

dSPACE

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Announcing TargetLink 2.0:
Impressive New Features

Business

User Conferences in
the USA and Germany



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dSPACE NEWS

dSPACE NEWS is published periodically by:

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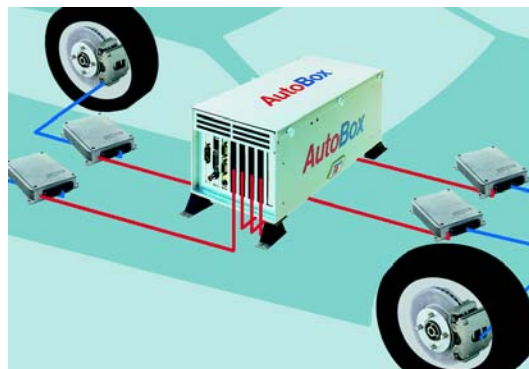
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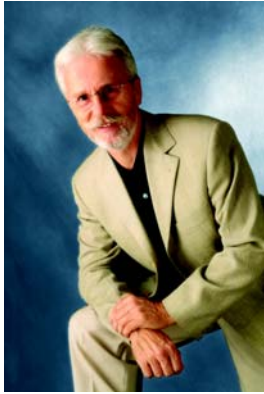
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4 TRW Automotive is developing a new brake-by-wire system with dSPACE Prototyper. One MicroAutoBox per wheel and an AutoBox are used to test the controller design.



10 TargetLink was the ideal solution at MAN for the development of the emission-reducing CCRT System Control. The code generator produced 80% of the total code volume automatically.



dSPACE has customers in all sorts of industries. You may buy a washing machine that was developed with dSPACE Prototyper. You may ride a train where the power electronics controls were tested with dSPACE Simulator, or a plane whose hydraulic actuators underwent

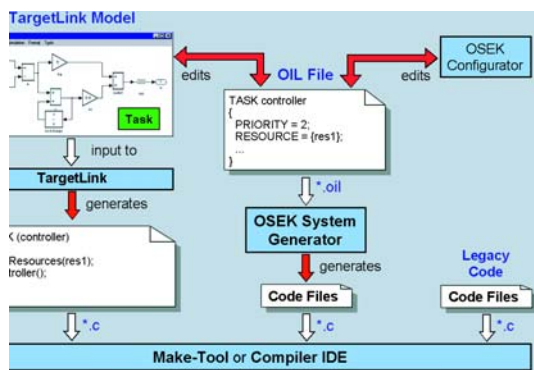
simulation testing before they left the factory. You may even use a PC with hard-disk technology that was improved with dSPACE tools.

We are happy that our products can be used so widely. Nevertheless, the automotive industry is by far our biggest customer segment. This includes vehicle manufacturers (OEMs), suppliers of electronic systems, and suppliers of mechanical systems that become mechatronic systems when electronics are added. Naturally we have a strong focus on the automotive industry and have earned a reputation for understanding its requirements and providing solutions. The automotive segment now accounts for about three quarters of our revenue. It is the development pressure this industry feels that makes it invest in tools and process improvement so heavily. Experts say that 90% of innovation in cars is now

based or dependent on electronics, which mainly means software. As a consequence, the OEMs want to develop, own and control critical functions themselves because they are differentiators. As the new CEO of BMW, Dr. Helmut Panke, recently said: "from sheet metal to software", which means a clear focus on software-driven functionality.

Indeed, the OEMs invest the most in new tools and processes and generate by far the biggest portion of our automotive revenue. On the development side they give models of new controller functionality to their suppliers for implementation, after the prototyping stage when the concept has already been proven. Often they also go a step further and generate the production code themselves, then give it to the ECU supplier for integration. This is why we see so many TargetLink licenses going to OEMs. On the testing side, OEMs are increasingly forced to do comprehensive and thorough testing of the large networks of ECUs coming in from a dozen suppliers. One OEM recently stated that software glitches made up 75% of all glitches in the recent launch of a new car. This is why our dSPACE Simulator Full-Size, which can accommodate anything from a handful to dozens of ECUs, is in such strong demand, so that we need to step up capacity all the time.

*Dr. Herbert Hanselmann
President and CEO*



13 TargetLink 2.0, the next major release of our automatic code generator, will add OSEK/VDX compatibility, data dictionary and worst-case autoscaling to its high-quality code generation.

17 For the third time dSPACE GmbH is holding its German User Conference in Stuttgart, Liederhalle, providing a forum for development experts to share their technical expertise.

Braking at its Best

- Tunable pedal characteristic
- Environmental benefit of eliminating brake fluid
- Easy integration of electronic parking brake

The technological concept of “x-by-wire” means replacing essential mechanical components by electrical ones. It was originally used for aircraft only, but now the automotive industry is showing increased interest. As in aeronautics, this method has enormous potential for implementing new design concepts. For example, it will be possible to design the interior of a car with completely different mechanical connections between the steering wheel or the pedals and the engine compartment. Innovative user interfaces will also be possible – for example, a joystick instead of a steering wheel. At TRW Automotive, we are currently designing a new brake-by-wire system, using dSPACE tools to speed up the development.

Brake-by-Wire Basics

The “x” in x-by-wire is a wildcard for automotive systems like gearshifting, steering, braking or damping. In this article we will describe the development of brake-by-wire systems. Brake-by-wire means no more mechanical connections between the braking actuators on each wheel and the brake pedal. The required braking force is calculated from the driver’s input at the brake pedal unit and applied individually to the wheel actuators.

In the first generation of brake-by-wire systems (electro-hydraulic brake, EHB), all the control functions are implemented in one main electronic control unit (ECU) only. A hydraulic backup mode is still installed for safety reasons to ensure braking in the case of an ECU outage or electrical failure.

In the next generation, the hydraulic backup mode will no longer be necessary,

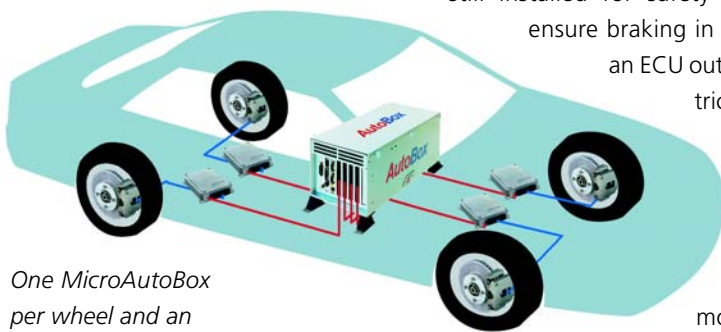
because there will be an autonomous braking system with its own ECU on every wheel. So there will be at least four independent ECUs, which means a multi-redundant system – a method well-known from aircraft construction. This electro-mechanical brake (EMB) is still under development by TRW and has some time to go before mass production.

Benefits of Second-Generation Brake-by-Wire (EMB)

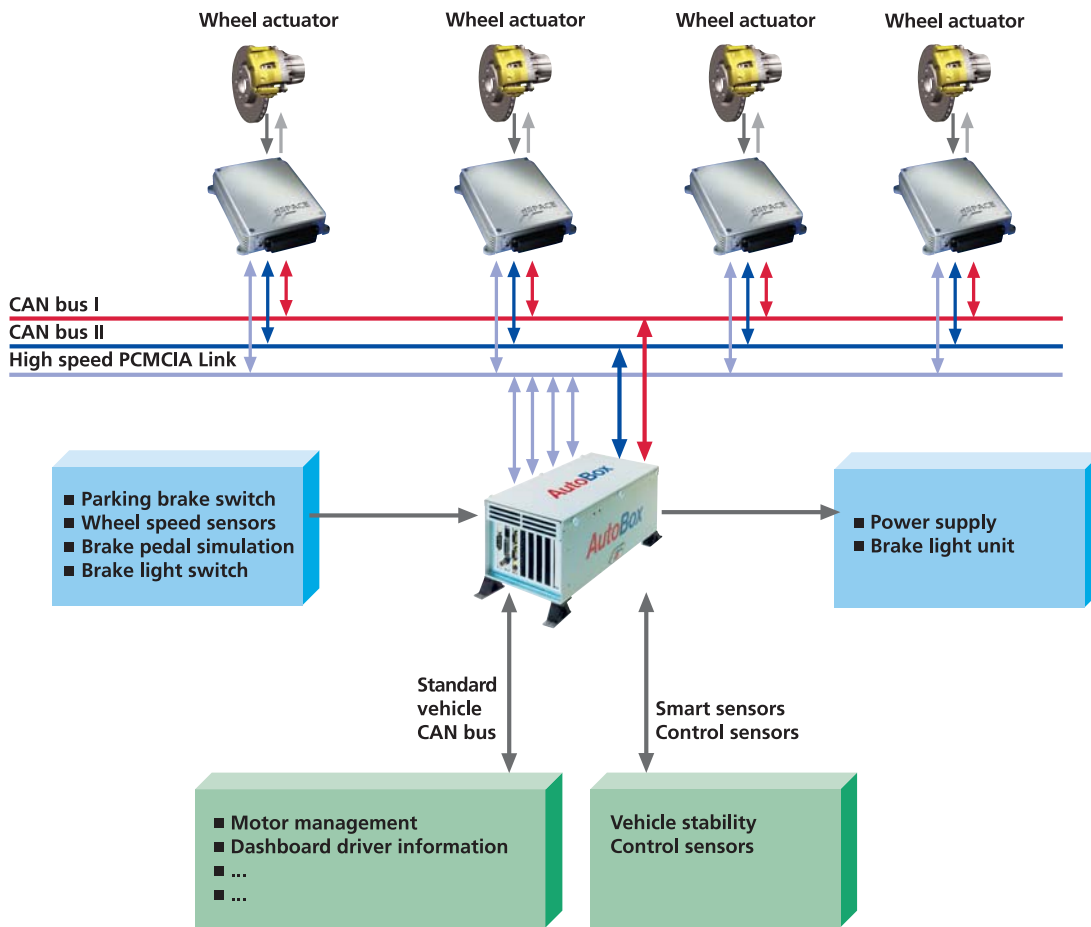
The second generation (EMB) will have advantages at all stages for both manufacturer and consumer – from production to a lifetime of service. The properties and behavior of the brake will be easy to adapt by changing software parameters and electrical magnitudes instead of adjusting mechanical components. So it will be far easier to integrate new features, for instance ABS (anti-lock braking system), VSC (vehicle stability control), BA (brake assist), EPB (electronic parking brake), GCC (global chassis control) or IVCS (integrated vehicle control systems), and the next generation of ACC (adaptive cruise control) features. Diagnostic features are an additional benefit.

For drivers, optimum control of the braking behavior of each individual wheel means a higher braking performance. The feel of the brake pedal is also significantly improved and easily adjusted to different needs. And because the need for brake fluid is eliminated, the environment benefits too.

Each wheel actuator of TRW’s EMB consists of a brushless DC motor, a gear and a spindle arrangement, which are housed in a conventional Colette-type caliper. The brake force control is provided with the highest possible system safety by a fault-tolerant system architecture and redundant fail-safe power management (42-V technology). For the prototype concept development, we are using one MicroAutoBox per wheel as an electronic control unit (wheel ECU) and an AutoBox as the main electronic control unit (main ECU).



One MicroAutoBox per wheel and an AutoBox as the main electronic control unit.



The set-up in detail of the second-generation brake-by-wire system (EMB) at TRW.

Results

The dSPACE architecture makes it easy to observe all the system components, using standardized software under real-time conditions on a central system PC. Since function development is carried out exclusively by MATLAB®/Simulink®/Stateflow® and the dSPACE hardware platform, code generation can be automated. This considerably speeds up function development.

The integration of simulation blocks (simulation of the remaining function components and the actuator/sensor units) in the Simulink/Stateflow models makes start-up easy to perform. As a result, most of the everyday start-up problems can be detected early on, and putting the vehicle into operation is astonishingly uncomplicated and speedy. Because only a reduced number of test vehicles is needed, a huge cost reduction is possible and we can concentrate on our main task, control design. The develop-

ment work is well accepted by our customers, since they are familiar with the electrical assemblies and software tools used.

The Future

To put brake-by-wire technology on the road, it is clear that a new hardware platform needs to be developed. The platform will have a time-triggered architecture (TTA) with TTP/C, FlexRay or TTCAN, and will integrate the signal conditioning and performance output stages. Because of our good experience with dSPACE tools, TRW is looking forward to using TargetLink in this next step. This will make it very easy to reuse existing functions and minimize the overall development time.

Reference: TRW Automotive, Koblenz, Germany
New Product Europe Team

- Wheel-specific braking
- Enhanced system functions
- Functionality dependent on software only

Perfecting Paper Paths

Inter-sheet spacing control for large volume printers and copiers

Experimental paper path controlled with dSPACE Prototyper

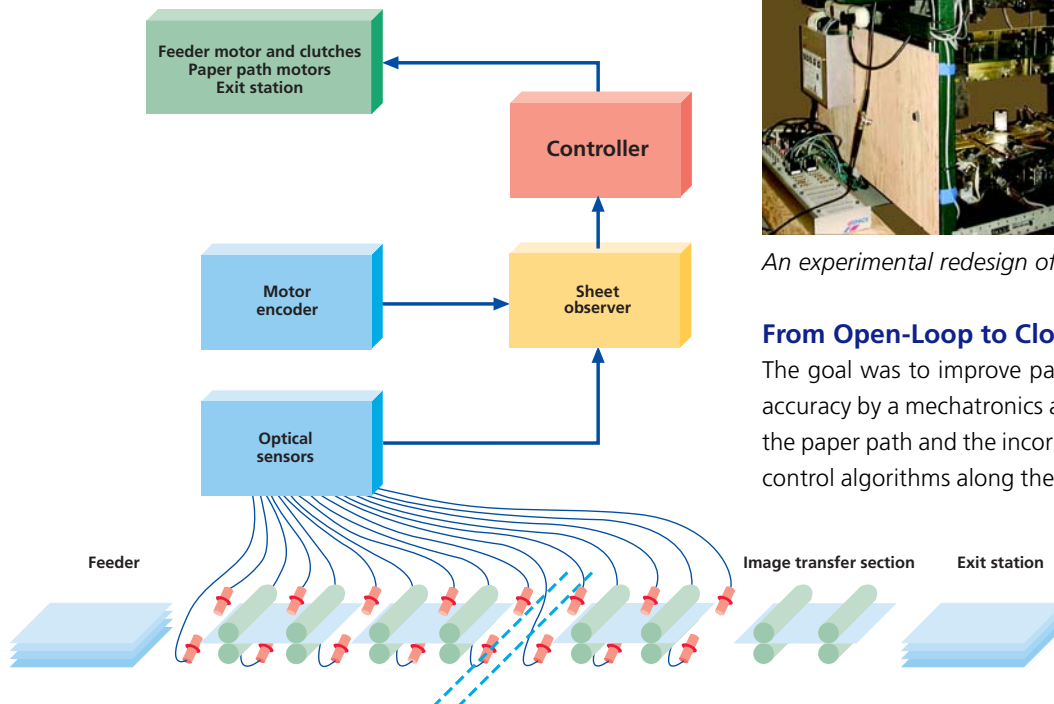
University of California at Berkeley and Xerox Corporation in a joint project

Increasing demands on printers and copiers, like increasing velocities and throughputs, called for an increase in reliability and operation accuracy, especially of the paper path. A joint research project between the University of California, Berkeley, and Xerox Corporation has developed an innovative control process that detects and corrects slight timing inaccuracies by utilizing feedback control along the full paper path, thus avoiding so-called "soft jams". With dSPACE Prototyper the whole control development process was sped up, resulting in a first-cut closed-loop control implementation of certain control loops in only one day instead of weeks.

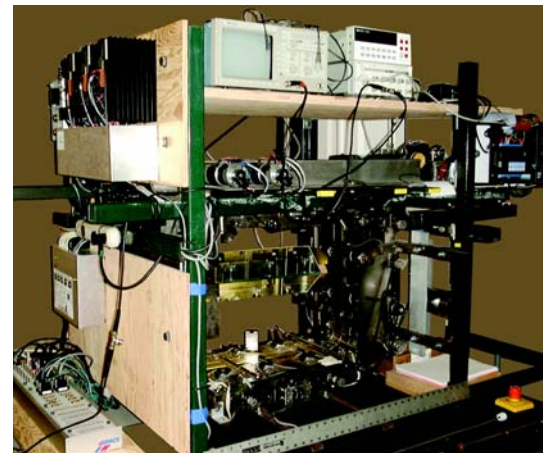
Fatal Soft Jams

As sheets of paper are transported through a printer paper path, the exact path they take through bends depends on a variety of factors, for example, sheet stiffness, thickness, weight, velocity, and bend radius and angle. For longer paper paths, the actual path length that various types of papers are subjected to can vary on the order of centimeters, which results in variations in paper path timings. This means sheets arrive at certain locations earlier or later than intended. If these variations get excessive, the paper path controller shuts down the machine, which can easily happen if the user prints on media with nontypical properties. Such shutdowns are re-

ferred to as "soft jams", and represent more than half of all shutdowns. These jams correspond to papers being slightly too early or too late and can be attributed to the traditional open-loop operation of the paper path. A better mode of operation would be if the controller could detect slight timing inaccuracies and correct them before they get too large for the system to handle.



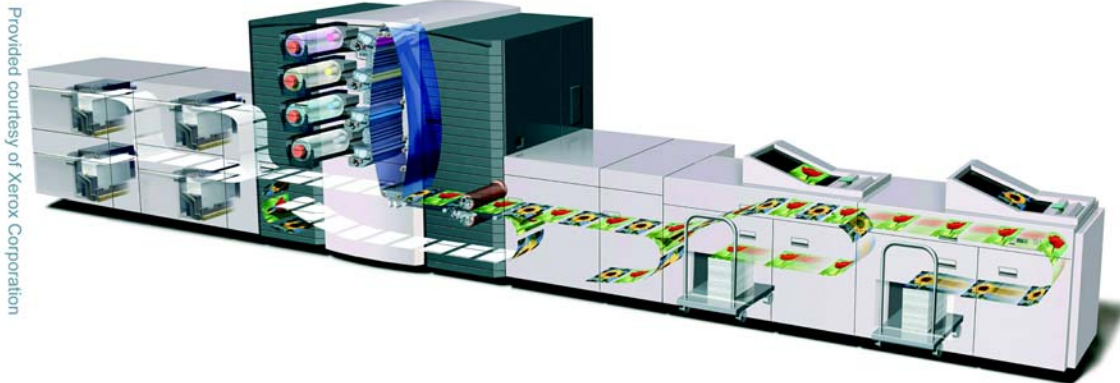
Basic overview of the paper path and other printer subsystems.



An experimental redesign of the paper path.

From Open-Loop to Closed-Loop Control

The goal was to improve paper path reliability and accuracy by a mechatronics approach, a redesign of the paper path and the incorporation of closed-loop control algorithms along the full paper path to con-



Internal overview of the Xerox DocuColor iGen3 Digital Production Press.

control the sheet positions. Optical sensors along the paper path measure sheet positions, and motor encoders provide indirect measurements of sheet velocities. These measurements are processed by a sheet observer, which generates position and velocity estimates for all sheets in the paper path. These estimates are used by the controller to control the sheet positions along the paper path by sending currents and voltages to feeder motors and clutches, paper path motors and a solenoid activated exit station. The exit station enables sheets to exit from the paper path.

Easy Function Development

An experimental paper path was built and controlled using dSPACE Prototyper: The control algorithm is coded in Simulink® and Stateflow®, with a small portion of custom C code implementing the paper position and velocity observer. A MATLAB® script defines all system parameters: paper path dimensions, sensor locations, print job parameters, control parameters, etc. The application is then built and downloaded to a DS1103 PPC Controller Board, which was chosen as the electronic control unit prototype. The experiment is started from dSPACE's experiment software, ControlDesk, and all the data, which includes estimated sheet velocities and positions, section velocities, sensor signals and control errors, is collected by MATLAB scripts utilizing MLIB/MTRACE. The sheet positions in the process direction are controlled using an inter-sheet spacing control algorithm that removes position errors and rejects disturbances due to varying paper path geometries and media type throughout the whole paper path.

Speedier Development Process

One key advantage in using dSPACE Prototyper and MATLAB/Simulink/Stateflow control design environment from The MathWorks is the speed at which control algorithms can be designed, implemented, tested and executed on the real hardware. We experienced this first hand since initially, the control hardware consisted of a PC with interface boards programmed in C++. With the new rapid control prototyping tools, the whole control development process was sped up by an order of magnitude and the implementation of certain closed control loops was possible within one day instead of weeks. During the whole development process we really appreciated the support of dSPACE support engineers, who were always very helpful.

A Controller for any Printer and Copier

With the architecture redesign and the use of feedback control algorithms, soft jams are now avoided. When operating near the system performance limits, the system is able to correct for errors using the new concept of closed-loop control of the full paper path. As an example: In a print job with 10 sheets of papers of varying weight, stiffness and other properties, the sheets follow the same trajectories using the new control as if all 10 sheets had been the same type of paper. We developed a controller that is ready to be successfully introduced in future products with long paper paths.

Dr. Martin Krucinski, Xerox Corporation

Dr. Carlo Cloet, Real-Time Innovations

USA

Firmware Tests with Hard Disk Simulation

➤ HIL simulation of an HDD plant with dSPACE Simulator

➤ Integration of Fujitsu's MATLAB/Simulink models

➤ Tests even before mechanism prototype exists

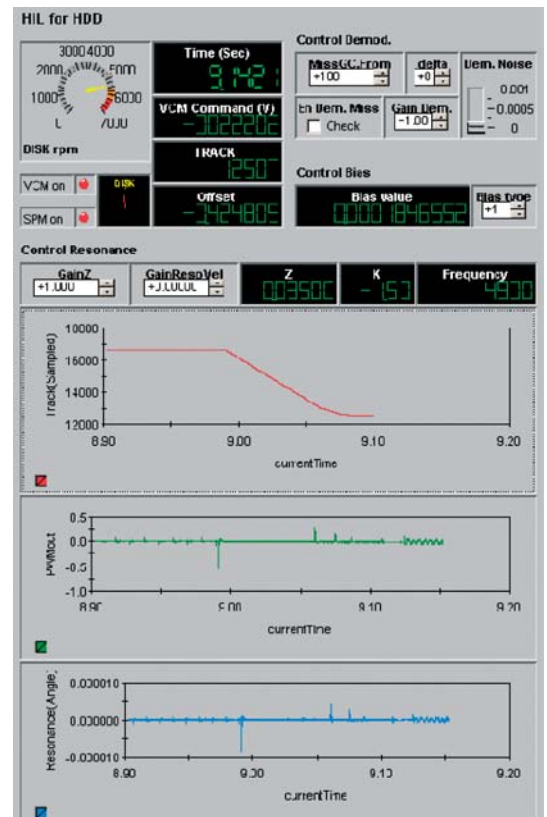


Fujitsu is one of the leading manufacturers of computer HDD units, building several million HDDs every month. In this business, with rapidly increasing requirements on HDD performance, the firmware of the HDD unit plays a key role. For example, servo controllers run by the firmware must control the arm of the HDD with a precision greater than a nanometer. Therefore, the characteristics of the mechanics and the recording magnetism cannot be neglected; they are vital factors that require thorough investigation.

At the early stage of firmware development, we use MATLAB®/Simulink® to evaluate our servo algorithm. When this work is done, we have completed about 25% of the whole firmware development process. The remaining 75% consists of generating code – taking into account the restrictions of RAM and ROM size and execution time – and thoroughly testing it. For example, we have to test whether the generated code works perfectly in extraordinary situations like defective mechanisms, shocks or vibration caused by surface unevenness. In the past, all this was done by hand. There must be a smarter way to do this kind of work – which gave Fujitsu's HDD Firmware Development Department the idea of using a hardware-in-the-loop (HIL) system.

We decided to acquire dSPACE Simulator for many reasons. The most obvious are:

- We have many MATLAB/Simulink HDD plant models that we use in the algorithm evaluation stage. Using dSPACE Simulator means we can reuse them for HIL extremely efficiently.
- ControlDesk, dSPACE's experiment software gives us an excellent platform for monitoring and capturing any state variables of our MATLAB/Simulink models.
- dSPACE Simulator is easy to operate. Although our firmware developers are experts on microcontroller code, they are not always familiar with Windows or UNIX programming. dSPACE Simulator gives them the opportunity to customize the system themselves, without complex GUI programming.



ControlDesk monitors and captures the state variables of Fujitsu's HDD simulation.

A Smarter Way for Testing Firmware Code

By testing the code with dSPACE Simulator, it is possible to save time and maintain the required precision of the HDD units, especially the arm's position. It is also possible to start the firmware development even before a mechanism prototype exists. Moreover, we can reproduce conditions of mechanical unevenness and combinations of extraordinary con-

ditions by simulation. At nanometer level, an arm and a disk appear as if they are soft and flexible, which makes it impossible to find the relative velocity between them continuously. HIL simulation enabled us to estimate the relative velocity.

However, dSPACE Simulators are usually used for simulating systems such as cars, ships, or trains, with sampling times in the range of milliseconds. When simulating a hard disk drive, you face much lower sampling times, because the plant itself is tiny. In our case, the sampling time is around 1 μ s, which was impossible to achieve, even with dSPACE Simulator. We therefore lowered the sampling time of the firmware running on the control unit to synchronize it with the simulation speed. The simulation speed is now 300 times slower than the real sampling time of 1 μ s. It greatly depends on the model size, but firmware developers say that slowing the sampling rate down three hundred times is enough.

This “synchronized simulation” may be in slow motion, but it does enable us to do a time-critical simulation. dSPACE Simulator controls the firmware, for example, by waiting for acknowledge signals from it, which allows the simulation to be paused from either the simulator or the firmware side.

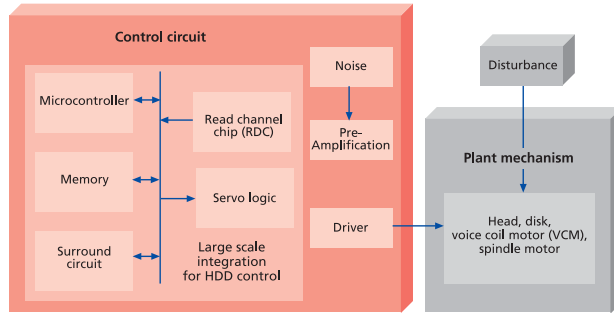
Synchronized simulation brought us the following advantages:

- The simulation time can be set to any value.
- After a temporary program stop, for example, by an event break, the simulation can be restarted.

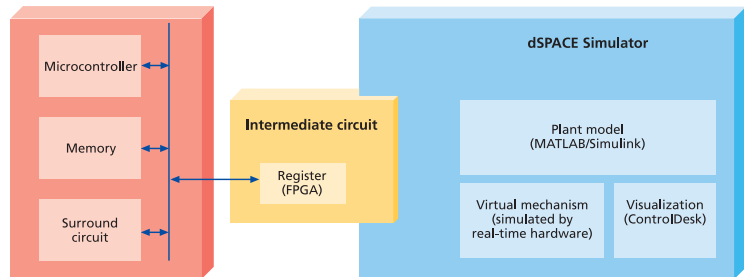
The model calculated on dSPACE Simulator is the magnetic disk model, and it is possible to add another processor board to simulate the influence of wind by calculating hydrodynamics.

Flexibility for Different Hard Disk Types

Communication between dSPACE Simulator and the microcontroller executing the firmware is via shared memory. Normally, the position information and commands to a motor for arm servo control are sent via special circuits, such as a read channel (RDC) or servo logic. But since the HIL sampling time is reduced and the firmware just requires information on the register (memory) values of the RDC and servo logic, we created our own intermediate circuit with a register. This intermediate circuit is based on

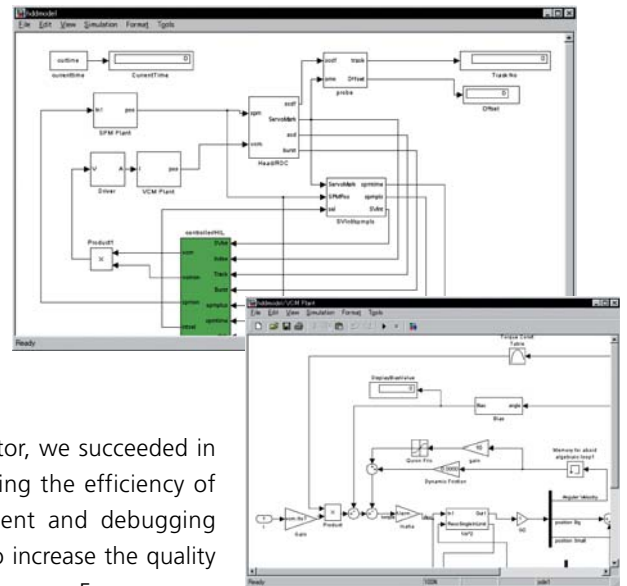


Former development method.



New development in comparison: dSPACE Simulator increases the efficiency.

FPGAs. Therefore, when switching between MCU memory maps for different targets or when changing read and write timing, it is only necessary to replace the configuration ROM of the FPGA.



The Simulink plant models used in the evaluation stage can be reused efficiently with dSPACE Simulator.

By using the simulator, we succeeded in significantly increasing the efficiency of firmware development and debugging tasks. We could also increase the quality of our production firmware. From now on we will use dSPACE Simulator in other fields, such as MO (magneto-optical) and DVD.

Yosuke Senta
Fujitsu Laboratory
Japan

How MAN Controls Emissions with TargetLink

- 80% of the code done by TargetLink
- Flexibility and openness are the key factors of TargetLink
- TargetLink's generated code comes close to handcoded quality

Increasingly stringent vehicle exhaust laws require increasingly powerful exhaust treatment technologies. In diesel engines, the main emissions are soot particles and nitrogen oxide (NO_x), which can be significantly reduced by additional exhaust treatment systems. MAN Nutzfahrzeuge AG has developed a controlled continuously regenerating trap (CCRT) system that can cut particle emissions by up to 90%. To develop the CCRT system, we successfully used TargetLink, the production code generation software from dSPACE.

The Idea Is to Oxidize the Soot

Filtering soot particles is itself not a great problem in the field of exhaust treatment. The real technical challenge is to regenerate a filter when it is clogged with soot, in other words, to burn off the soot so that it does not adhere permanently. There are a number of methods available for filter regeneration. For example, automatic regeneration while the vehicle is in motion can be achieved by means of a

diesel-fueled burner. Another option is filter regeneration using the CCRT system.

A Chemical Reaction with a Remarkable Effect

The CCRT system is currently one of the approaches being used to find a quick solution to the problem of harmful particle emissions. The CCRT system combines the effect of the particulate filter with that

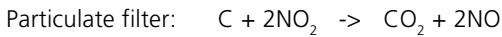


MAN busses and coaches with state-of-the-art exhaust technology.

of the oxidation catalyst. Using the system, soot is combusted (oxidized) as follows:

A preceding oxidation catalyst turns nitrogen monoxide (NO) into nitrogen dioxide (NO₂) by adding oxygen (O). In the particulate filter, the nitrogen dioxide (NO₂) combusts with soot (C) to form carbon dioxide (CO₂).

Reaction equation:



However, this reaction can only occur at specific operating states. The temperature and quantity of the present NO_x molecules play a decisive role in oxidizing the soot.

The CCRT ECU Intervenes to Prevent Clogging

The CCRT electronic control unit (ECU), which regulates the reaction, monitors the quantity of soot in the particulate filter by means of the differential

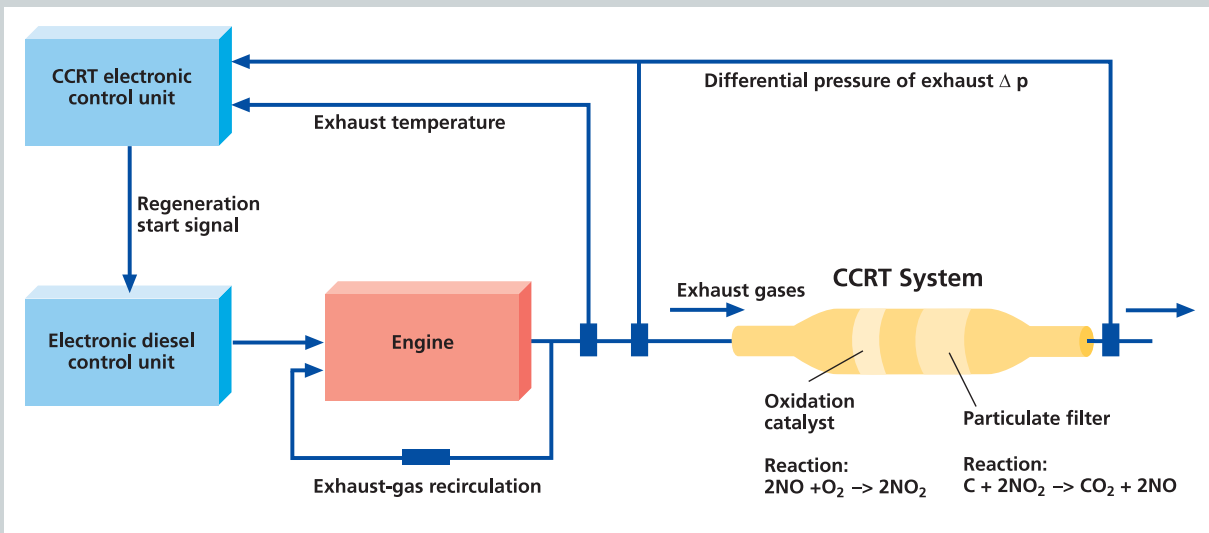
pressure at the two outputs of the CCRT system. When clogging is imminent, the ECU sends a start signal to the engine ECU, which then brings about



CCRT system: ceramic surface of the particulate filter.

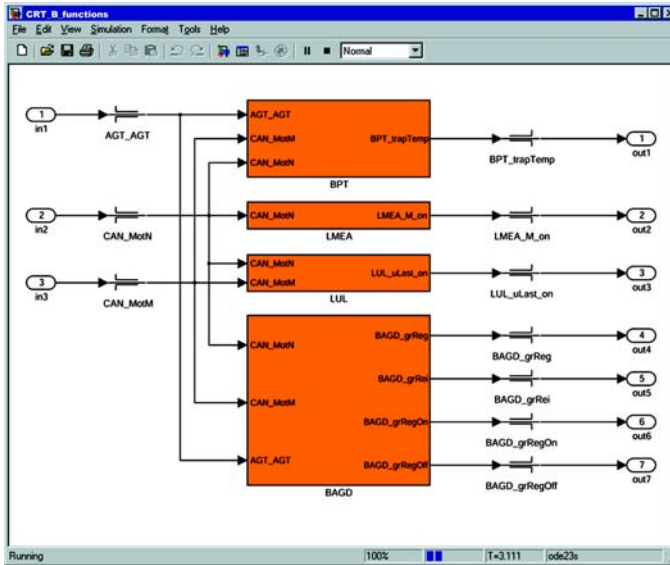
the temporary operating state (for example, an increase in exhaust temperature) that is required for the regeneration of the particulate filter. The CCRT

CCRT System Control

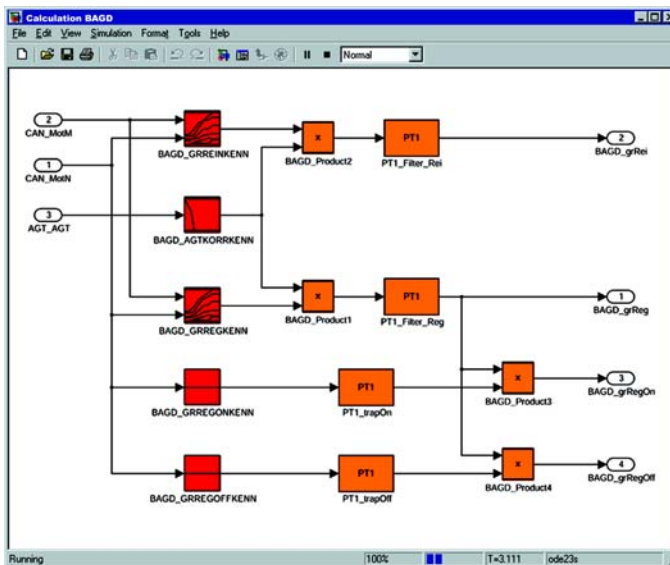


The CCRT ECU has sensors that measure the raw exhaust temperature and the exhaust pressure differential, which is an indication of the quantity of soot particles in the particulate filter. If the exhaust pressure differential rises above a certain limit, the CCRT ECU initiates regeneration of the particulate filter by prompting the engine ECU to bring about the necessary operating state. This is

achieved by a temporary increase in exhaust temperature, among other methods. At this operating state, the soot combusts to form CO₂, and the exhaust pressure differential drops continuously as soot is burned off the filter. When a lower limit is reached, the CCRT ECU prompts the engine ECU to return to the normal operating state.



Module structure for CCRT model computation.



Function for computing exhaust pressure differentials.

ECU was implemented on the basis of a C167 processor platform. In addition, a task-oriented operating system developed by MAN was used.

As only around 20% of the function specification was known at the start of the project, it was important to simulate the functions, especially the new ones, in advance, and be able to include them in the ECU quickly using the code generated by TargetLink.

TargetLink Produced 80% of the Code

A point to note is that apart from pure hardware-related software components such as drivers, logs, etc., all the software functions including the diagnostic functions were generated by TargetLink. This

is around 80% of the total code volume of the application, which was 82 kilobyte.

This high proportion of TargetLink code was achieved by systematically utilizing TargetLink's functionalities and MAN's own TargetLink function libraries.

Flexibility and Openness are Key Factors

TargetLink was the ideal solution for us, as the generated code came close to handcoded quality in the quasi-continuous function components. Moreover, TargetLink had already been used successfully in several in-house projects. Because it uses MATLAB®/Simulink® as a platform, TargetLink is very flexible and open. The system can be adapted to requirements, and if necessary extended, at any time. We prefer this approach to systems that impose rigid structures for modeling and code generation.

Another important point is the ability to use TargetLink to generate standard application files that comply with the ASAM-MCD 2MC standard, so that the ECU can be calibrated by a standard application tool.

Finally, we would like to praise the dSPACE support service, which responded with exemplary speed and high quality throughout the project.

Another Application in the Pipeline

This positive experience has convinced us to continue relying on TargetLink. We will therefore be expanding the field of automatic production code generation.

The next ECU for another application is already being planned. It will be implemented with the support of TargetLink and an operating system compliant with the OSEK/VDX standard. Its complexity will be similar to that of an engine ECU.

Dipl.-Ing. Stefan Teuchert
MAN Nutzfahrzeuge AG
Germany

More Than Just a Code Generator: TargetLink 2.0

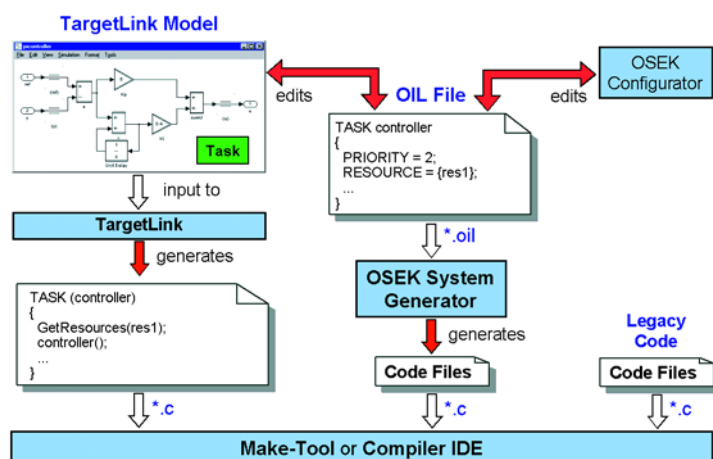
In 1999, dSPACE introduced TargetLink to the market. Since then, automatic code generation with TargetLink has been proven in a wide range of control applications. By the end of the year, dSPACE will widen the scope of production code generation with TargetLink 2.0. Many innovations like generating code for OSEK/VDX-compliant real-time operating systems, scaling a model via worst-case autoscaling or using the new data dictionary as a new opportunity for single-source management and manipulation of data will enable the user to shorten overall development time. TargetLink 2.0 stands for more compatibility, more tool integration, more efficiency, more usability and more opportunities for customization.

Supporting OSEK/VDX-Compliant Operating Systems

This main new feature of TargetLink 2.0 makes OSEK operating system objects and services available on the block diagram level. For instance, the user will be able to set up alarms, define tasks or specify intertask communication without leaving the block diagram level. Another essential part of the new feature is that TargetLink now supports multirate systems that are mapped to operating system tasks – periodic or event-driven – in a very flexible manner. As part of the operating system standard, the specification and generation process involves the definition of system services and their attributes via the OSEK Implementation Language (OIL). TargetLink 2.0 will give full freedom to use either TargetLink’s built-in graphical user interface or the dialog-based OSEK configurator of the OSEK operating system vendor to specify OIL attributes. Editing OIL files with an ASCII editor definitely is a thing of the past. Combining TargetLink and the OSEK/VDX standard will offer huge advantages to the user. A whole real-time system can be described in one environment. Control algorithms and operating system objects will be specified in one model. Automatic mapping of the model characteristics to operating system objects means there will be no more need to memo-

size OSEK/VDX specifications in detail. As a consequence, development time will be reduced significantly. By means of consistency checks on user inputs and OSEK-aware automatic code generation, common mistakes will be prevented and the user will have shorter installation and testing phases. Finally, the code will be optimized for OSEK operating systems, which will reduce the code size and shorten the execution time. TargetLink 2.0 will support all OSEK/VDX-compliant operating systems and is being tested with Metrowerks OSEKturbo, Vector Informatik osCAN

- Release planned for the end of the year
- Supporting OSEK/VDX-compliant operating systems
- A data dictionary will be an integrated part of TargetLink 2.0
- Saving time with intelligent fixed-point scaling



Intermeshing: TargetLink and OSEK/VDX.

and osCANopen, 3Soft ProOSEK, Realogy RTA/OSEK and Windriver OSEKWorks.

The Data Dictionary Supports Large-Scale ECU Development

The data dictionary is a central data container that holds all relevant information for code generation. It will work across model boundaries and is independent of any model partitioning. As a consequence, the data dictionary will keep data consistent throughout all stages of the development process and facilitate multimodel applications. The user can define variables and corresponding properties. Structured data types can be specified and used for variable declarations. Scaling formulas can be entered and used to uniformly scale signal paths in the model. The data dictionary holds a great wealth of additional information, for example, specifics about function calls, tasks, variable classes, data variants, code generation options and so forth.

Open API interfaces make it easy to integrate the data dictionary into company-specific environments. The data dictionary supports various import/export formats, including XML and ASAM-MCD 2MC Classic (ASAP2).

The data dictionary will be introduced for the first time in TargetLink, but will gradually be connected to other tools in the dSPACE tool chain. This will enable consistent data management in parallel to algorithm development throughout the complete V-cycle.

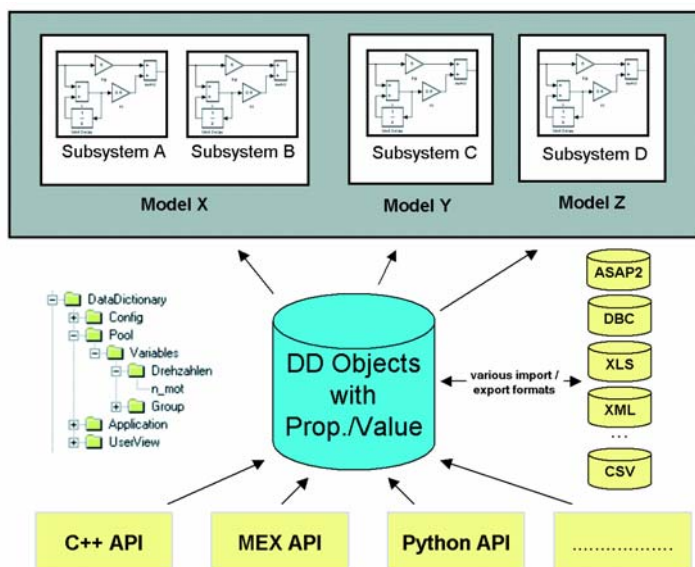
New TargetLink Blockset Concept

The new concept allows the TargetLink Blockset to be used independently of the TargetLink Base Suite. The TargetLink Blockset can be installed on any PC and used in stand-alone mode. This will enable TargetLink models to be used for simulation in Simulink®/Stateflow® without the need to purchase a full TargetLink license. Rapid prototyping with Real-Time Workshop® and dSPACE hardware does not require model conversion. The TargetLink model can be used for all development steps without any modifications.

Using the TargetLink Blockset independently of the TargetLink Base Suite, the user cannot generate production code or change TargetLink-specific properties. Data logging in TargetLink during simulation will be disabled too, but normal simulation with the Simulink Simulation Engine and entering Simulink-specific properties is possible without restriction. This new blockset concept will provide an inexpensive solution for all customers who want to use TargetLink on a large scale in their company, but do not need the code generation capabilities at every user’s workstation.

Saving Time with Intelligent Fixed-Point Scaling

The most important advantage of worst-case autoscaling is that no plant models or stimuli signals are required, which ensures stimulation of worst-case values for all signals. However, simulation-based autoscaling will continue to be available for those who can run simulations for their models. Before starting the worst-case autoscaling tool, the user enters all available a priori information about signal range limits or fixed-point parameters. These are usually known at system boundaries, for example, at blocks that send or receive their signals directly via the processor periphery. Often many internal signal ranges are known as well and stored in company-wide databases. The autoscaling tool propagates this range information backward and forward through the model according to worst-case assumptions for signal processing. The user can select the whole model or portions of it for this computation. From the worst-case ranges, the tool automatically computes scaling parameters, taking code efficiency, accuracy and other “common sense rules” into account. Signal paths that require additional user information to be calculated are high-



Data and model are systematically separated.

lighted in the model.

Complying with Standards

The list of international standards that are used for or met by TargetLink continues to grow. In addition to ASAM-MCD 2MC Classic (ASAP2) for calibration systems and OSEK/VDX for real-time operating systems, TargetLink will follow coding rules from the British MISRA C standard. A compliance document will be available from dSPACE, which includes a list of all rules met by TargetLink and documents exceptions to the rules that have been made for efficiency reasons.

The TargetLink development process is currently being aligned according to ISO/IEC 15504 and will be audited by an independent assessment company. ISO/IEC 15504 is a software quality standard commonly known under the name SPICE (Software Process Assessment and Capability Determination). This process assessment is a necessary step to qualify TargetLink for use in safety-critical software development.

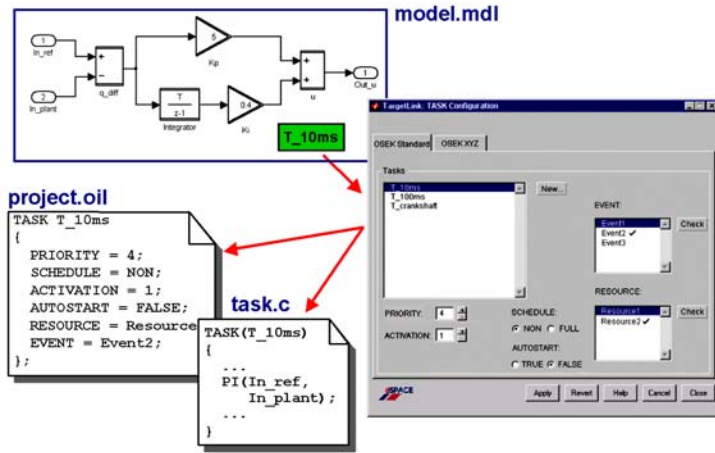
Enhancements to Block Library and New Target Optimizations

The new version of TargetLink will also have enhancements with regard to the block library and target optimization. TargetLink 2.0 will support the Direct-Look-Up Table block, the Zero-Order-Hold block and the Trigonometric Function block for fixed-point data types. The MSR-MEGMA blockset will be available upon request for customers who need compliance to this standard. New backend target optimization modules will be available for the processor/compiler combinations Motorola MPC555/Diab-SDS and MPC555/Green Hills and a new target simulation module will be available for the new Motorola processor HCS12.

At One Stroke: Specific Code Formatting, Code Coverage and Incremental Code Generation

The customer-specific code formatting will enable the customer to specify the format of the generated C code with respect to file and function headers and comment lines when specifying variables. Furthermore, users can provide their own customer-specific "include.h" files, which can be automatically included in each generated C file.

Coverage analysis is used to dynamically analyze the



Task specification with TargetLink 2.0.

way that a program executes. One kind of coverage is called line coverage, sometimes abbreviated to C1. The coverage measure will document how often each line in a C function was executed. TargetLink will capture all C1 coverage data during simulation on host or target systems and generate a detailed documentation file to provide a measure of test efficiency and proof of test completeness. The generated documentation can be used for software certification in accordance with international standards, for example, DO178B. The required instrumentation of the code is done by the output formatting tool, independently of the core code generator.

Incremental code generation significantly speeds up the code generation time, especially in the case of large models or if changes to the model are marginal. Incremental code generation will be available on C function level. The user may generate code only for subsystems which have changed. Subsystems which have not changed are documented in the data dictionary, enabling TargetLink to perform consistency checks and build the application.

Conclusion

TargetLink 2.0, planned to be released by the end of 2002, will have specific new features for better support of a seamless development process for large ECU development projects and teamwork in large project groups. OSEK/VDX compatibility, the data dictionary and worst-case autoscaling are just three highlights that will set new standards in production code generation. All these innovations reflect TargetLink's technological leadership and dSPACE's commitment to high-quality code generation.

dSPACE Release 3.4

➤ **New software tool
MotionDesk**

➤ **Floating network
licences**



INFO 01

The recent dSPACE Release 3.4 offers some new functionalities for your dSPACE environment. Here's a short overview of the key features:

The new MotionDesk software offers 3-D online animation in real time, with textured rendering for a realistic look. Drag & drop scene design is easy with the graphical objects library and intuitive user interface. The new MotionDesk Blockset allows you to calculate the motion data and connect your simulation model to MotionDesk in Simulink®.

For dSPACE Release 3.4, you can purchase floating network licences: So only the number of software modules running simultaneously is limited – and not the number of installations.

MicroAutoBox now supports the control of direct current motors. It also provides a software-controlled power supply. This allows the termination of all processes to prevent data loss when MicroAutoBox is shut down. In addition, flash

memory access has been implemented for MicroAutoBox to store data to the Simulink model and restore data from it, for example, the mileage or the air conditioner settings.

Flash memory access is also available for the DS1005 PPC Board. You can also record up to 250 variables in a 16-MB flight recorder.

The CAN bus supports raw data access to perform custom encoding. The DS4302's CAN bus can now handle an unlimited number of messages.

Unlike PCs, common ECUs do not provide floating-point calculation. So for easy value conversion between ECU and PC, the ControlDesk experiment software now provides scaling functions.

For more information: www.dspace.de

If you wish to receive dSPACE Release information via e-mail, please send your e-mail address to release.news@dspace.de.

New: Interface to the LIN Bus

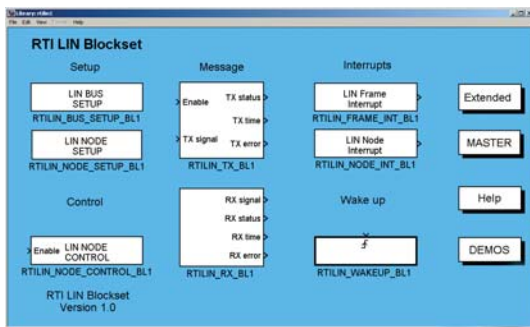
The Local Interconnect Network (LIN) allows inexpensive serial communication systems to be set up, particularly for in-vehicle electronic comfort systems

and non-safety critical elements of engine control systems.

Typical comfort systems are seat adjustment, sunroof and central locking. The new dSPACE DS4330 LIN Interface Board is specially tailored to the needs of the automotive environment and connects dSPACE Simulator to the LIN bus, offering 16 independent

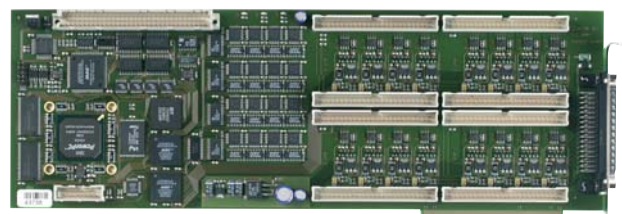
With the help of the new RTI LIN Blockset, you have an intuitive and convenient approach within Simulink to configure and simulate LIN nodes. It is possible to import files in the LIN database format (LDF) and database container (DBC) files to configure the nodes to be simulated. You can also access LIN raw data - for example, if you need to calculate checksums. There is also support for error simulation including LIN protocol errors and variable in-frame response times.

The DS4330 LIN Interface Board for DS1005-based systems – supporting LIN slave node simulation – is planned to be released in the 4th quarter of 2002. LIN master node simulation and MicroAutoBox support will follow soon thereafter.



The RTI LIN Blockset extends Real-Time Interface for easy configuration of the DS4330 board from Simulink block diagrams.

LIN channels with up to 16 slaves per channel to be simulated. LIN data from within a Simulink model can be transmitted and received, and LIN messages and LIN bus events as well as energy-saving scenarios such as wake-up and sleep mode are supported.



The new DS4330 LIN Interface Board.

INFO 02

German User Conference

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

Our User Conference is a forum for experts that will give you plenty of opportunity to share your technical expertise with other engineers and managers from leading automotive companies. A comprehensive technical program awaits you, including user presentations and developer highlights on using dSPACE products for the controller development process. Draw inspiration from the solutions and concepts that other dSPACE customers use to improve quality and save precious development time.

With its broad focus on fields like rapid control prototyping, automatic production code generation, hardware-in-the-loop simulation, or any combination of these, the German User Conference is a rich source of information for anyone involved in controller development.

We look forward to welcoming you to our third German User Conference: Your presence will ensure that the conference continues to be a lively discussion forum and a treasure trove for new ideas.

Come and join us – order your brochure via the response card, or register online on our home page at: www.dspace.de/ankon.htm



INFO 03

User Highlights at US Conference

dSPACE Inc. held its second North American User Conference on May 16-17, 2002 in downtown Detroit, Michigan. From across the embedded controller software development industry, 122 participants gathered to share achievements and learn from the various industry applications.

The showcasing of the latest applications included 17 presentations: 12 invited papers from dSPACE users, one presentation by The MathWorks, and four from our product managers, one in each of the four technical discussion tracks: new developments, rapid control prototyping, automatic production code generation, and hardware-in-the-loop simulation.

Besides presenting the latest applications, asking questions and expressing future requirements, two

expert panels were assembled to discuss present and future challenges for each day of the two-day conference. The first panel discussion was about automatic production code generation with dSPACE users from Visteon, Motorola and General Motors.

The second panel on hardware-in-the-loop simulation was with users from the Ford Motor Company, Moog Inc., and DaimlerChrysler.



Jim Tung from The MathWorks giving a presentation at the dSPACE Inc. User Conference in Detroit.



Jian Shen, Bombardier Transportation Systems, participating in the user discussion.

Our User Conference is about exchanging ideas, sharing information, professional networking and getting to know each other. We would like to extend our thanks and appreciation to all those who took part and the inspiration they provide. It is very rewarding for us at dSPACE to experience this event, and we appreciate the hard work of all of our speakers, and our customers for their loyalty and continued support.

New Address: Project Center in Munich

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For two and a half years now, our successful Project Center in Munich has been offering extensive knowledge transfer and dedicated services to our customers in southern Germany. Its proximity to some of Bavaria's key locations for high-tech industries – including automotive companies such as BMW and Audi – has helped us build a very close relationship with our customers on site. This enables us to react to customers' enquiries immediately and be on the spot whenever help is needed. To give our growing team more space and expand our services, our Project Center relocated on April 15, 2002.

We are looking forward to continuing our mutually successful cooperation with our customers in southern Germany and would be pleased to welcome you in our new office in Pfaffenhofen.



From left to right: Hassen Ouni, Arne Kusiek, Christian Senger, Jürgen Gehring, Jorge Pascal, Peter Rißling (Lead Project Engineer), Dirk Jegminat, Eugenio Acevedo Fernández.

dSPACE Grows Again



New offices right beside the main dSPACE GmbH building in Paderborn, Germany.

Expansion to a fifth building at dSPACE headquarters in Paderborn (Germany) went ahead smoothly in May. Two departments now have their new offices on two floors with 1000 m² right beside the main building. Now five of the ten buildings that form the "Technologiapark Paderborn" have a dSPACE doorplate. The "Technologiapark Paderborn" was founded in 1995 as a business park for research- and development-oriented companies whose innovative technologies have been providing the industry with scintillating new ideas since then. Meanwhile, the number of dSPACE staff has expanded to more than 350 highly motivated employees worldwide. We'd like to express our special thanks to all of our customers and everyone who supported us.

Papers



J. Gehring, H. Schütte:
"A Hardware-in-the-Loop Test Bench for the Validation of Complex ECU Networks" (SAE 2002)

English 04

T. Thomsen:
"Integration of Automotive Standards into Production Code Generation" (ECT 2002)

German 05

English 06

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



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

For more details, please visit www.dspace.de or check the corresponding field on your response card.

Events



EUROPE

MessComp

September 3-5, Wiesbaden, Germany
Rhein-Main-Hallen
Booth #447-449



Aachener Kolloquium

October 7-10, Aachen, Germany
Eurogress

dSPACE User Conference

October 9-10, Stuttgart, Germany
Liederhalle

Semaine de l'Electronique

October 22-24, Paris, France
Paris Expo - Porte de Versailles, Hall 7.3
Booth #F05

USA

Guidance, Navigation & Control (GNC)

August 5-8, Monterey, CA

Convergence Embedded Systems

October 21-23, Detroit, MI



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

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