## EDITORIAL



*Dr. Herbert Hanselmann*

We are now looking back on 16 months of TargetLink product history, and I feel this product once more deserves some attention in this column. There are customers who have gone far beyond the 'proof-of-concept' stage. TargetLink is already in production ECUs and is used in projects without the backup option of "if it doesn't work, we still can do it by hand." It has to work, and it does.

Just a few days ago I received a letter from one of our more aggressive customers (aggressive in the sense of making full use of TargetLink and squeezing the maximum out of it). About a year ago they were faced with a project with such tight timing that they would not have taken it on at all without TargetLink. On top of this, the processor and compiler were not only new to them, but also to dSPACE. The supplier offered very little RAM and ROM, and the driveable system was to be presented to their vice president of passenger car development within 4 months, as a real ECU, and not a prototyping system. The system was presented, approved, and the software released after just 6 months. The customer particu-

larly emphasized the partnership he experienced with dSPACE. Changes and customizations were quick and to the point. It is no surprise that this customer is among those with a large number of TargetLink licenses.

Speaking of which, TargetLink sales have been increasing fast over the last few months. That's even before version 1.2 and the big enhancements coming with the next major release, some of which are critically important for certain customers. Clearly TargetLink has left behind the "let's see if it works in a real project" stage.

## CUSTOMERS

- **TargetLink cuts development time by approx. 40%**
- **Seamless design chain based on dSPACE tool suite**
- **TargetLink generated code will go into series ECU**

# Coming Soon: Steer-by-Wire at ZF Lenksysteme

X-by-wire: A hot topic for all car manufactures and suppliers when exploiting potential areas for improving vehicles. In this context, ZF Lenksysteme (ZFLS) is developing the first generation of steer-by-wire systems, planned to be available on the market in the near future. To develop the corresponding electronic control unit (ECU), ZFLS opted exclusively for dSPACE tools. Function prototyping is performed with dSPACE Prototyper, and to generate the code automatically for the target hard-

ware, ZFLS uses TargetLink. By choosing TargetLink as the production coder, ZFLS estimates a cut in development time in the range of 40%.

### Steer-by-wire Basics

To establish steer-by-wire systems, the conventional architecture is replaced by electrically and electro-hydraulically driven actuators. The steering forces are generated by an induction motor, which is controlled by the corresponding motor angle sensor. To give the driver the familiar feeling, a brushless DC-motor provides torque feedback at the steering wheel. For safety reasons a hydraulic backup system provides steerability under all circumstances.

### Benefits

By using dedicated controllers, the steer-by-wire system revolutionizes steering functionality, in the form of vehicle state dependent steering ratio, automatic

parking assistance and lane keeping control, just to list the most obvious examples. Furthermore this system allows vehicle dynamics control by automatic



*Feedback actuator with steering wheel.*
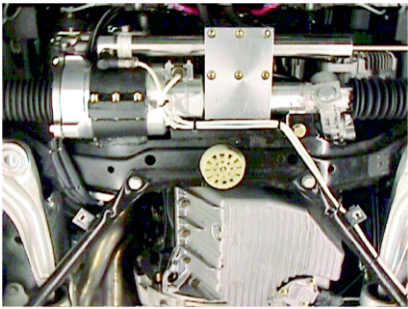
*Underside of the engine compartment with steering actuator.*

steering interventions. Due to the missing intermediate shaft, there is also potential to improve crash performance and steering system integration: left- and right-hand-drive vehicles follow the same mechanical set-up. Steer-by-wire provides excellent flexibility regarding modifications to the steering characteristics. If a specific steering design is to be installed on a different car type, only the software code needs to be altered in order to modify the desired performance.

### The Procedure
To develop the ECU software, we designed the controllers graphically in the MATLAB/Simulink environment. To evaluate the control functions, the Simulink model, consisting of 355 blocks, was transferred to dSPACE Prototyper. Onboard verification and parameter tuning was performed on

dSPACE AutoBox, which features a sample time of 1 ms. The next step is often considered the most critical and error-prone. The Simulink model must be transferred accurately into executable C code in order to run on the target processor, the TMS470 from Texas Instruments. The code must represent the graphical specification exactly. With TargetLink, we found a tool which precisely meets our requirements, such as
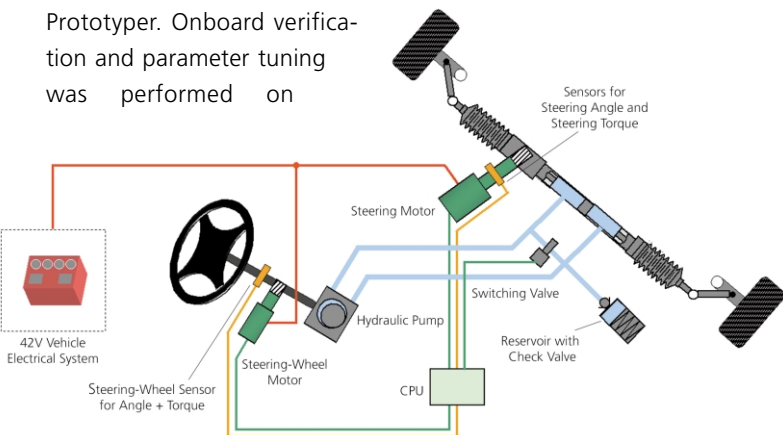
- flexible variable naming according to our programming directives
- manual and automatic variable scaling
- floating- and fixed-point simulation

Equally important are the code properties with respect to readability and documentation. Since the report file is generated automatically, we value the good project overview provided by TargetLink. dSPACE's commitment to our success has not gone unnoticed: In cases where we needed some additional assistance, the technical support was friendly, quick and competent. With respect to the training ef-
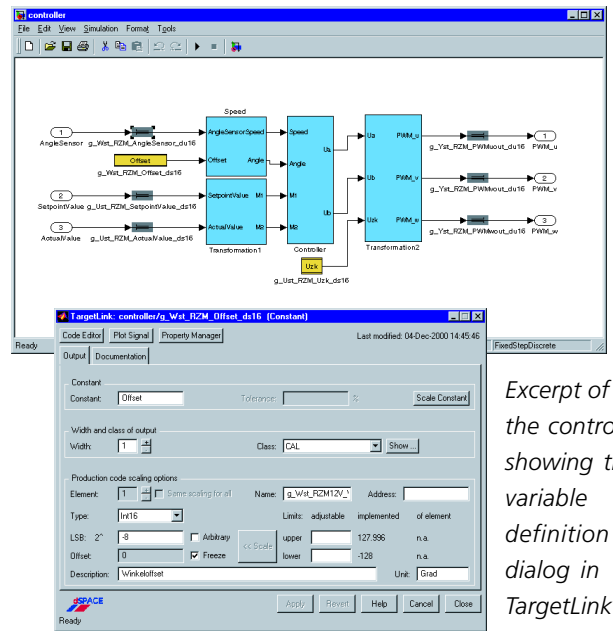
fort, we regard TargetLink as an easy-to-use tool that fits ideally into our development environment. Since we were already familiar with Simulink, it took us only two weeks to achieve useful results. This is significantly less than competitive products.

### Speeding It Up
TargetLink is the stepping stone between the prototyping stage and the target hardware. It provides a seamless design approach, which is a frequent re-



*Excerpt of the controller showing the variable definition dialog in TargetLink.*

quirement of our customers. Modifications made within the Simulink model are transferred accurately into C code. This speeds up the development process significantly since the main design task is performed solely within MATLAB/Simulink. We are looking forward to using TargetLink as the primary tool for automatic code generation in our development department.

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*Principle layout of the steer-by-wire system.*