

Modeling and Implementation of Multirate Control Applications with TargetLink

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Abstract

The software development for embedded systems is increasingly being done with the help of simulation tools and block diagram specifications. MATLAB, Simulink, and Stateflow are well accepted products in this area [Ma00]. Production code generators like TargetLink [Ds00] are used to turn such graphical specifications of real-time control algorithms into a highly efficient, readable and reliable C code that fits into an Electronic Control Unit (ECU).

When this technique was first introduced, users started with pilot projects to gain experience with automatic code generation. The model covered only relatively small parts (features) of the whole control system, for example, the idle speed control of an engine. Typically, there was only a single sample rate, and the code was generated for each operating system task separately. The users had to integrate the auto-generated code into the existing real-time kernel on their ECUs manually.

This contribution presents the TargetLink approach to the modeling and implementation of multirate Simulink models [KST01]: The function developer creates a Simulink/Stateflow model containing all the features that have to be implemented. This model concentrates on the control algorithms; implementation aspects are not taken into account. In the next step the control algorithms have to be implemented. The functional model is automatically converted into a TargetLink implementation model. This conversion process is bidirectional. TargetLink provides a special block set for the specification of implementation aspects. The software engineer can make all the settings for the implementation within the blocks. Finally, production-ready code including the RTOS configuration for the OSEK [Os00] real-time operating system family is automatically generated out of the TargetLink implementation model.

The presented approach is based on quasi-standards in the automotive industry (i.e., Simulink, OSEK, C). The Simulink block diagram as the modeling basis holds all the necessary information from top-level function development down to the ECU implementation, providing a system specification that is executable in all development phases. Task separation and inter-task communication can be specified with the help of special blocks for operating system support. This allows full integration of the OSEK configuration tools and the Simulink/TargetLink model.

Bibliography

- [Ds00] TargetLink Production Code Generation Guide. dSPACE GmbH, Paderborn, 2000.
- [KST01] Köster, L.; Stracke, R.; Thomsen, T.: Connecting Simulink to OSEK: Automatic Code Generation for Real-Time Operating Systems with TargetLink. In: (Mueller, A.F. Hrsg.): Proc. SAE 2001 World Congress, Detroit, 2001.
- [Ma00] Using Simulink Version 4. The MathWorks Inc., 2000.
- [Os00] OSEK Specification Vs. 2.1. <http://www-iiit.etec.uni-karlsruhe.de/~osek/>. 2000.