Model-based development and commissioning on industrial assets

SIEMENS
Ingenuity for life

siemens.com

Model-based development and commissioning on industrial assets

SIEMENS
Ingenuity for life

Speaker Introduction

- Lead Research Engineer
- Systems Modelling And Analog Electronics Group
- Corporate Technology, Siemens
- Expertise in systems modelling and analog electronics to design sensing systems with unparalleled precision, low power operation, and wide range of connectivity options.

Hardik Shukla /CT REE ELM SAE-IN

Model-based development and commissioning on industrial assets

SIEMENS
Ingenuity for life

Example – Conveyor Belts for coal mining

Images adapted from https://new.siemens.com/global/en/markets/mining-industry/transport/conveyor-systems.html

Hardik Shukla /CT REE ELM SAE-IN

Model-based development and commissioning on industrial assets

SIEMENS
Ingenuity for life

Example – Conveyor Belts for coal mining

1 1370 mm wide belt

2 3.8 KW synchronous motors

3 Gearless drive system

Hardik Shukla /CT REE ELM SAE-IN

Model-based development and commissioning on industrial assets

Example - Cranes

1 Dynamic setpoint

2 Sway control

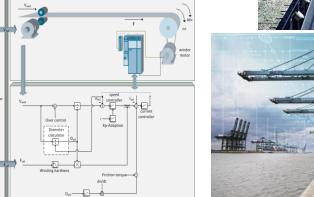Image adapted from https://new.siemens.com/global/en/markets/cranes.html

Hardik Shukla /CT REE ELM SAE-IN

SIEMENS
Ingenuity for life

Model-based development and commissioning on industrial assets

Example - Winder

1 Indirect tension control

2 Pre control torque setpoints

Image adapted from https://support.industry.siemens.com/cs/attachments/38043750/38043750_DCC_Winder_en_V4_3_1.pdf

Hardik Shukla /CT REE ELM SAE-IN

Model-based development and commissioning on industrial assets

SIEMENS
Ingenuity for life

Onsite commissioning

Why do we need it?

- Customer product installation
- Setup up operating conditions like speed torque set points
- Setup engineering/commissioning tools for system monitoring

Drawbacks

- Undetected errors can cause expensive mistake
- System optimizing can cause downtime

Model-based development and commissioning on industrial assets
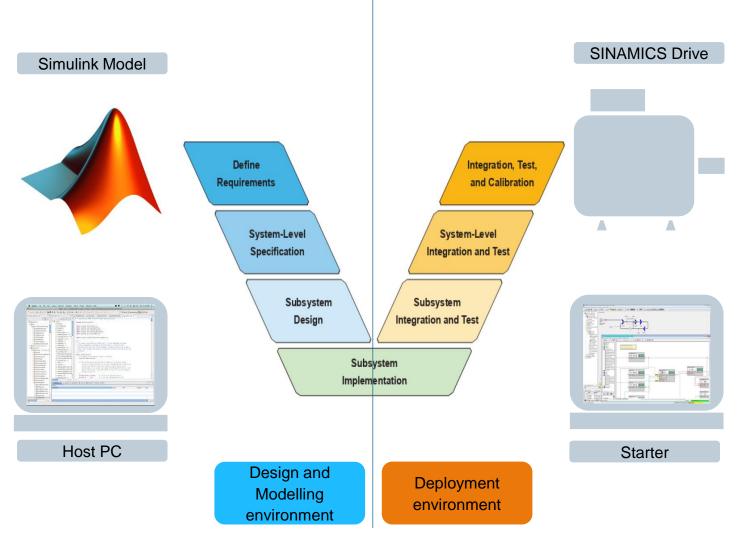
SIEMENS

Ingenuity for life

Motivation

- Industrial assets in a typical plant scenarios are modelled and simulated in Simulink to evaluate control and process timings and tuning.

- Deployment and tuning with the plant dynamics is generally performed outside of Simulink using engineering and commissioning tools that integrate with the process communication.

- This restricts the design tools such as Simulink to perform parameter sweeps, optimization and in general breaks the model-based-development philosophy

- With MathWorks support, we have achieved code-generation for industrial asset targets for Siemens' SINAMICS drives. Users are now able to generate model blocks and deploy them directly to commissioning tools.

Hardik Shukla /CT REE ELM SAE-IN

Commissioning Matlab models onto industrial assets

SIEMENS

Ingenuity for life

Simulink Model

SINAMICS Drive

Define Requirements

System-Level Specification

Subsystem Design

Integration, Test, and Calibration

System-Level Integration and Test

Subsystem Integration and Test

Subsystem Implementation

Host PC

Starter

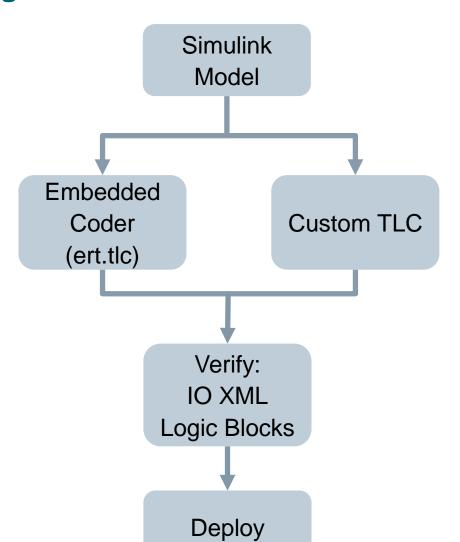Design and Modelling environment

Deployment environment

Model compatibility between Simulink and Commissioning tools

To ensure model compatibility between the two worlds:

- Making **representation compatible** between Matlab and Starter tool

- Making **logic compatible** between host PC and Sinamics drive

- External target simulation and communication for **V&V**

V model image source: Simulink Model Management And Architecture, Mathworks training – 8/20/2020
MathWorks logo: Property of MathWorks

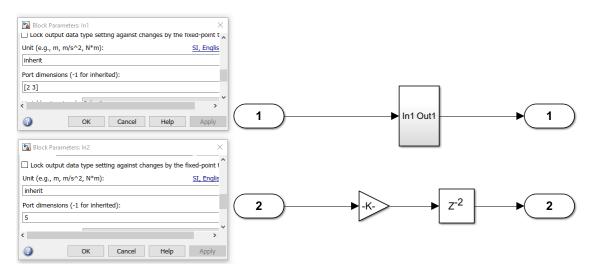Hardik Shukla /CT REE ELM SAE-IN

Target specific code generation

```
          ┌─────────────┐
          │  Simulink   │
          │   Model     │
          └──────┬──────┘
                 │
        ┌────────┴────────┐
        ▼                 ▼
  ┌───────────┐    ┌─────────────┐
  │ Embedded  │    │             │
  │  Coder    │    │ Custom TLC  │
  │ (ert.tlc) │    │             │
  └─────┬─────┘    └──────┬──────┘
        └────────┬────────┘
                 ▼
          ┌─────────────┐
          │   Verify:   │
          │   IO XML    │
          │ Logic Blocks│
          └──────┬──────┘
                 ▼
          ┌─────────────┐
          │   Deploy    │
          └─────────────┘
```

Hardik Shukla /CT REE ELM SAE-IN

Target specific code generation

Coder Descriptor

- Well documented APIs
- Debugging as Matlab functions
- Vector/Matrix IO pins translating directly to target block pins IO pins in code generation
- Tunable Parameters for on-the fly tuning

Target specific code generation

IO compatibility

XML:

```
<PIN Name="IN1_0" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN1_1" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN1_2" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN1_3" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN1_4" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN1_5" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN2_0" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN2_1" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN2_2" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN2_3" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="IN2_4" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="GAIN_P" DataType="REAL" Direction="DIRECTION_IN" Display="DEC"> <ValidValues DefaultValue="2"/></PIN>
<PIN Name="OUT1_0" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT1_1" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT1_2" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT1_3" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT1_4" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT1_5" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT2_0" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT2_1" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT2_2" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT2_3" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
<PIN Name="OUT2_4" DataType="REAL" Direction="DIRECTION_OUT" Display="DEC"> <ValidValues DefaultValue="0"/></PIN>
```

Model-based development and commissioning on industrial assets

SIEMENS
Ingenuity for life

Conclusion

- Model-based design paradigm
- From system modelling in Matlab to deployment on drives
- Automated code generation for custom targets
- Deployable drive blocks

Disclaimer

SIEMENS
Ingenuity for life

© Siemens 2020

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

All product designations may be trademarks or other rights of Siemens AG, its affiliated companies or other companies whose use by third parties for their own purposes could violate the rights of the respective owner.

Hardik Shukla /CT REE ELM SAE-IN

Thank You

SIEMENS
Ingenuity for life

Hardik Shukla
Lead Research Engineer
105 Hosur Road

Bangalore – 560100

Phone: +91-9825971461

E-mail:
hardik.shukla@siemens.com

siemens.com