A Catalog-based Platform for Integrated Development of Simulation Models

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Simulation Models in Systems Development

- Model Based Engineering: To handle complexity and reduce development costs and time of complex systems.

- Simulation can be used in the automotive domain to identify potentials for energy saving of electrical vehicles.

- Simulation Models can be reused and integrated as subsystems to develop complex system simulations supported by tool-automation.
  - TIL Suite from TLK-Thermo

(1) Purpose of model-based development in industry according to a survey by Liebel et al.

(2) Example: Heat transfer for thermal coupling of air and components in a vehicle cabin


Vision for an Industrial Value Chain: Model Supplier/Integrator relationship

Model Supplier B Platform

Model Integrator A Platform

Reuse of simulation models

Integrates subsystem

Integrates subsystem

uses subsystem

develops subsystem

develops simulation models

Developer A1 Workspace

Developer A2 Workspace

Developer B1 Workspace

Developer B2 Workspace

Toolframework

Toolframework
Outline

- Introduction
- Catalog based Platform Infrastructure
- Platform Services
- The Design of the Integrated Platform
- Conclusion
The Platform approach

- The platform on supplier/integrator site is used to manage simulation models as reusable components.

- Components can be reused as variants of series to ease the integration step at the integrator site.

- Problem: There is no common standard to describe the meta-data of components from different simulation model suppliers.

- System integrators have to cope with additional effort in the integration step.
  - Developers implement not reusable solutions (e.g., finding optimization parameters, interface-adapter, ...).
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Catalog based Platform Infrastructure

- A description language for modelling the structure of catalogs and system simulation models.
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Versions and Variants for a Managed Evolution

- Each catalog element can be assigned a version/interface information using the concept of metadata.

- Relations for a managed evolution
  - basedOn: Allows to derive variants sharing the features from the base component.
  - remove: A prototype from a rapid prototyping step is no longer a different variant.
  - successorOf: Further development of a component (e.g., bugfix).
  - assignedTo: To differentiate the component’s catalog’s origin.
  - replacedWith: A version is no longer supported.
Thumbnail based Search

- The view of this search service allows the developer to get the variants properties and their distribution within the series at a glance.

- The thumbnails of the view ease the comparison of variants from different series using tag clouds, which are generated from the meta-data.

- A cloud can form a group for variants with the same property…
  - … identifier
  - … unit

- The larger the font-size of a tag cloud, the more variants are found.
Other services

- **Refactoring**
  - A service for the automatic indication of changes in a catalog to developers
  - The automation supports the following cases
    - To replace a component, because it has a bug.
    - To improve an existing component.
    - To replace a component by another different component.

- **Modelinversion**
  - Allows fast solving of algebra-differential equation to calculate steady-state simulation results.
  - As an example to control the temperature to a certain operating range, an appropriate state of the simulation behaviour must be reachable.
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Design of the Integrated Platform

- Client, Server based architecture

- Services and Database side
  - EMF based technology for the implementation of the catalog infrastructure. Services are implemented in java *.jar.

- Workspace side
  - Is implemented as a graphical development environment based on eclipse libraries.
  - The catalogs and services can be accessed by the developer using the workspace.
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- Integrated Platform Design
- Conclusion
Conclusion

- The current state of practice in the integrator/supplier based development of simulation models requires great expertise and manual handling in the model integration step.

- We proposed a catalog platform designed to enable seamless and integrated development of simulation models.
  - The infrastructure of the platform is used for modelling and exchanging catalogs between integrators and suppliers.
  - Moreover, different services are provided by the platform to automate several development tasks

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