3rd Annual OpenModelica Workshop Feb 7, 2011

Workshop Opening

OpenModelica – Status and Directions

Peter Fritzson

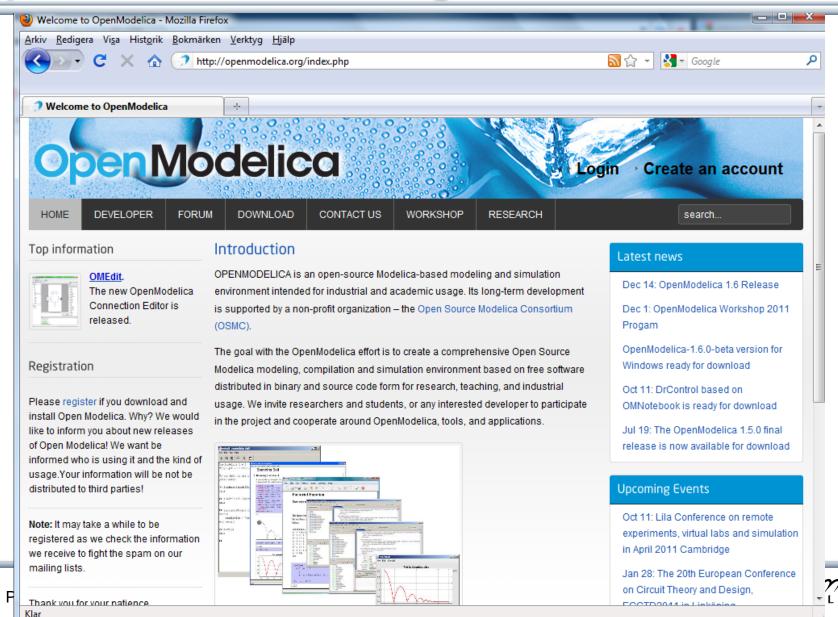# To All Participants!

Very Welcome to this
Third Annual OpenModelica Workshop!

MODELICA

Goals for the OpenModelica Effort

- Comprehensive **modeling, simulation and systems engineering** environment for research, teaching, and industrial usage

- **Open-source** for both **academic** and **industrial** usage

- Invitation for **open-source cooperation** around OpenModelica, tools, and applications
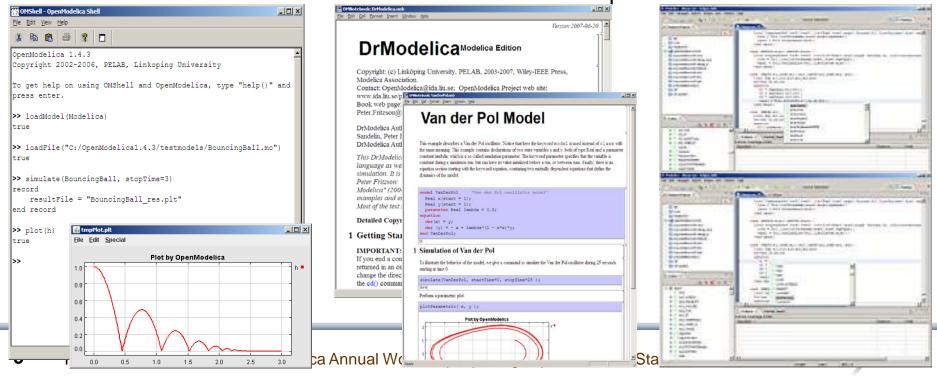
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OpenModelica Web Page

Current OpenModelica   www.openmodelica.org

- Advanced Interactive Modelica compiler (OMC)
  - Supports most of the Modelica Language

- Basic environment for creating models
  - OMShell – an interactive command handler   * ModelicaML UML Profile
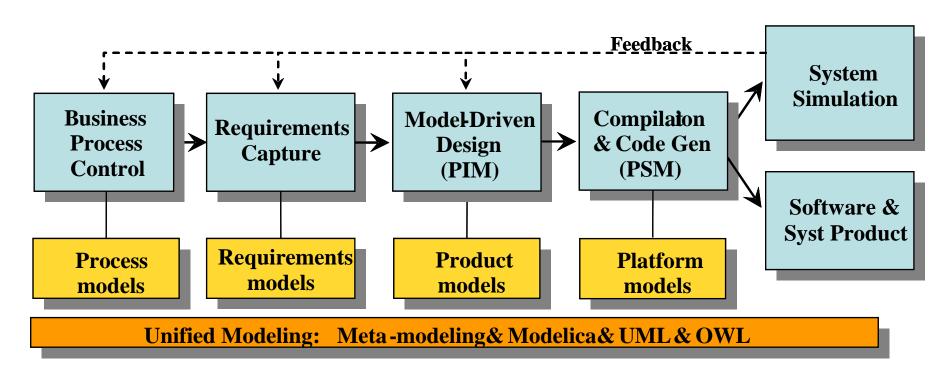 - OMNotebook – a literate programming notebook * MetaModelica transforms
  - MDT – an advanced textual environment in Eclipse

Expanded Vision for OpenModelica Effort: Integrated Model-driven Development Based on OpenModelica, e.g. in OPENPROD project

Vision of unified modeling framework for model-driven product development from platform independent models (PIM) to platform specific models (PSM)

Main Events 2010

Outlook for 2011

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Main Events 2010

- OSMC expanded from 28 to 32 organizational members

- Bylaws and license update to OSMC-PL 1.2 (1st vote Dec 7)

- OpenModelica **1.5 release** (July 2010)

  - Whole **MultiBody** library flattening and some simulation

  - Simple tearing in OMC backend (needed for efficient simulation)

  - New code generator based on template language.

  - ModelicaML state chart translator

- OpenModelica **1.6 release** (Dec 2010)

  - **Scalability**. **Factor 10-20** or more **speedup** in OMC compiler

  - Progress on Media/Fluid libraries

  - New event handling, symbolic Jacobians, in **modularized OMC backend**

  - **Stream connectors** implemented

  - Better support for **Modelica Standard Library 3.1**

  - New **OMEdit** graphic editor; DrControl teaching material.

OpenModelica – Outlook for 2011

- Spring 2011. Further improved **scalability** handling larger models.

- Feb/Mar -2011. **FMI** 1.0 export. Mar/Apr 2011. **FMI** 1.0 import

- February-March 2011. **Fluid/Media** library flattening support.

- Spring/Fall 2011. Improved **MultiBody** & **Fluid/Media simulation**

- Feb-March 2011. OpenModelica **compiler bootstrappin**g with **partial Modelica 4** support completed.

- Spring 2011. Modelica **debugger** and **performance** analyzer

- Spring 2011. **OMOptim** and **OMWeb** subsystems

- Spring/fall 2011. **Operator overloading** and Modelica 3.2 and Modelica 3.3 features.

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OSMC Bylaws and License Change to OSMC-PL 1.2 Also vote today Feb 7

- **Redistribution** of binary code from a Level 2 OSMC member through a **reseller** will be possible, if the reseller has a redistribution agreement with that Level 2 OSMC member

- **Internal distribution within a group of companies** (affiliates) will be possible, if at least one affiliate pays a Level 2 membership fee corresponding to the whole group.

- The current **OpenModelica copyright** of Linköping University will be **transferred to OSMC**

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OpenModelica Compiler Bootstrapping

- Bootstrapping = OMC Compiler Compiles itself

- Advantages
  - **Faster** compilation for the developers
  - Complete Modelica language for **easier programming**
  - Better error messages and maintainability
  - Makes a faster Modelica **debugger** possible
  - Makes **performance** analysis possible
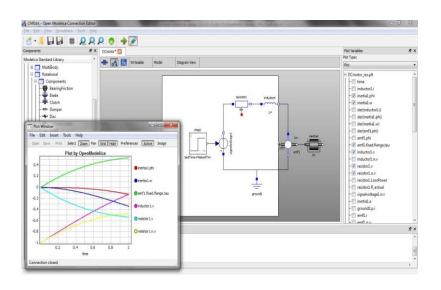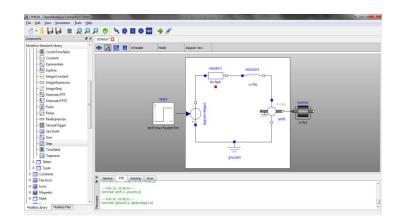 - Supports some **Modelica 4** like features

- Status
  - Dec 2010, OMC first compiled itself
  - Jan 2011, factor 9-10 increased compilation speed
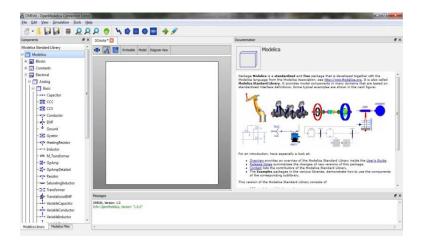 - Feb-Mar 2011. Planned completion, automatic memory reclamation

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New OpenModelica Connection Editor OMEdit

- Supports MSL 3.1

- Easy to use

- Rather stable

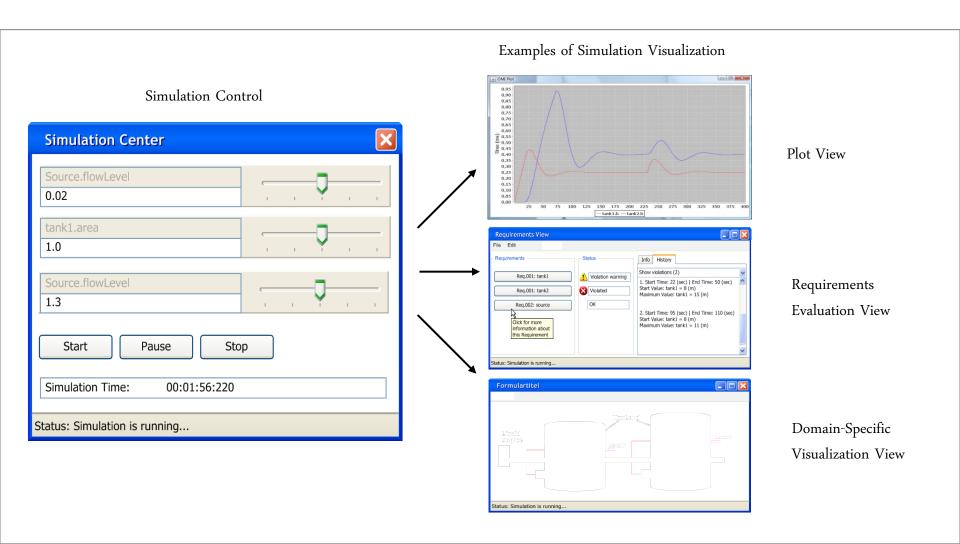- Implemented in C++ Qt library

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Interactive Simulation with OpenModelica (NEW Prototype developed at EADS)

Examples of Simulation Visualization

Simulation Control

Plot View

Requirements Evaluation View

Domain-Specific Visualization View
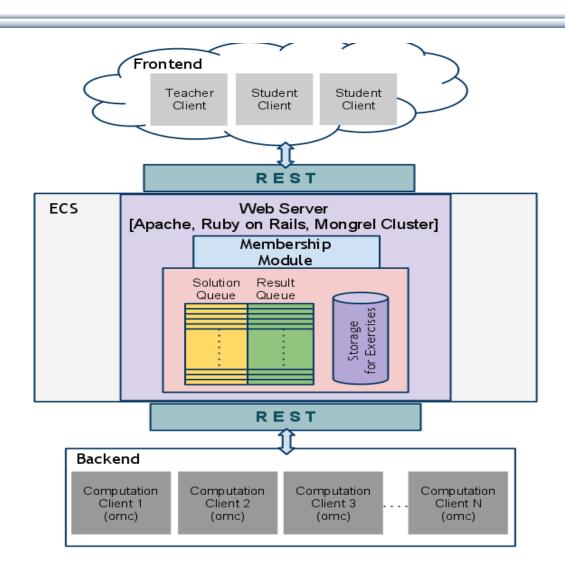
New OpenModelica Optimization Subsystem OMOptim

- Parameter optimization
- Currently using genetic optimization algorithms in OMOptim 0.9.

Web Server Based Teaching/Learning Subsystem OMWeb

- Runs on ordinary web server

- Teachers provide modeling exercises

- Students send in solutions

- Running of simulations through server

- Lila EU project

The Open Source Modelica Consortium

Purpose of the Consortium

- The Open Source Modelica Consortium, created the 4th of December 2007 in Linköping, Sweden, in the following called OSMC, is a non-profit, non-governmental organization with the aim of developing and promoting the development and usage of the **OpenModelica open source implementation of the Modelica computer language** (also named Modelica modeling language) and OpenModelica **associated open-source tools and libraries**, collectively named the OpenModelica Environment, in the following referred to as OpenModelica.

- OpenModelica is **available for commercial and non-commercial usage under the conditions of the OSMC Public License**. It is the aim of OSMC, within the limitations of its available resources, to provide **support and maintenance of OpenModelica**, to support its publication on the web, and to **coordinate** contributions to OpenModelica.

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Open Source Modelica Consortium
Originally Created Dec 4, 2007

7 Founding Organizational Members

- Bosch-Rexroth AG, Germany

- Equa Simulation AB, Sweden

- TLK Thermo, Germany

- VTT, Finland

- Linköping University, Sweden

- Hamburg University of Technology/TuTech, Institute of Thermo-Fluid Dynamics, Germany

- Technical University of Braunschweig, the Institut of Thermodynamik, Germany
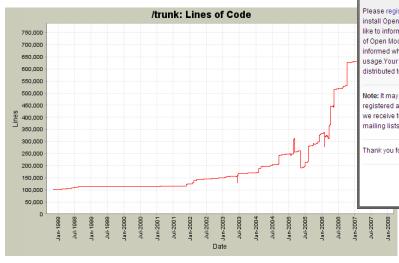
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OSMC – Open Source Modelica Consortium
32 organization members Dec 2010

Founded Dec 4, 2007

Open-source community services

- **Website and Support Forum**
- **Version-controlled source base**
- **Bug database**
- **Development courses**
- **www.openmodelica.org**

Code Statistics

OSMC 32 Organizational Members, Dec 2010
(initially 7 members, 2007)

Companies and Institutes (18 members)

- ABB Corporate Research, Sweden
- Bosch Rexroth AG, Germany
- Siemens Turbo Machinery AB, Sweden
- CDAC Centre for Advanced Computing, Kerala, India
- CEIT Institute, Spain
- Creative Connections, Prague, Czech Republic
- Frontway AB, Sweden
- Equa Simulation AB, Sweden
- Evonik Energy Services, Dehli, India
- IFP, Paris, France
- InterCAX, Atlanta, USA
- MOSTforWATER, Belgium
- MathCore Engineering AB, Sweden
- Maplesoft, Canada
- TLK Thermo, Germany
- VI-grade, Italy
- VTT, Finland
- XRG Simulation, Germany

Universities (14 members)

- Linköping University, Sweden
- Hamburg University of Technology/TuTech, Institute of Thermo-Fluid Dynamics, Germany
- FH Bielefeld, Bielefeld, Germany
- Technical University of Braunschweig, Institute of Thermodynamics, Germany
- Technical University of Dortmund, Process Dynamics and Operations Group, Germany
- Université Laval, modelEAU, Canada
- Griffith University, Australia
- Politecnico di Milano, Italy
- Mälardalen University, Sweden
- Technical University Dresden, Germany
- Telemark University College, Norway
- Ghent University, Belgium
- Ecoles des Mines, CEP, Paris, France
- University of Ljubljana, Slovenia

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Open Source Modelica Consortium Individual Members

(53 individual members, 7 February 2011)

- Peter Fritzson Adrian Pop, Martin Sjölund, Per Östlund, David Akhvlediani, Syed Adeel Asghar, Bernhard Bachmann, Vasile Baluta, Simon Björklén, Mikael Blom, Robert Braun, Willi Braun, David Broman, Stefan Brus, Francesco Casella, Filippo Donida, Henrik Eriksson, Anders Fernström, Jens Frenkel, Pavel Grozman, Michael Hanke, Alf Isaksson, Kim Jansson, Daniel Kanth, Tommi Karhela, Joel Klinghed, Juha Kortelainen, Petter Krus, Alexey Lebedev, Magnus Leksell, Oliver Lenord, Ariel Liebman, Rickard Lindberg, Håkan Lundvall, Henrik Magnusson, Eric Meyers, Maroun Nemer, Hannu Niemistö, Peter Nordin, Kristoffer Norling, Lennart Ochel, Atanas Pavlov, Karl Pettersson, Pavol Privitzer, Reino Ruusu, Per Sahlin, Ingo Staack, Wladimir Schamai, Gerhard Schmitz, Klas Sjöholm, Anton Sodja, Kristian Stavåker, Sonia Tariq, Hubert Thierot, Mohsen Torabzadeh-Tari, Parham Vasaiely, Niklas Worschech, Robert Wotzlaw

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Open Source Modelica Consortium – OSMC Board of Directors

- **Oliver Lenord**, OSMC Chairman; Manager, Bosch-Rexroth, Germany

- **Per Sahlin**, OSMC Vice Chairman; CEO, Equa Simulation AB

- **Peter Fritzson**, OSMC Director; Prof, Linköping University, Sweden

- **Juha Kortelainen**, Manager, VTT, Finland

- **Gerhard Schmitz**, Prof, Univ. Hamburg, Germany

- **Alf Isaksson**, Manager, ABB Corp. Research, Sweden

- **Francesco Casella**, Prof, Politecnico di Milano, Italy

- **Jan Brugård**, CEO, MathCore Engineering AB, Sweden

- **Kilian Link**, Manager, Siemens, Germany (and Sweden) (New board member since Dec 7 2010)

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OSMC Board – 7 Meetings Jan 1 2010 – Dec 31 2010

Meeting dates

- 100302
- 100421
- 100616
- 100903
- 101022
- 101126
- 101207

Board Work

- Planning and prioritizing the OSMC work
- Admitting new members
- Preparing Bylaws change
- Planning the workshop
- Budget
- etc.

- Extra Annual Meeting 101207
- Voting for Bylaws and OSMC-PL license change

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OPENPROD –OpenModelica related Project

- Duration: June 2009 – Sept 2012 (3.3 years)
- Budget: approx 11 Meuro, 94 Manyears
- 28 partners
- Very important for future OpenModelica development
- Successful review Sept 2010 after 1 year

Main workpackages

- Integrated hardware software modeling by Modelica - UML - SysML integration.
- Model compiler enhancements.
- Compilation of Modelica to parallel multi-core platforms.
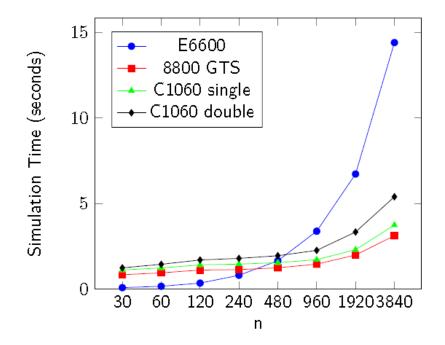- Tool interoperability.
- Application demonstrators.

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Some Swedish OpenModelica-Related Projects

- **HIPo** – High Speed Simulation for Product Design and Operation (2010 – 2013)
  - Model partitioning using TLM techniques
  - TLM-Partitioning for hi-speed on multi-core
- **EDOp** – Efficient Traceable Model-Based Dynamic Optimization (2011-2013)
  - Dynamic and parameter optimization
  - High-speed optimization on multi-core
- **RTSIM** – Real-Time Simulation (2011-2013)
  - India CDAC – Sweden PELAB Cooperation
  - Real-time code generation and control

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Research on Compiling Modelica to Multi-Core

- New scaleable OMC parallel codegenerator on the way

- Support for non-expanding arrays

- Installed January 2011: An NVIDIA Fermi 2050 2 Teraflop peak parallel platform

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Special Thanks

- The developers (Especially Adrian) who worked very hard during 2010. Adrian Pop, Martin Sjölund, Per Östlund, Jens Frenkel, Willi Braun, Alexey Lebedev, Pavol Privitzer, and many others.

- The 32 OpenModelica consortium organizational members for support, especially Bosch-Rexroth, with OSMC Chairman Oliver Lenord; ABB, Siemens, etc...

- Master students and PhD students who made important contributions.

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Conclusions and Summary 2010

- OSMC expanded from 28 to 32 organizational members.

- July 2010, MultiBody library flattening and some simulation, OpenModelica 1.5 release.

- Progress on Media/Fluid libraries. Stream connectors implemented.

- Dec 2010, OpenModelica 1.6 release. Factor 10-20 or more speedup in OMC. Event handling and Jacobians. Better support for Modelica Standard Library 3.1. New OMEdit graphic editor

- 2011. Good prospects for the future – towards a standard high quality open source Modelica implementation in Modelica, increased tool support for integrated systems engineering.

Questions?

www.openmodelica.org

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