

CLAAS Takes TargetLink to the Fields

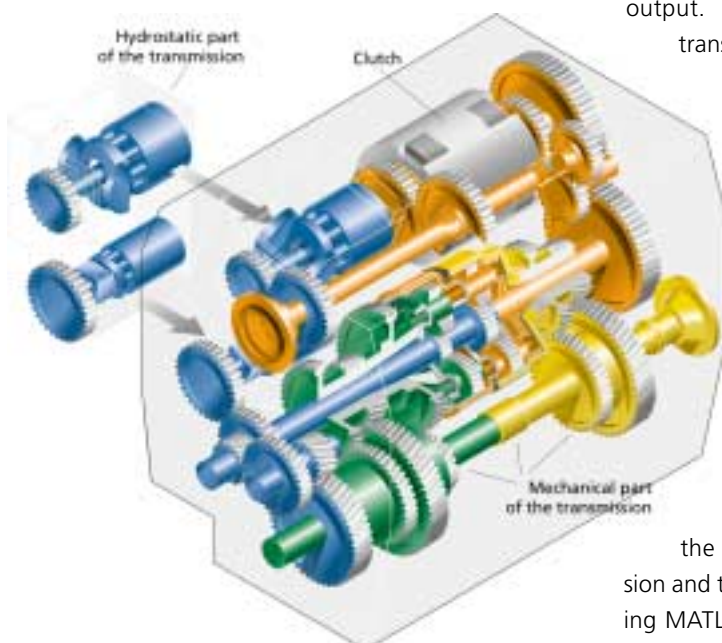
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- CLAAS opts for TargetLink for transmission control
- TargetLink is four times better than supplied library functions
- TargetLink boosts coding speed like an additional programmer

Alongside the CLAAS products for farming, CLAAS Industrie-technik, a subsidiary of the CLAAS Group, also produces hydraulic components and transmissions. When it came to developing the transmission control for the TRAXION transmission for application in XERION, CLAAS' new basic machine, TargetLink played an important part in production code generation. Our team of developers used TargetLink to generate the control software for the hydrostatic part of the transmission, not only considerably boosting computing speed, but also cutting the time needed by over 50% compared with handcoding.

Innovative Transmission Systems

The continuously variable TRAXION transmission is based on the principle of power split technology. It consists of a mechanical part and a hydrostatic transmission. In conjunction with



TRAXION transmission with hydrostatic and mechanical part.



CLAAS XERION at work.

a specific gear arrangement, this ensures continuous adjustment. The variable characteristic is achieved when an adjustable swash plate changes the displacement of a hydraulic pump. Mechanical clutches within the transmission are also engaged in a very specific manner.

What is Controlled?

The controller for the hydrostatic part of the transmission adjusts the swash plate of the hydraulic pump so that the desired speed is reached at the transmission output. RPM sensors at the transmission input and output and valve current meters are the key input variables.

The actuators are electro-hydraulic and operate proportionally to achieve continuous adjustment to the angle of the swash plate.

We developed and specified a model of the hydrostatic transmission and the control structure using MATLAB/Simulink, the modeling tool from The MathWorks.

TargetLink – Far Better than Supplied Library Functions

After C implementation with supplied library functions for integer computation returned unsatisfactory results, we decided to use a production code generator for our second attempt. Our specifications were that it must be easy to learn, have very good integration into MATLAB/Simulink, and generate efficient production code.

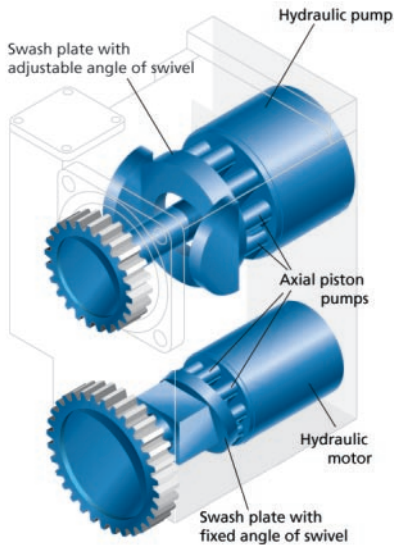
Even during the evaluation phase, TargetLink produced an improvement in run-time behavior of 400% compared with the library functions. The comprehensive simulation and optimization options helped us to generate high-quality code. The ability to record the minimum and maximum values of the variables during simulation was particularly helpful in scaling.

When the code had been generated, the TargetLink code was implemented on a test ECU (electronic control unit) together with the handcoded I/O functions and tested on a real transmission unit. The result: The code generated by TargetLink can be transferred to the production ECU without any modifications.

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As Reliable as a Swiss Clock TargetLink made it possible to significantly enhance the performance of the controller previously designed in MATLAB/Simulink. Our requirements with respect to code quality, readability and integration capability were fully met. However, the decisive factor was the short learning curve needed for learning. It took us only half a day to produce the first useful results. As controller development progressed, TargetLink code consistently proved to be reliable. The development time for the control of the hydrostatic part of the transmission was reduced to half the time originally planned for.

Future
At CLAAS, we are convinced of TargetLink's value and are already using it in two further projects: a project for automatic steering and a project for automatic reel speed



Hydrostatic transmission.

control of the cutterbar in combine harvesters. To sum up, we would say that TargetLink has become an important tool for our development departments. We are looking forward to using TargetLink in other applications.

Andreas Wilken
CLAAS KGaA
Germany

The Principle of Hydrostatic Transmission

Hydrostatic transmission units consist of a hydraulic pump and a hydraulic motor. The hydraulic fluid transfers the force from the hydraulic pump to the hydraulic motor. On the hydraulic pump, there are several axial pistons arranged in a ring and sliding on a swash plate while rotating with the cylinder block. The swash plate itself is fixed in this version. The pumping action is produced by the entire assembly with the axial piston pumps rotating on the swash plate.

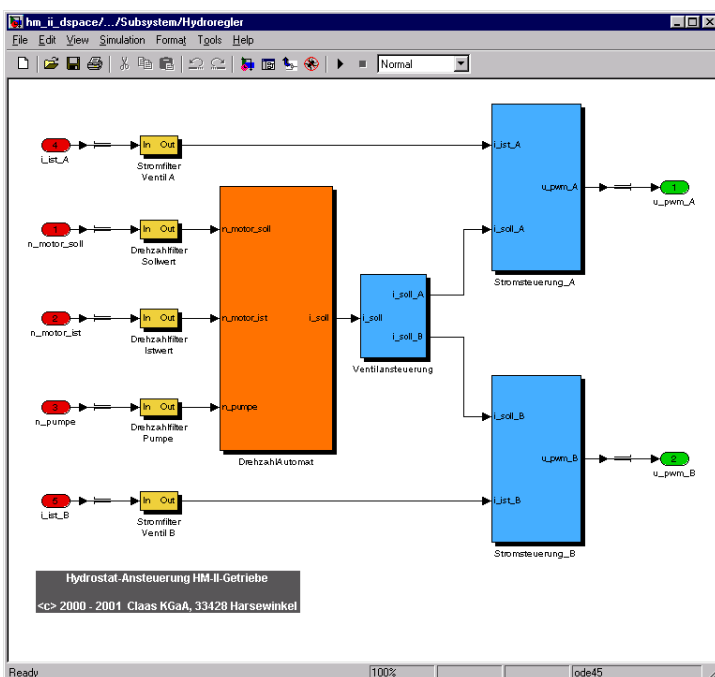
By adjusting the angle of swivel of the swash plate on the hydraulic pump, it is possible to vary the volume of hydraulic fluid delivered in the hydraulic pump and therefore also in the hydraulic motor. This means that the output speed of the hydrostatic transmission unit can be regulated continuously.

The hydraulic motor operates on the completely opposite principle. The hydraulic fluid now exerts pressure on the axial pistons, which are also arranged in a ring, thus applying force to a swash plate. Here too, the swash plate is fixed, thereby generating torque on the axial piston pump assembly, which is fixed rigidly to the drive shaft. In this way the hydraulic energy is converted back into mechanical energy.

Project Information

- Software:**
- Model design: MATLAB/Simulink
 - Production code generation: TargetLink
 - Model size: approx. 300 Simulink blocks

- Control unit hardware:**
- Processor type: Infineon C167CS
 - Operating system: osCAN by Vector Informatik



Excerpt from the hydrostatic transmission controller.