Synergy of UML and Simulink

Agenda

- Why should we think about multiple tools?
- Requirements or how to choose the right tool?
- Examples for synergetic application of UML and Simulink
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Complexity facts

- A Peugeot 607 contains more software than an AIRBUS A310 from 1982
- A luxury vehicle is controlled by up to 80 electronic control units
- Each of them is more powerful than the controller inside Apollo 11 on its way to the moon

Technological tendencies

- Growth of communication and networking functions and their influence, e.g. message based systems
- (Dynamically) distributed functions
- Operating systems with management functionality
- Encapsulated, parallel tasks on one ECU
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Hybrid?

- Discrete time, distributed systems
- Continuous time physics and control, signal flows

The System Engineers View

- Hybrid character of the actual system

Requirements

- Goal definition:
  - Consistent, traceable, measurable specifications
  - Early definition of quality goals and tests

- Support of the individual views of all process roles

- Organizational: OEM, Supplier, Authorities

- Process: Customer, Specification engineer, Developer, Tester, Quality assurance

- Efficient experimentation and target implementation environment
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BMW Principle

- Beschreibungmittel (Means of description)
- Methode (Method)
  - How to apply the means of description?
- Werkzeug (Tool)
  - Technical realization of means of description and method

Influencing Factors
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Solution: Divide and conquer

- System
  - Function vs. Topology
- Method
  - Support of staggered, distributed processes
- Tool & Notation

and their integration?

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Partitioning und Abstraction

Abstraction
- Reduction to the essentials
- Generalization
- Leads to simplification

Partitioning
- Grouping of objects to sub-systems
- Interfaces
- Different mechanisms that have to be applied together

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### Classification of coupling tools

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### Co-Simulation Principles

- Coordination
- Synchronization
- Communication
- Information

Distributed model
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**EXITE Framework**

- Tool A
- Tool B
- Tool C
- Tool D
- Tool E

EXITE backplane
CORBA/
MPI

Distributed model

**Flexible Experimentation Environment**

- Matlab/Simulink
- Plant
- Java / Altia
- HMI
- Control
- Dymola
- UML
- ...

Quelle: STEP-X Workshop, Braunschweig, 10.02.03

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Co-Simulation und Code integration

Simulink
- Plant model
  - Continuous Control
    - Discrete Control and Communication

Rhapsody in C

Real
- Plant
  - Embedded Controller
    - C-Code

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Integration platform
Both worlds (UML and Simulink) are necessary.

They can be used together leveraging strength from both sides.

Real-world application depends on processes and actual conditions. Long term strength requires also separations of concern when it comes to the definition of a tool chain.