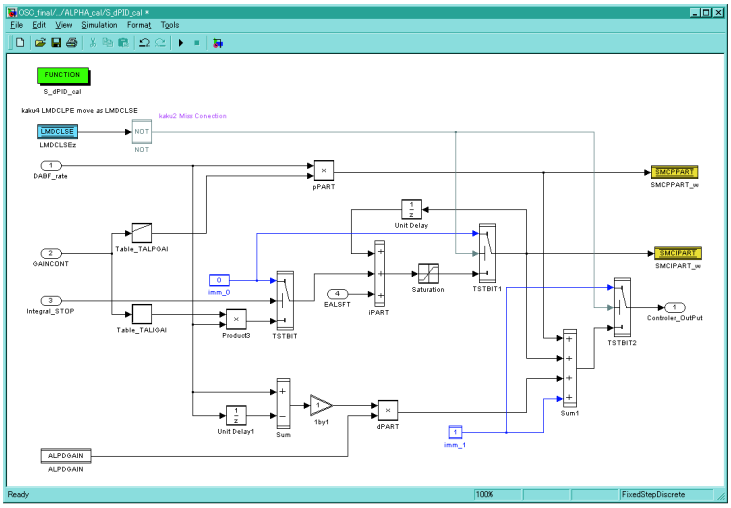
TargetLink Comes off the Assembly Line

CUSTOMERS

- **Air/Fuel controller implemented with TargetLink**
- **Dramatically improved development time**
- **First P-ZEV compliant car on the market**

Reducing vehicle emission levels has become a big issue in recent years. For example, in California, USA, the strict Partial-Zero Emission Vehicles (P-ZEV) standard was introduced. The Nissan 2000MY Sentra CA is the first car ever in series production to achieve the P-ZEV requirements. Having chosen TargetLink for code generation, we shortened the development time down to 60% for the air/fuel controller.



Excerpt of the air/fuel controller.

Design Concept

To achieve the required emission levels, we developed a new air/fuel ratio controller along with an efficient catalytic converter. The cleaning effect is activated in a very narrow range of air/fuel ratio around stoichiometrics (see page 5). Enhanced catalytic performance is usually obtained by dedicated feedback control of the air/fuel ratio with a corresponding exhaust gas oxygen sensor. Problems in increasing the catalytic converter's performance were caused by the time delay in the feedback loop. Therefore, the new air/fuel ratio controller adapted on the Sentra CA has an observer. This constantly monitors the state of the catalytic converter. The observer's output is used in a feed-forward control to adjust the air/fuel ratio. This new air/fuel controller always gets the maximum performance out of the catalytic converter.

Engine and catalytic converter to achieve P-ZEV compliance.

The Primary Tool of Choice

We planned the Sentra CA project to be accomplished in minimum development time. Our goal was to get a car with P-ZEV compliance to our customers as soon as possible. Our main hurdle was how to transfer designed Simulink models to production code. The conversion task of transferring the Simulink model into executable C code is always difficult. And handcoding is time-consuming and error-prone. The required tool for this process is an automatic code generator for production type ECUs. After investigating different automatic code generation tools, we decided to go for dSPACE's beta version of TargetLink. We based our decision on TargetLink's main features:

- Efficient code generation
- Entirely integrated into Simulink environment
- Functional user interface
- Highly readable code
- High reliability of generated code
- Configurable to Nissan's development environment

Papers

By Infineon and dSPACE
G.Amato, L. Köster:
"High Performance Code Generation for Audo, an Automotive MicroController from Infineon Technologies"
Info 05

By dSPACE
P. Bechberger:
"Modellbasierte Softwareentwicklung für Steuergeräte"
Info 06

Keyword:
Stoichiometric Combustion
Stoichiometric or Theoretical Combustion is the ideal combustion process during which a fuel is burned completely. A complete combustion is a process which burns all the carbon (C) to CO_2, all hydrogen (H) to H_2O and all sulfur (S) to SO_2. If there are unburned components in the exhaust gas such as C, H_2 and CO the combustion process is incomplete.

TargetLink closes the gap between the Simulink specification and corresponding production code. With TargetLink we shortened the development time despite the software training necessary to become familiar with the tool. In fact it took just three months to create the new controller. Just in time to unveil the car at the North American International Auto Show in Detroit in January 2000. And we succeded in making the Nissan Sentra CA rapidly available to our customers.

The Prospects

Due to the enormous time saving effects, we are planning to apply the innovative control development process to other advanced projects with an increasing number and size of the models. We will customize TargetLink and fully integrate it into our development environment.

Engine management controller.

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