

Model Based Design

sT-Embed Training

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Topics:

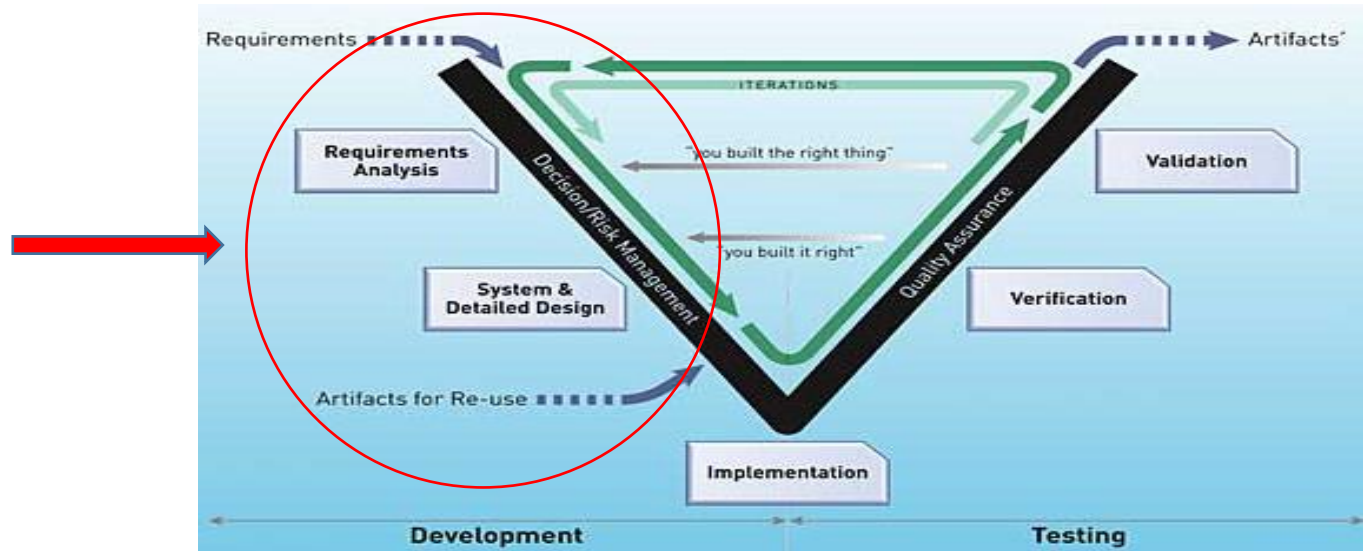
- V Model for software development
- How sT-Embed is used for MBD
- MBD Video – Furuta Inverted Pendulum
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What is Model Based Design (MBD)

MBD is a methodology for requirement verification using **dynamic models**, **automatic code generation**, embedded systems (**PIL** = Processor In the Loop), and physical components (**HIL** = Hardware In the Loop). It provides engineers the ability to continuously and fully test designs as they evolve.

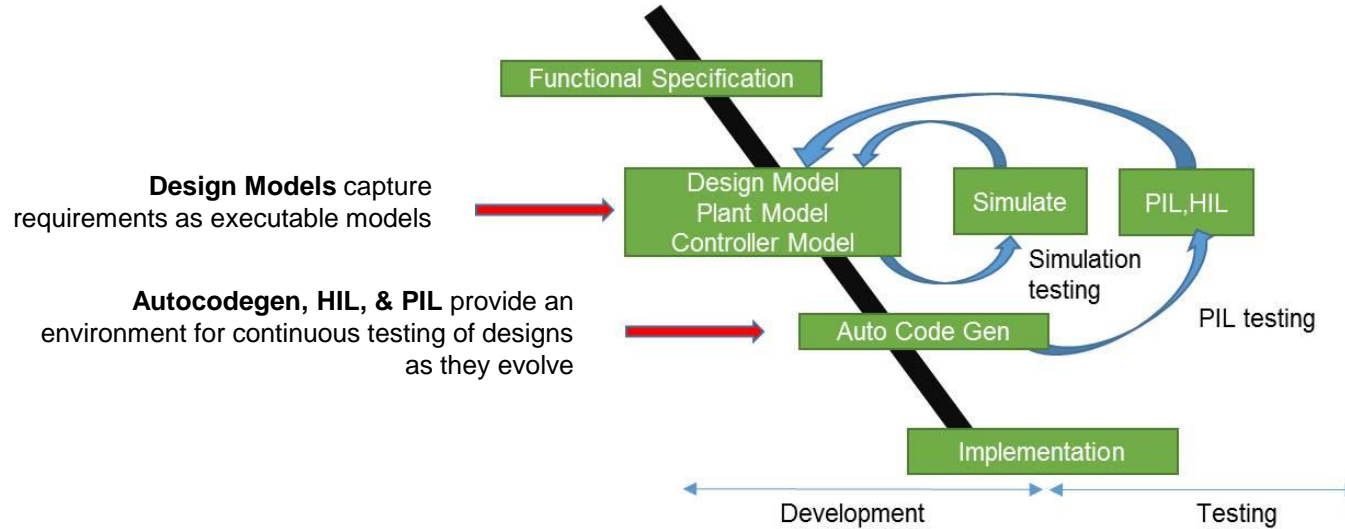
V Model for Verification & Validation

MBD is implemented in the “Development” phase of the V Model before the “Implementation” phase



MBD Key Features in V Model

Model Based Design in V Model – Development Phase



- Requirements are fully tested during the Development Phase reducing escapes & rework.
- Requirement changes can be addressed sooner reducing Test Phase time & cost

MBD: Test Early, Fail Early, Fix Early

MBD Steps

MBD is a four step process:

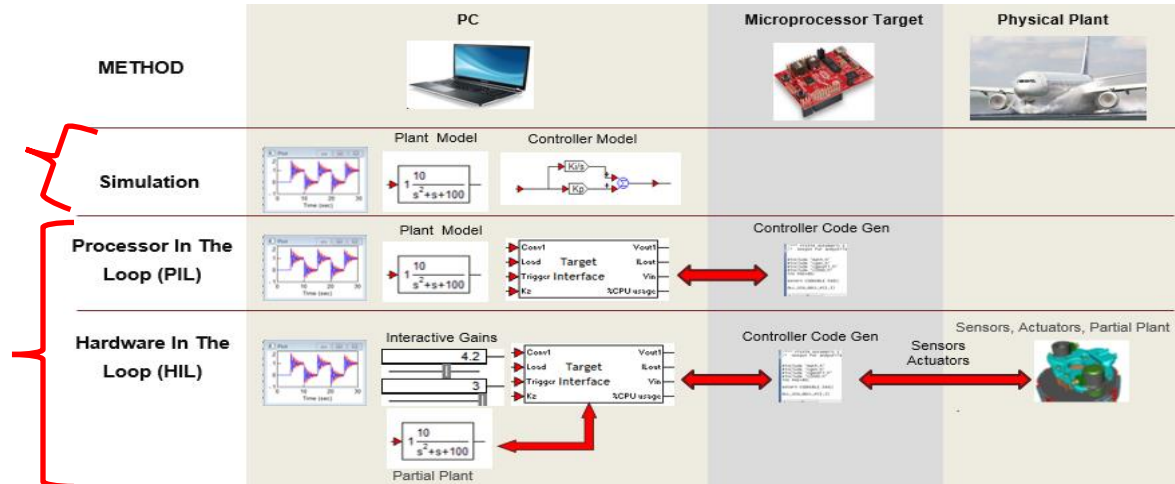
1. **Design Model:** Functional Specifications are converted into a block diagram based Design Model that can be simulated.
2. **Plant Modeling & Simulation:** The system to be controlled (Plant) is modeled and simulated.

3. **Control System Design & Simulation:**

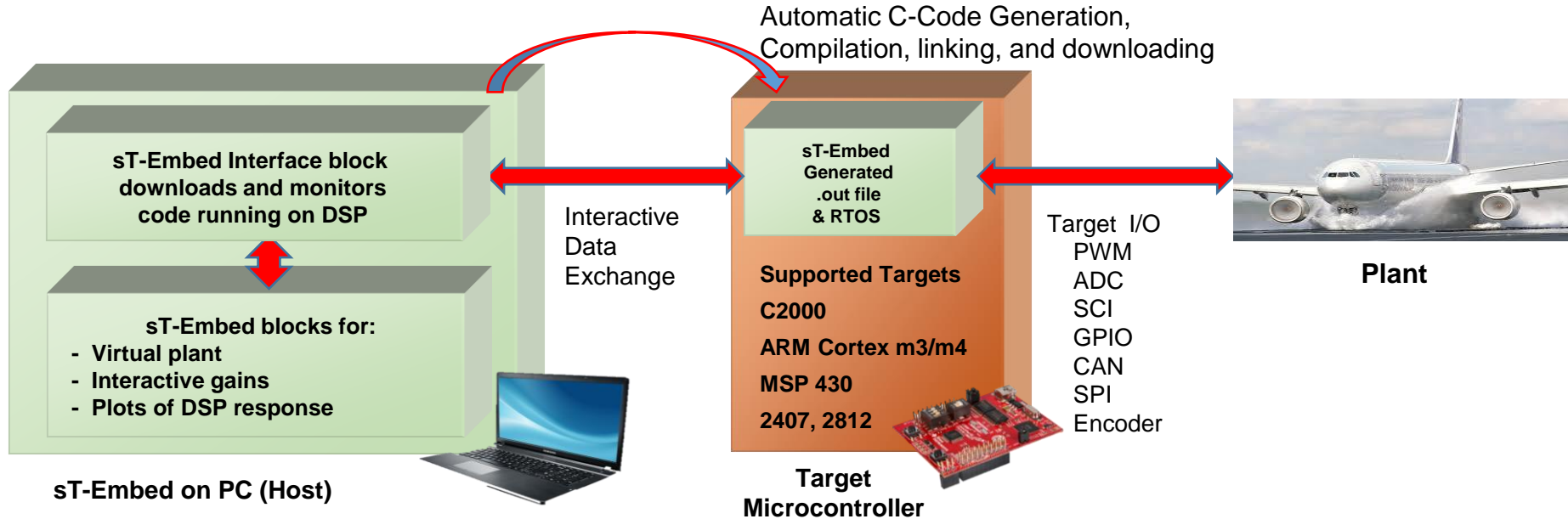
The controller is designed, analyzed, and simulated in closed loop with the Plant Model until performance agrees with Design Model.

4. **Deployment:**

Controller Model autocode is generated and executed on the target processor with (a) PIL using entire Plant Model and/or (b) HIL using components of the Plant Model replaced with physical components.



sT-Embed – MBD Support Features



sT-Embed supports the entire MBD process:

- Automatic efficient C Code Generation from block diagram models
- Compile, Link, Download, & Execute C Code on target microcontroller in 3 easy steps.
- Real Time Operating System allowing control and background threads
- Interactive data exchange between the Target & PC Host at the target execution rate.
- Full support for Texas Instruments C2000 microcontroller family and others

[MBD Video Example – Inverted Furuta Pendulum](#)

sT-Embed – MBD Product Differentiators

Key Product Differentiators:

- **Automatic Code Generation** – efficient to within 4% hand coded size & speed to accommodate processor memory limitations.
- **Multi-Threaded Models** – The sT-Embed Real Time Operating System (RTOS) provides the ability to partition your model into multiple threads of operation;
 - “**Main control threads**” (low jitter) for time sensitive control tasks
 - “**Background threads**” for tasks that can be preempted such as display, data export, dynamic user inputs.
- **HIL & PIL Deployment** – 100% peripheral support for the Texas Instrument Launchpad families of microcontrollers (C2000, MSP430, ARM Cortex M3/M4) and add-on board, Host codegen for DLL or .exe, foreign RTOS codegen (without peripheral support) for any microcontroller.
- **High speed target data collection** - (15-100+KHz) from the target to the Host using the “Monitor Buffer” to capture high speed signals. Data can be displayed in sT-Embed Plot blocks or exported to data files.
- **Interactive real time control** – Use sliders and other signal producers to dynamically control the behavior of the target from the Host at frequencies up to 100Hz+.

HyperLink to Requirements

“Labels” (“Blocks/Annotation”) can be used to link parts of a sT-Embed model to sections of a Word document. The following procedure is used:

1. Open Word document.
2. Do File > Save, if it has not been saved.
3. Highlight some text in Word document and click the Edit > Copy command.
4. Go to sT-Embed.
5. Right click on Label block.
6. Activate the Hyperlink button
7. Click the Paste Hyperlink button.
8. The text you highlighted in Word is automatically inserted in the Label text block. The URL to the Word document is automatically inserted in the Link To File or URL box. The exact location of the highlighted text is inserted into the Named Location in File text box. *(Do not edit the text in the Named Location in File text box, at least not yet. There may be a bug that causes sT-Embed to “not respond.” Do not tell customers. Support will look at this and fix it.)*
9. Click OK button.
10. Click the sT-Embed File > Save command.

Now, you can click on the Label URL and the Word document will open

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