trains.

Precise Control Requirements

The drive module is based on a doubly-fed linear motor, which is divided into two parts: The primary (stator) is placed between the tracks and the secondary is placed in each individual shuttle. The drive control is realized on board the shuttle via secondary currents. Only the stator segment that the shuttle is approaching is supplied with primary current. And the stator has to be controlled according to the commands given by the shuttle drive control. The electrical position of the stator current therefore has to be controlled with great accuracy, as the synchronous transition from one stator segment to the other is very important for a homogenous stator field. If a stator was supplied with only a short delay, the shuttle would jolt slightly when passing from one stator segment to the next.



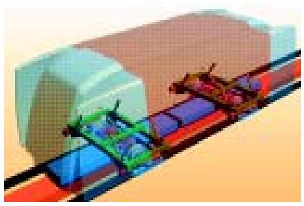
Magnetic forces between stator and secondary accelerate the shuttle.



Block diagram of laboratory test set-up.

On the Test Bench

Two servo controllers supply the secondary and there is one for each of the stator segments. They communicate with dSPACE TandemAutoBox on the shuttle via interface boards attached to the dSPACE DS4201 Prototyping Board. To validate the control model we had produced in MATLAB/Simulink, we divided the stator into two separately supplied parts in order to examine the switching between the two stator segments when the shuttle is approaching and leaving. The rotor was also divided into two parts, for longitudinal dynamics control and for additional pitch control. It was very easy to monitor the experiment on the host PC with ControlDesk, which proved to be the right experiment software for special manoeuvres and for measuring significant parameters and fault diagnostics, as we had expected.



Driverless shuttle with actively controlled undercarriage.

On the Test Track with dSPACE Prototyper

The experiments on the test bench show that dSPACE Prototyper is a time-saving development tool for testing and optimizing the control model. This will especially apply to further tests at our outdoor test site. Depending on the shuttle position, the stator segments will be switched on by converters which receive the references directly from the shuttle drive control via radio commands. We look forward to testing and optimizing the actual railway-system with dSPACE Prototyper this year.

Markus Henke, Andreas Pottharst
Institute for Power Electronics and Electrical Drives, University of Paderborn, Germany

3-D Animation with MotionDesk

MotionDesk is our new tool generation for visualizing real-time simulations on your dSPACE system as a 3-D online animation. Compared to its predecessor, RealMotion, it provides much more realistic graphics thanks to textured rendering. The new interactive configuration of cameras and 3-D objects means that developers get results fast when they set up the visualization for ECU tests using hardware-in-the-loop simuation.

An Easy-to-Create 3-D World

MotionDesk is used for 3-D animations, for instance in robotics and flight simulation, and in its main application: the automotive field. With a high-end hardware system, MotionDesk is the solution for "man-in-the-loop" applications because these require a high frame rate and low latency times between simulation and visualization.

MotionDesk's graphical user interface is similar to other dSPACE tools. It will be easy for you to create a virtual 3-D world by simply dragging and dropping objects from a 3-D library to a scene. The library contains the objects you need to create all the driving scenes you can think of: roads, houses, car bodies and wheels. Additional objects can easily be added as the 3-D object geometries are described in the VRML2 standard. And even existing car geometries created with CAD systems are usable when converted to VRML2.

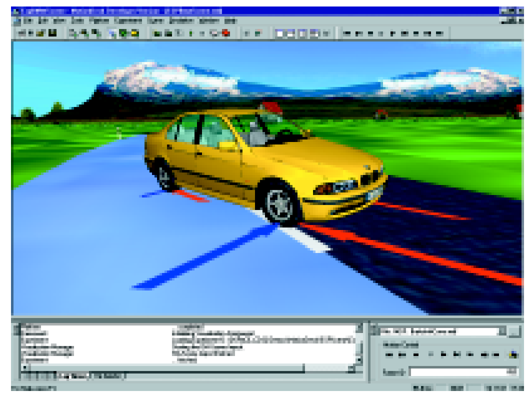
Realistic 3-D graphics

Intuitive scene navigation

Get Realistic Results Fast

Experience the jump in 3-D online animation with MotionDesk, to be released by mid-March. For information regarding migration from RealMotion to MotionDesk, please contact our technical sales.

If you want more general information on MotionDesk, please refer to our Website **www.dspace.de**.



Vectors visualize the forces between the wheels and the road in MotionDesk.

INFO 01

MicroAutoBox Now at 300 MHz

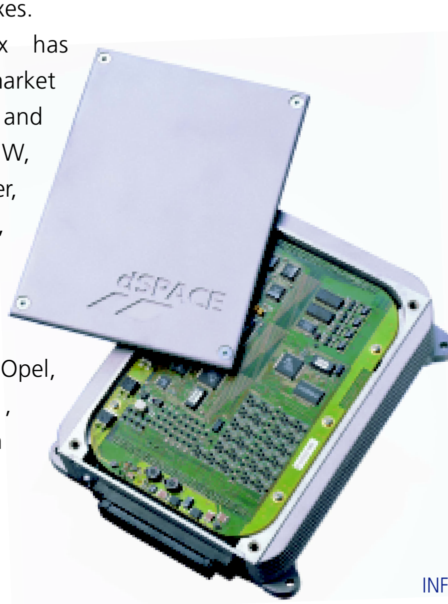
MicroAutoBox, our in-vehicle hardware for rapid control prototyping, is now available with a 300 MHz PowerPC Processor, replacing the previous 200 MHz version. This innovation speeds things up by 10-30% - depending on the application you are running. The faster CPU requires a slightly higher power input of typically 9.5 W (formerly 8.5 W). The resulting physical changes such as temperature are within the specified limits.

Speed up your application by 10-30%

Simple Switch to 300 MHz

Programs or models that were prepared and compiled for the 200 MHz MicroAutoBox do not need to be recompiled. So you can enjoy a trouble-free changeover to the new 300 MHz MicroAutoBox. This makes it easy to take advantage of all the well-tried features of MicroAutoBox like signal conditioning for automotive signal levels, bypassing interface, automatic boot-up and complete software support – to mention only a few. Small dimensions and the vibration-resistant construction of MicroAutoBox make it possible to use it just like an ECU in a real car. In 2001 dSPACE delivered more than 300 MicroAutoBoxes.

MicroAutoBox has been on the market for four years and is used at BMW, DaimlerChrysler, Delphi, DENSO, Fiat, Ford, General Motors, Hella, Nissan, Opel, Visteon, Volkswagen and many more.



INFO 02

Calibration System Under Way

- Optimized in-vehicle usability
- Seamless integration into dSPACE tool chain

Today, the task of calibrating the parameters in an algorithm has become a key element in ECU (electronic control unit) development. To meet this challenge, we are currently developing the dSPACE Calibration System. The first pilot projects will start in the second quarter of 2002, and the release of the dSPACE Calibration System is planned for the end of 2002. To optimize the dSPACE Calibration System for your needs, we are cooperating closely with automotive customers on the development of the dSPACE Calibration System to ensure that it fits calibration engineers' special requirements precisely - for example, keyboard-only operation and acoustic signals.

Whether you are calibrating in the vehicle during field tests or at the test bench, or even optimizing your Simulink offline model for function development – all these tasks require a powerful, intuitive and easy-to-use calibration tool. The dSPACE Calibration System will support several different kinds of calibration interfaces like the generic dSPACE memory emulator, CAN via the CAN Calibration Protocol (CCP) or NEXUS. The dSPACE Calibration System will enable you to perform all calibration and measurement tasks on your ECU throughout the complete development process, thus enhancing the dSPACE tool chain. Its intuitive handling will enable you to adjust your ECU to the real world in a minimum of time and with a maximum of convenience.

INFO 03

The dSPACE Calibration System will offer a modular hard- and software concept, so you can benefit from highly scalable solutions to fit all calibration scenarios. To guarantee the highest level of flexibility, the dSPACE Calibration System will allow you to choose from a variety of today's data acquisition modules. It will be fully compatible with the different ASAM MCD standards and optimally integrated into the dSPACE tool chain, based on MATLAB/ Simulink.

Catalog 2002 and Demo CD

Our 2002 dSPACE Demo CD and Catalog are available now. With 232 pages, the new catalog provides details on dSPACE products and examples of how they are typically applied. You can also gain a first impression of the new dSPACE Calibration System described in the above article.

If you want to find out even more about dSPACE and our products – we are really proud to announce that our new Demo CD features a multimedia company profile and many audiovisual software demonstrations that give you an excellent inside view of the dSPACE tools' functions. For example, see MotionDesk in action, our impressive new software for 3-D online animation of HIL experiments. Just check the box on your response card to get your Demo CD and Catalog.

Kevin Kott President of dSPACE Inc.

dSPACE is pleased to announce that Kevin Kott has been named President of dSPACE Inc., located in Novi, Michigan, USA. An introductory interview with dSPACE NEWS follows:

What was the reason behind filling this position locally?

The Novi office is responsible for Sales, Applications Engineering, and Service in the USA and Canada. For the past several years, Herbert Hanselmann was acting President of the USA office at the same time that he was CEO of, and located at, our German headquarters. The dramatic growth in demand for dSPACE products worldwide has required increases in personnel and facilities, both in the USA as well as in Europe. Thus, Herbert Hanselmann hired me to direct the operations of the Novi office so that he could focus on other worldwide growth issues.

What is your professional background?

25 years' experience in automotive product development, engineering and testing services, and scientific instrumentation manufacturing. 13 years of this was as president of companies that produced related products and services.

What attracted you to dSPACE?

The opportunity to be affiliated with an exceptionally high-quality, cutting-edge technology product in a fast-growth market developed and marketed by a highly competent staff focused on helping customers. What more could I ask for in a job?

First official photoshoot with Kevin Kott, dSPACE Inc. office Novi, MI.

Have you visited dSPACE GmbH?

I recently returned from a two-week trip to our headquarters in Paderborn, Germany to meet the people behind the e-mail addresses. dSPACE headquarters is a very exciting operation, and everyone I met was exceptionally impressive. I want to especially thank all of my dSPACE Paderborn colleagues for giving me such a warm welcome.

What is your main target, and your idea for the future?

Our main goal is to improve our ability to help customers evolve their methods of developing embedded controls. dSPACE GmbH is leading the way in providing the tools to make this process faster, cheaper and better, and we intend to be here to help customers realize the optimum benefits our products can provide. In this way, we believe that our overall market penetration will continue its growth.

Thanks for the interview and welcome to the dSPACE team!

User Conference in the USA

dSPACE Inc. is proud to announce its second North American User Conference. It will take place on May 16-17, 2002 at the Atheneum Suite Hotel and Conference Center in Detroit, MI. The conference offers a comprehensive technical program that includes keynote speakers, user presentations, and developer highlights on using dSPACE products for the controller development process.

The program is organized into four tracks of discussion: new developments, function development with dSPACE Prototyper, production code generation with TargetLink, and automated testing with dSPACE Simulator. The conference will also host an interactive panel discussion and an exhibition with hands-on demonstrations of dSPACE's latest products. Our call for papers is complete and an agenda is now available if you have not already received yours in the mail. Rooms are reserved, and a social event is planned at Fishbone's, one of America's Top 50 Restaurants, that captures the exciting spirit of Mardi Gras! Qualify for a 30% discount for early registration, deadline March 29, 2002. So please join us, contact us at **info@dspaceinc.com**, call us at #(248)567-1300, or check out our home page listed under EVENTS, for more information.

At the last User Conference in 2000, 133 attendees from across several industries came together.

Trip to Japan

Meeting our Japanese customers in early November was a very interesting and fruitful time for our dSPACE colleagues. Our representative LinX Corporation with its President, Nobuo Murakami, organized an automotive exchange forum with major car manufacturers like Honda, Mazda, Nissan, and Toyota. In addition, visits were made to several important automotive suppliers.

Talking about the customer's applications: Kei Murakami (LinX) with André Rolfsmeier and Herbert Schütte (dSPACE).

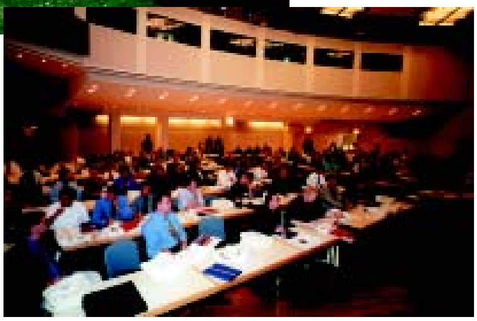
The objective was to learn more about the market-specific and customer-specific requirements in Japan and how our products and services, including support and training meet those requirements.

Experiencing the culture and impressing landscape of Japan: Nobuo Murakami (LinX) with Rainer Otterbach and Reimund Wischnewski (dSPACE) in front of Mount Fuji-San.

The visit was a very informative exchange of experiences and solutions, both for our customers and for dSPACE. The information acquired will definitely have an impact on the future development of products and processes at dSPACE.

German User Conference

Join our user conference at Liederhalle downtown Stuttgart.



More than 150 people from industry and research came together at our last User Conference that was also held in Stuttgart two years ago.

We are pleased to announce our third German User Conference which will take place on October 9-10, 2002 at the Liederhalle in Stuttgart.

Continuing the pattern of well-attended user conferences, we are again offering you an inside view into the present research and development work at various automotive and non-automotive companies. This event is the expert exchange forum that brings together engineers and managers from leading companies to discuss new applications and share their technical expertise. This year, the conference will focus on Rapid Control Prototyping, Automatic Production Code Generation, Hardware-in-the-Loop Simulation, Calibration, and any combination thereof.

Call for papers

Let us invite you to participate actively on this German conference and bring in your experience and knowledge with dSPACE Systems.

We are especially interested in papers describing new applications, new technologies, new methods covering innovative, complex processes or even complete tool chains.

Please e-mail your proposal in the form of an abstract (400-500 words) to Bettina Henking: **bhenking@dspace.de** by March 29. For updated information about speakers and contents, please check our home page under **www.dspace.de**.

We are looking forward to an intensive dialogue with you.

Papers

R. Venugopal:
"Rapid Prototyping Comes to Motion Control"

English ☐ ***04***

A. Rolfsmeier, J. Richert:
"ASAM MCD Interfaces in the ECU Software Development Process"

German ☐ ***05***
English ☐ ***06***

P. Urban, P. Wältermann, B. Henking:
"Toyota Motorsport Racing Ahead with dSPACE"

German ☐ ***07***
English ☐ ***08***

Please check the corresponding field on your response card. For more papers to download, visit **www.dspace.de.**

Job Opportunities

Are you an engineer who is just graduating? Or are you looking for new professional challenges? Then come and join our team in Paderborn, Munich or Stuttgart, Germany; Paris, France; Cambridge, United Kingdom or Novi, MI, USA! Due to our continuous growth, dSPACE is looking for engineers in

- **Software Development**
- **Hardware Development**
- **Applications**
- **Technical Sales**
- **Product Management**

For more detailed information, please refer to **www.dspace.de**.

Training

For more details, please visit **www.dspace.de** or check the corresponding field on your response card. Further dates available on request:

- dSPACE Systems
- ControlDesk Basics
- ControlDesk Advanced
- Test Automation
- HIL Simulation
- TargetLink

Events

EUROPE

Embedded Systems 2002
February 19-21, Nuremberg, Germany
Messezentrum Nürnberg, Hall 12
Booth #K01

RTS' Embedded Systems 2002
March 26-28 Paris, France
Porte de Versaille, Hall 5
Booth #M24

IIR Mechatronik im Kraftfahrzeug Getriebeelektronik
May 13-15, Mannheim, Germany

PCIM 2002
May 14-16, Nuremberg, Germany
Messezentrum Nürnberg, Hall 12
Booth #310

Embedded Systems Show 2002
May 15-16, London, United Kingdom
ExCel, London

USA

SAE Congress
March 4-7, Detroit, MI
Booth #2601

Electronic Powertrain Controls (TOPTEC)
April 8-10, Southfield, MI

Automotive Dynamics & Stability Conference
May 7-9, Detroit, MI
Booth #5

American Controls Conference (ACC)
May 8-10, Anchorage, AL

dSPACE User Conference
May 16-17, Detroit,MI

For more details, please visit **www.dspace.de.**

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