As the crow flies – Model to Implementation via Automatic Production Code Generation

aka SLX2C – State-of-the-Art from Model to Embedded Code

Michael Fröstl
Pilot Engineering, Production Code Generation
MathWorks

http://www.mathworks.de/embedded-code-generation/
switch(braindump)
{

case 'Applications':
A Toyota engine.

The USS Makin Island.

Van Helvoort (left) and van Bakel with a Philips Healthcare MRI scanner.

The HB-SIA aircraft on a test flight over San Francisco Bay. Photo © Solar Impulse | Revillard | Rezo.ch

The AirSonea device, which connects to an asthma patient’s smartphone ...

Alstom Grid’s HVDC demonstrator system with power converter modules.

Sonova’s hearing aid and cochlear implant solutions.

The IRIS observatory.

http://www.mathworks.com/company/user_stories
case 'Programming':
case 'Hardware':
case ‘Operating Systems’:
Green Hills® Integrity RTOS
Texas Instruments™ DSP/BIOS™
OSEK-OS
Embedded Linux®
QNX® Neutrino® RTOS
Android™
Wind River® VxWorks®
Microsoft® Windows Embedded
case ‘Standards’:
AUTOSAR

MISRA AC AGC

DO-178B/C

IEC 61508

EN 50128

ISO 26262
default:
    printf("Wrong session?");
}
MBD_Overview();
TEST & VERIFICATION

INTEGRATION

ANALYSIS • SPECIFICATION • DESIGN

Model

Architecture
Constraints
Environment

Physical Components
Algorithms

RESEARCH ACTIVITIES

REQUIREMENT DOCUMENTS

TEST & VERIFICATION

Implementation

C, C++
VHDL, Verilog
Structured Text

MCU
DSP
FPGA
ASIC
PLC
PAC

TEST & VERIFICATION

Physical Modelling mit Simscape

Standardkonforme Absicherung mit Model-Based Design

MATLAB für FPGA Design und ASIC Prototyping

Rapid Prototyping und HiL-Simulation mit Simulink Real-Time

Mit Polyspace die Qualität des generierten und handgeschriebenen Codes effektiv verbessern
switch(topics)
{

}
case ‘Code Generation – Top 5’:

- with slope and bias encoding scheme: $V = 1*Q + 1$
IP Protection
Password Protected Models

Protect design IP for models and generated code

- Support options
  - Simulation: Allow Accelerator mode simulation
  - Code generation: Include obfuscated code to support code generation
  - (New in R2013b) Read-only view: Web view of model
  - (New in R2013b) Password protection: Access protected by password
AUTOSAR Roundtrip
Update and merge AUTOSAR authoring tool changes into Simulink models for iterative round-trip workflows

- `updateModel` method automates ARXML import and merge
  - Simulink model
  - Workspace variables
  - AUTOSAR configuration

- Generates report of changes with hyperlinks to model

- Identifies changes left for user
RAM Optimization
Average Global RAM & Unnecessary Data Copy Reduction Since R2008b (Using 70+ Industry Models)

**Global RAM Usage**

86% 88% 90% 92% 94% 96% 98% 100%

Relative to R2008b

8b 9a 9b 10a 10b 11a 11b 12a 12b 13a 13b

**Data Copy Measurement**

70.00% 75.00% 80.00% 85.00% 90.00% 95.00% 100.00%

8b 9a 9b 10a 10b 11a 11b 12a 12b 13a 13b
Simulink Data Dictionary
Code Generation for Simulink Data Dictionary

Manage data outside of base workspace

- Componentization
- Scalability and performance
- Change tracking and differencing
- Integration with Simulink Projects
- Code generation
case ‘Targets’:
Connect MATLAB and Simulink to Hardware

Connect MATLAB® and Simulink® to hardware platforms for project-based learning, signal processing, computer vision, communications, data acquisition, instrument control, embedded systems, and more. Use low-cost hardware platforms like Arduino® and Raspberry Pi™, embedded systems like ARM® and Zynq®-based architectures, or high-end systems for real-time testing. Find the right solution to help you prototype and implement your applications with MATLAB and Simulink.

Search Hardware Support from MATLAB and Simulink

Explore supported hardware by:

- **Vendors**
  - Select vendor –

- **Applications**
  - Select application –

- **Product Families & Products**
  - Select product or family –

Or enter a keyword:

Search Hardware Support
Training Services

Developing Embedded Targets
Advisory Service
case 'Getting FREEd':
Embedded Coder Support Package for Freescale FRDM-KL25Z Board

- Integration of the GNU-ARM Toolchain
- Automatically:
  1. Generates C code
  2. Compiles code
  3. Loads binary to hardware
- Now available via Support Package Installer
“Go Green” – Getting Started

Blink a LED
- Create a new Model
- Set it up for the Freescale Target
- Add Blocks (incl. I/O)
- Generate code
- Deploy to the hardware
default:
  printf(“Brain up-to-date!”);
}