TargetLink: A Driving Force at Honda

CUSTOMERS

- TargetLink code controls electric power steering
- Production code generated for complete application part
- Convincing execution speed thanks to the efficient code

INFO 01

A significant step in the development process of electronic control units (ECUs) is production code generation. Honda applied TargetLink to set up electric power steering (EPS), and found the generated code highly satisfies the conditions required for production code.

What is EPS?

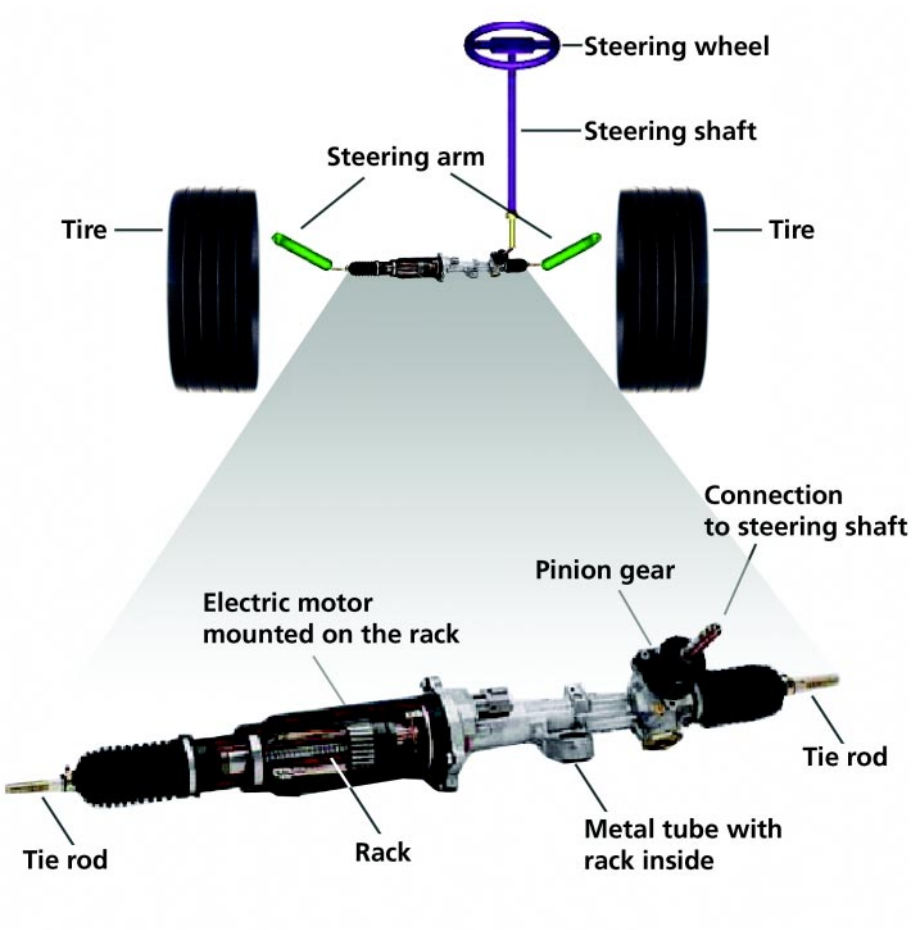
Normally, steering power is supplied by a hydraulic pump driven by a motor. With EPS, an electric motor, mounted on the rack, provides the driver with power assisted steering. Sensors on the steering wheel tell a control system where the driver is steering, and the electric motor provides steering power accordingly.

Modeling and Offline Simulation

First of all, we designed the new control functions in a block diagram using the modeling tool MATLAB/Simulink. We then converted the Simulink model into a TargetLink model, a simple process involving only a few mouse-clicks. This allowed us to add production code information to the Simulink model like scaling for fixed-point variables or variable classes. In addition, offline simulation was performed to check for possible computation overflows during floating-point simulation and to analyze the effect due to quantization errors during fixed-point simulation. TargetLink performed these tasks effectively.

TargetLink for the Application

The application part is coded by TargetLink, whereas the hardware related parts are generally handcoded. We clearly separated the application part from the hardware part, which enabled us to develop both ECU programs concurrently with application engineers (control algorithms) and software engineers (I/O and OS). The automatically generated application code was delivered to



The components of electric power steering.

The Principle of EPS

EPS is a system which generates steering power by means of an electric motor. It is a form of direct electric steering where no hydraulic pump is necessary. An electric motor is mounted directly on the rack to provide the driver with the power assisted steering.

The illustration shows that this EPS is based on a rack-and-pinion steering system.

This rack-and-pinion gearset is enclosed in a metal tube, with each end of the rack protruding from the tube. A tie rod is connected to each end of the rack.

When the driver turns his steering wheel, the steering shaft, which is attached to the pinion gear, turns the pinion, thus moving the rack.

The rotational motion of the steering wheel is converted into a linear motion.

The electric motor, which is controlled by an ECU assists the driver with an additional force at the linear motion part, thanks to the direct mounting on the rack.

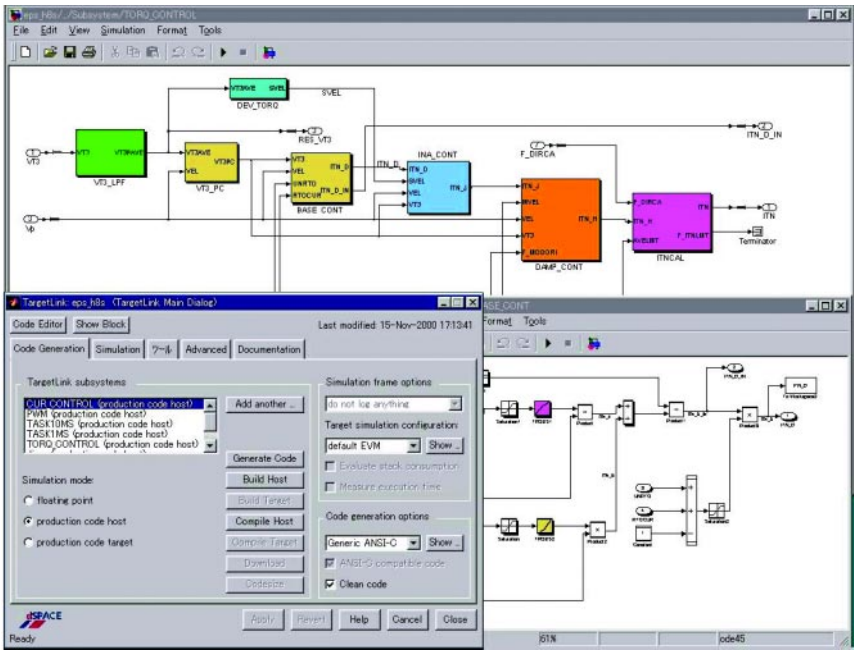
the software engineer, who compiled, linked and implemented it. We finished this work in only 2 months. This confirmed that TargetLink dramatically shortens the time required for the implementation process including documentation, coding and debugging.

Highly Reliable Code

We verified the proper behavior of automatically generated code by performing offline fixed-point simulation (production code host simulation). This provided us with time histories of input/output data to and from the control algorithm. The behavior of the test ECU was identical to the one we obtained by fixed-point simulation, which was a result of the highly reliable code generated by TargetLink.

Convincing Execution Speed

We tested the performance of the generated code on two types of target processors, a 32-bit RISC CPU and a 16-bit CPU, supplied by Hitachi. Because the sampling period of the EPS plant was very short, in the order of a few hundred microseconds, the requirements for execution speed were very strict. The fixed-point simulation mode (production code target simulation) showed that 32-bit microprocessors fulfilled the requirements for both execution speed and code size. This convinced us that the generated code is at the level required for implementation on the production-type ECU. By slightly optimizing the Simulink model, we would have got similar results even on the 16-bit CPU.



TargetLink block diagram.

A Perfect Solution

We achieved considerable improvements in development efficiency by applying TargetLink. The evaluation of TargetLink convinced us that TargetLink has completely solved the technical problems of automatic code generation and meets industrial needs perfectly.

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