OpenModelica SimulationRuntime Interface - OMSI?

Status and Plans

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Motivation

Current issues

- Every development in the Backend require independent development in the Templates
- Differences in Backend and SimCode
- The Templates contain a lot of similar code
- No clear separation between model data and runtime data
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Goal: Specify a clear simulation model interface with a uniform data model.
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OMSI - OpenModelicaSimulationInterface or OSMI - OpenModelicaSimulationModelInterface? (see slide 20)
Current Concept

Overview

OMSI -> OpenModelicaSimulationInterface or OSMI -> OpenmodelicaSimulationModellInterface? (see slide 20)
Current Concept

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OMSI -&gt; OpenModelicaSimulationInterface or OSMI -&gt; OpenmodelicaSimulationModellInterface? (see slide 20)
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Current Concept

Overview

OMEdit → OMC

OMSU → OSMI

Solver Library
- Linear Solver
- Nonlinear Solver
- ...

Basically FMI for ModelExchange with some OM extensions

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OpenModelica Simulation Interface (OMSI)

- Unification of the C and C++ Runtime
- Simulation interfaces include functions for configuring, initializing and starting simulation
- Model interface for OpenModelica Simulation Unit (OMSU) code generation is based on FMI 2.0 ME
- Additional Interface for
  - Solver for algebraic loops
  - Efficient access to model variables
OMSI: Simulation and Model Exchange Interface

```
OMSI

Attributes
+ models : omsi_t[*]

Operations
+ omsi_initialize_model(omsi_t*) : omsi_status_t*
+ omsi_load_omsu(name : String, path : String) : omsi_t
+ omsi_setup_experiment(e : omsi_experiment_t*) : omsi_status_t*
+ omsi_start_simulation(name : String) : omsi_status_t*
```

OMSI.h

- Functions for:
  - Loading OMSU/FMU
  - Configuring simulation
  - Initializing simulation
  - Starting simulation
Current Concept

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OMSI

omsi_t

- Main interface of OMSI
- Contains data structures for model information and simulation data
OMSI: Simulation and Model Exchange Interface

omsi_experiment_t
- Holds information for simulation settings like
  - Start time
  - Selected ODE solver
  - Selected solver for algebraic loops
OMSI: Simulation and Model Exchange Interface

**Current Concept**

**OMSI**

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**omsi_model_data_t**

- Holds model information like
  - Number of states
  - Number of real model variables
  - Number of zero crossings
OMSI: Simulation and Model Exchange Interface

- **Attributes**
  - models : omsi_t[*]

- **Operations**
  - omsi_initialize_model(omsi_t*) : omsi_status_t*
  - omsi_load_omsu(name : String, path : String) : omsi_t
  - omsi_setup_experiment(e : omsi_experiment_t *) : omsi_status_t*
  - omsi_start_simulation(name : String) : omsi_status_t *

**omsi_simulation_data_t**
- Stores the simulation data like
  - Model variables
  - Model pre-variables
  - Zero crossing functions
  - Zero crossing conditions

- Holds systems for linear and non-linear agloops
OMSI: Simulation and Model Exchange Interface

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+ models : omsi_t[*]

**Operations**
+ omsi_initialize_model(omsi_t*) : omsi_status_t*
+ omsi_load_omsu(name : String, path : String) : omsi_t
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+ omsi_start_simulation(name : String) : omsi_status_t*

**Callback functions for solving algebraic loop systems**

- omsi_solver_cb
Current Concept
OMSI: Model Exchange based on FMI

[Modelname]omsu

- Generated by the omc omsu code generation
- Implements FMI2.0 ME functions
Current Concept
OMSI: Model Exchange based on FMI

- Interface functions called by omsu to implement FMI 2.0 functions.
- omsi_fmi2_me functions using simulation runtime functions.
Current Concept
OMSI: Model Exchange based on FMI

OMSI_fmi2_me

- Holds the omsi_fmi2_me_t data structure
  - Stores specific FMI 2.0 data
  - Points to the omsi_t main data structure
Current Concept
OMSI: Model Exchange based on FMI

Example for fmi2Instantiate call

Simulation environment

["Modelname"]OMSU

omsi_fmi2_me

oms_fmi2_instantiate

allocate runtime specific objects

omsi_model_initialze

omsi me initialize

fmi2Component

fmi2Instantiate

fmi2Component
OMSI: Solver Interface

**Current Concept**

**Attributes**
+ models : omsi_t[*]

**Operations**
+ omsi_initialize_model(omsi_t*) : omsi_status_t*
+ omsi_initialize() : omsi_status_t*
+ omsi_load_omsu(name : String, path : String) : omsi_t
+ omsi_register_linear_solver(library : String, solver_name : String) : omsi_status_t*
+ omsi_register_nonlinear_solver(library : String, solver_name : String) : omsi_status_t*
+ omsi_setup_experiment(e : omsi_experiment_t*) : omsi_status_t*
+ omsi_start_simulation(name : String) : omsi_status_t*

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**Linear and Nonlinear Solver**

- Possible to register own linear or nonlinear solver for solving linear and nonlinear algebraic loops
Example for register linear solver

Simulation Environment

omsi

omsi_register_linear_solver(path,name)

load shared linear solver library

omsi_setup_experiment

create

omsi_initialize

create

create
OMSI Model Interface:

- New omsu code generation is based on the fmi cpp code generation
- omsu code generation implements the `omsi_fmi2_me` interface
- Open tasks:
  - Connection to omsi_t data interface
  - Support for linear and nonlinear solver interface
OMSI Simulation Interface:

- Adapted cpp runtime for OMSI simulation interface
  - Separated in two components *omsi* and *runtime*
  - *omsi* using *runtime* to implement omsi functions
Summary

**General open tasks:**
- Adjust the SimCode and Template phase for the use of the OMSI data model
- Adjust the runtimes for OMSI simulation functions
- Build up general solver library
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New Simulation and Model Interface based on FMI 2.0 ME

- Reduction of maintenance work, since fewer Code Generators are needed.
- New feature developments can be shared more easily.
- Since the interface is based on FMI, it is easily possible to integrate the generated omc model code in other projects
Summary
OMSI | OSMI | something else?

Credit: xkcd.com
Questions

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Summary
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