Model to Code, Made Simple and Easy
Challenges to bring an idea into real hardware

Manager

People

Specifications
Schematics
Diagrams
Algorithms
...

Software Developers

Hardware Engineers

Mechanical Engineers

Tools? Investments? ROI?
switch(idea)
{

case 'Applications':
Philips Healthcare MRI scanner

AirSonea device, which connects to a patient's smartphone

Toyota engine

The HB-SIA aircraft on a test flight over San Francisco Bay

Sonova’s hearing aid and cochlear implant solutions

Alstom Grid’s HVDC demonstrator system with power converter modules

http://nl.mathworks.com/company/user_stories/
case 'Programming':
case 'Hardware':
case ‘Operating Systems’:
case ‘Standards’:
STANDARDS

AUTOSAR  MISRA AC AGC

DO-178B/C  IEC 61508

EN 50128  ISO 26262
default:
    printf("Wrong session?");
}
MBD_Overview();
IMPLEMENTATION

MCU

DSP

FPGA

ASIC

Structured
Text

VHDL, Verilog

C, C++

Architecture

Algorithms

Schematics

Environment

Constraints

Physical Domains

TEST & VERIFICATION

TEST CASES

ANALYSIS – SPECIFICATION – DESIGN

MODEL

RESEARCH ACTIVITIES

REQUIREMENTS DOCUMENTS

INTEGRATION

TEST CASES

TEST CASES

MCU

DSP

FPGA

ASIC

PLC

PAC

Structured
Text

VHDL, Verilog

C, C++

Architecture

Algorithms

Schematics

Environment

Constraints

Physical Domains

Research Activities

Requirements Documents

Analysis – Specification – Design

Model

Implementation

Integration

Test & Verification

Test Cases
Model2Code();
function [symbols, weights] = gainctrl(rxsig, train)
% 1-tap adaptive equalizer using LMS or RLS algorithm

% Equalizer settings
lambda = 0.99;
Delta = 0.1+0i;
weights = 0+0i;

for n = 1:length(rxsig)
    u = rxsig(n); % received sample
    y = conj(weights) * u;
    if n==length(train)
        d = train(n);
    else
        d = detect(real(y)) + 1j*detect(imag(y));
    end
% Single-tap RLS
Delta = 1/(lambda/Delta + u*conj(u));
G = Delta * u;
e = d - y; % symbol estimation error
weights = weights + G*conj(e);
symbols(n) = y;
end

MATLAB

Simulink

Stateflow
function [symbols, weights] = gainctrl(rxSig, train)
% l-tap adaptive equalizer using LMS or RLS algorithm

% Equalizer settings
lambda = 0.99;
Delta = 0.1+0i;
weights = 0+0i;

for n = 1:length(rxSig);
    u = rxSig(n);
    y = conj(weights(n));
    if n==length(train);
        d = train(n);
    else
        d = detect(real(y)) + 1j*detect(img(y));
    end
    % Single-tap RLS
    Delta = 1/(lambda/Delta + u*conj(u));
    G = Delta * u;
    e = d - y; % symbol estimation
    weights = weights + G*conj(e);
    symbols(n) = y;
end
case ‘Code Generation – Top 5’:
In-the-Loop Verification Methodologies
Software- and Processor- in-the-Loop
SIL and PIL

Non-Real-Time Synchronization with Host at Each Time Step

Execution History
- Logged signal results comparison
- Code coverage
- Execution timing
Hardware-in-the-Loop
HIL, Rapid Prototyping

Logging and Tuning via Host

Hard Real-Time Execution
FPGA-in-the-Loop
FIL, Test Bench Simulation
Incremental Build Process
Incremental Build Process

- Significantly saves time
- Only build blocks that have changed
- Helps with partitioning and componentization
- Scalability!
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
Profiling of Generated Code
Measure Execution Time

Identify hot spots, worst-case execution

- Supports
  - SIL and PIL
  - Tasks and functions
  - HTML reports
Intellectual Property Protection
Password Protected Models

Protect design IP for models and generated code

- Support options
  - Simulation: Allow Accelerator mode
  - Code generation: Include obfuscated code to support code generation
  - Read-only view: Web view of model
  - Password protection: Access protected by password
case 'Targets':
Hardware Support Packages

- HW Support Packages are:
  - Downloadable from MathWorks websites
  - Available for free with required base product
  - Supported by technical support

- HW Support Package manages:
  - Licenses
  - 3rd-party software installation
  - Hardware setup
Services

- Automate compile, build, and download
- Integrate device drivers and RTOS with Simulink
- Optimize code replacements to your target
- Verify and validate code execution results

Developing Embedded Targets
Advisory Service

http://nl.mathworks.com/services/consulting/proven-solutions/developing-embedded-targets.html
case 'Getting FREEd':
}
Programming an heterogeneous system

Zynq Platform

This example shows how to use HDL Coder to generate a custom IP core which perform Sobel edge detection processing on streaming video.

In MATLAB, type the following:
```matlab
hdlsim('hdkcoder_sobel_video/Sobel_IP')
```