4th Annual OpenModelica Workshop Feb 6, 2012

Workshop Opening

OpenModelica – Status and Directions

Peter Fritzson

To All Participants!

Very Welcome to this
Fourth 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
  - **OMNotebook** – a literate programming notebook
  - **MDT** – an advanced textual environment in Eclipse

- **ModelicaML** – UML Profile
- **MetaModelica** – model transforms
- **ParModelica** – parallel programming
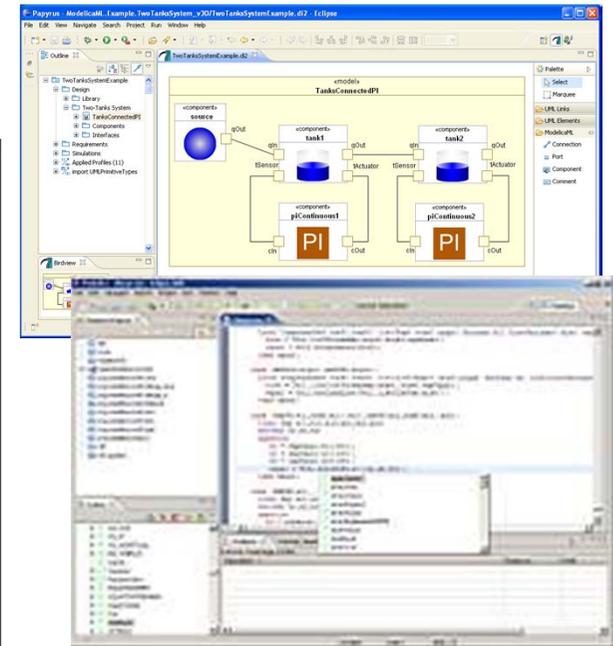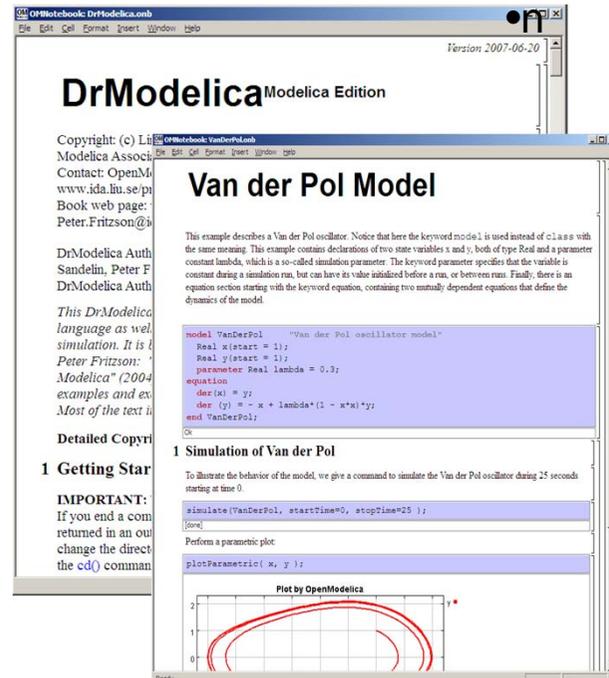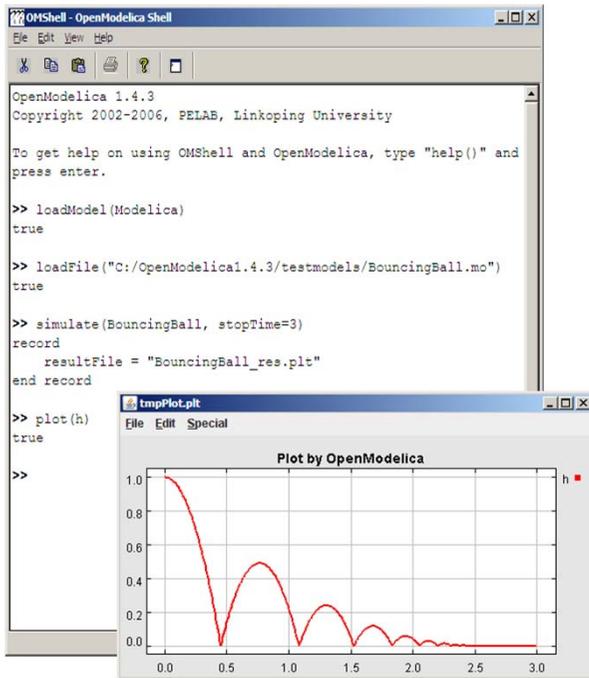
Expanded Vision for OpenModelica Effort:
Integrated Model-driven Development
Based on OpenModelica, e.g. in OPENPROD project
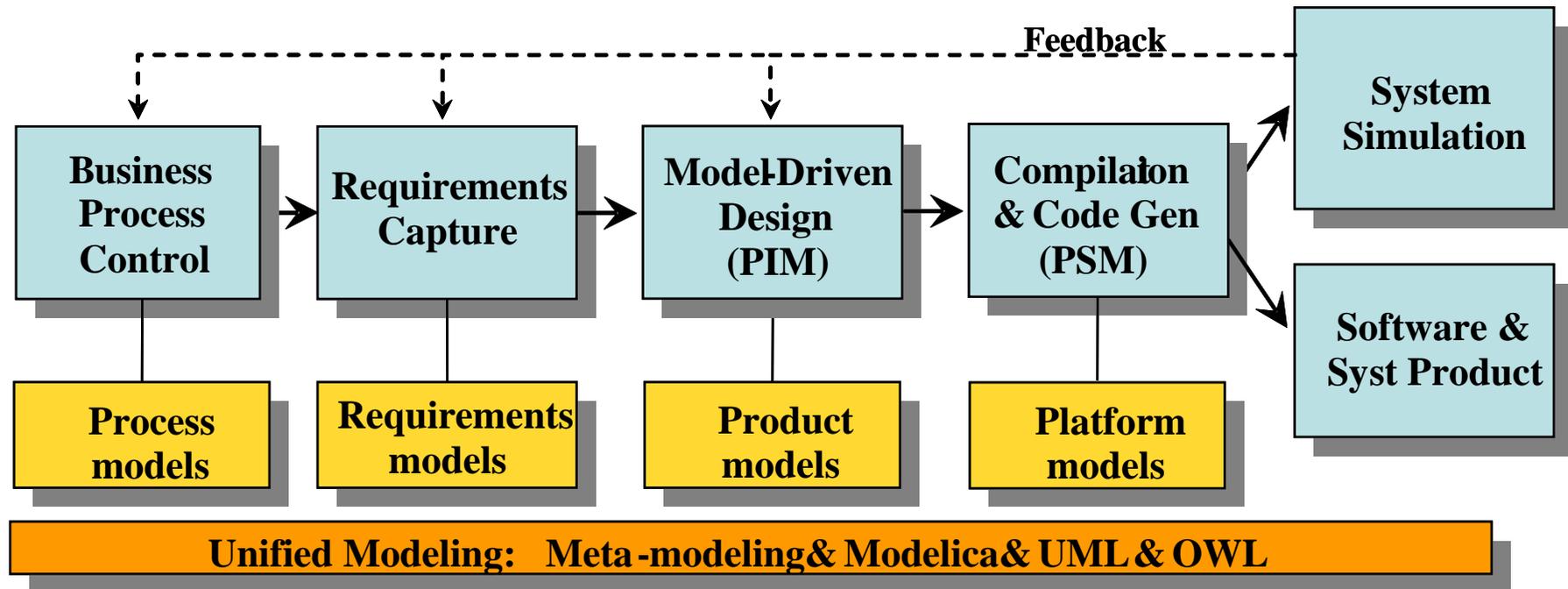
Vision of unified modeling framework for model-driven
product development from platform independent models (PIM)
to platform specific models (PSM)

Main Events 2011

Outlook for 2012

MODELICA

Main Events 2011 and January 2012

- OSMC expanded from 32 to 38 organizational members

- OpenModelica **1.7 release** (April 2010)

  - Faster and more stable simulation through improved event handling
  - New optimization subsystem OMOptim
  - Improvements in OMEdit including support for icon editing
  - Faster simulation storage, including binary .mat files and alias variables

- OpenModelica **1.8 release** (Nov 2011)

  - Support for FMI Export and Import
  - Flattening of the whole MSL 3.1 Media library, and about half of the Fluid library.
  - Improved index reduction with dynamic state selection
  - Beta release of new efficient debugger for algoritmic Modelica/MetaModelica

- OpenModelica **1.8.1 beta release** (Jan 2012)

  - Operator Overloading support
  - Dramatically improved flattening speed for some models
  - Improved simulation run-time
  - ModelicaML with Modelica library import (MSL) and value-bindings

OpenModelica – Outlook for 2012

- Whole 2012. Continued high priority on better support for the Modelica standard libraries.

- Spring 2012. Support for larger models and improved simulation efficiency.

- February 2012. Shifting to bootstrapped OpenModelica compiler for development.

- February-March 2012. Parallel Modelica simulation, OpenMP, and ParModelica for GPU simulation prototypes

- March-April 2012. Most of Fluid library flattening and simulating

- March 2012. improved support for MultiBody simulation.

- April-June 2012. Most of Media and Fluid libraries simulating

- May-June 2012. Integrated Modelica debugger.

- May-June 2012. Python API

- Fall 2012. Support for Modelica 3.3

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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
  - some **Modelica 4** like featureSupports s

- Status
  - Dec 2010, OMC first compiled itself
  - During 2011, used for development with the new debugger
  - Feb-Mar 2012. Planned completion of automatic memory reclamation

Improved OpenModelica Connection Editor OMEdit

- Supports MSL 3.1
- Easy to use
- Stable
- Implemented in C++ Qt library
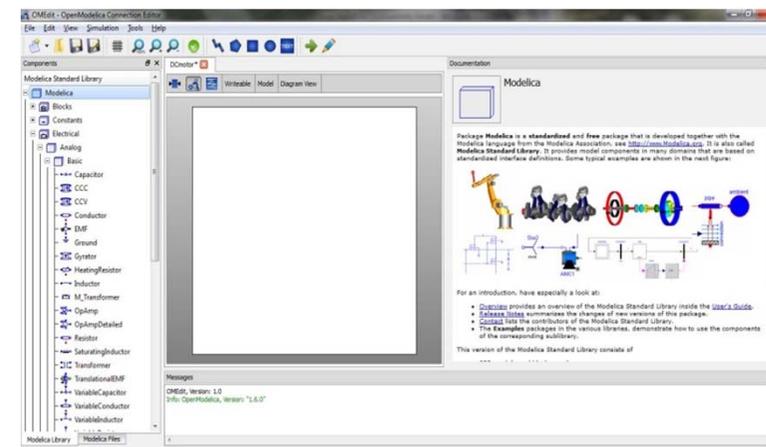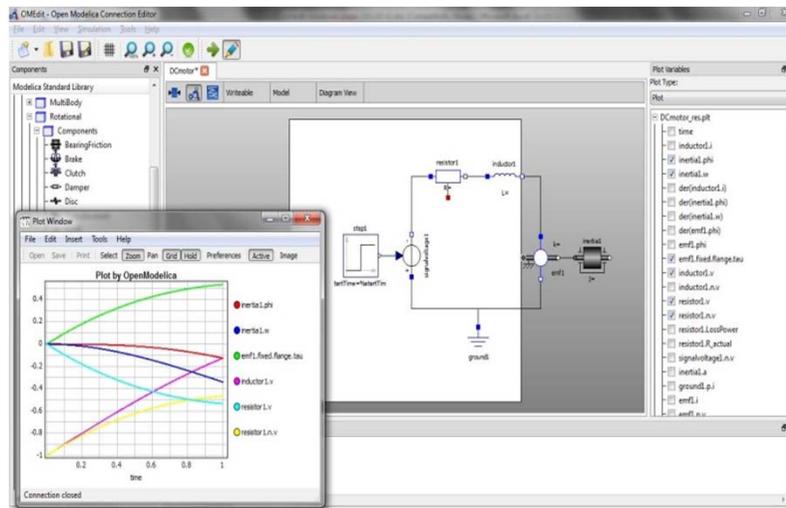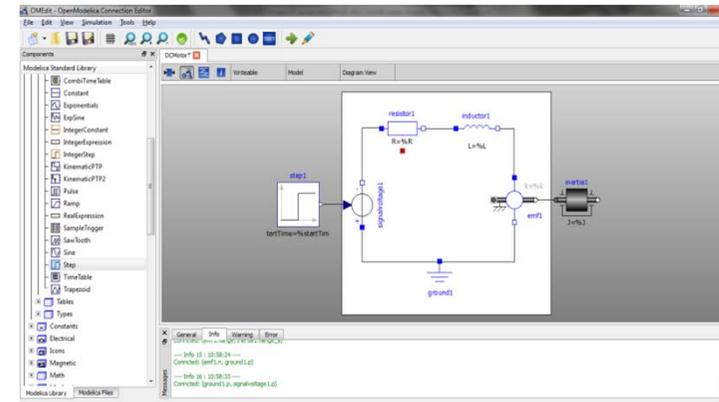
New Efficient OpenModelica MDT Debugger for Algorithmic MetaModelica/Modelica (Eclipse-based)

Here Using Japanese Characters

OpenModelica Optimization Subsystem OMOptim

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

Prototypes of Parallel Execution with OpenModelica

- ## ParModelica – Parallel Algoritmic Modelica Code Execution on GPU
    - Speedup factor 114 of matrix multiplication on NVIDIA Fermi GPU

- ## OPENMP support in OpenModelica, parallelization of partitioned models
    - Speedup factor 4 of trivial model on 4-core machine

The Open Source Modelica Consortium

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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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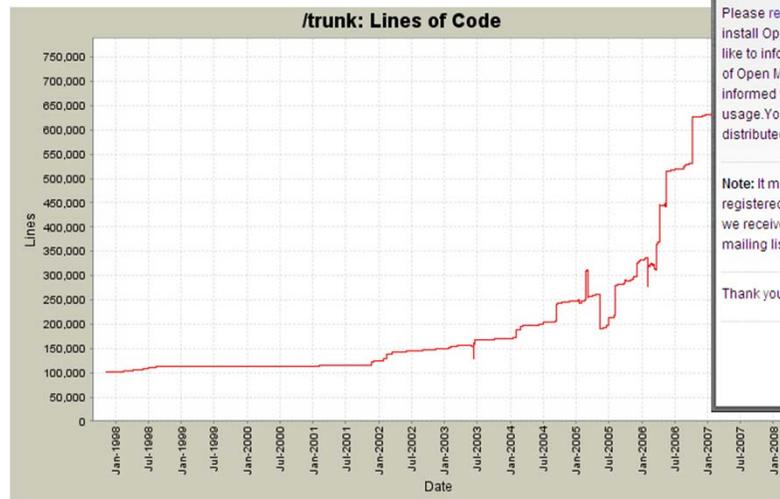
OSMC – Open Source Modelica Consortium
40 organizational members February 2012

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 40 Organizational Members, Feb 2012
(initially 7 members, 2007)

Companies and Institutes (22 members)

- ABB Corporate Research, Sweden
- Bosch Rexroth AG, Germany
- Siemens PLM, California, USA
- Siemens Turbo Machinery AB, Sweden
- CDAC Centre for Advanced Computing, Kerala, India
- Creative Connections, Prague, Czech Republic
- DHI, Aarhus, Denmark
- Evonik, Dehli, India
- Equa Simulation AB, Sweden
- Fraunhofer FIRST, Berlin, Germany
- Frontway AB, Sweden
- IFP, Paris, France
- InterCAX, Atlanta, USA
- ISID Dentsu, Tokyo, Japan
- MathCore Engineering/ Wolfram, Sweden
- Maplesoft, Canada
- TLK Thermo, Germany
- Sozhou Tongyuan Software and Control, China
- VI-grade, Italy
- VTI, Linköping, Sweden
- VTT, Finland
- XRG Simulation, Germany

Universities (18 members)

- Linköping University, Sweden
- TU Berlin, Institute of UEBB, Germany
- FH Bielefeld, Bielefeld, Germany
- TU Braunschweig, Institute of Thermodynamics, Germany
- TU Dortmund, Proc. Dynamics, Germany
- Technical University Dresden, Germany
- Université Laval, modelEAU, Canada
- Georgia Institute of Technology, USA
- Ghent University, Belgium
- Griffith University, Australia
- Hamburg Univ. Technology/TuTech, Institute of Thermo-Fluid, Germany
- University of Ljubljana, Slovenia
- University of Maryland, Inst. Systems Engineering, USA
- University of Maryland, CEEE, USA
- Politecnico di Milano, Italy
- Ecoles des Mines, ParisTech, CEP, France
- Mälardalen University, Sweden
- Telemark University College, Norway

Peter Fritzson   *OpenModelica Annual Workshop Opening, OpenModelica Status and Directions*

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Open Source Modelica Consortium
Individual Members

(58 individual members, 6 February 2012)

- Peter Fritzson, Adrian Pop, Martin Sjölund, Per Östlund, Peter Aronsson, Adeel Asghar, Mikael Axin, Bernhard Bachmann, Vasile Baluta, Robert Braun, Willi Braun, David Broman, Stefan Brus, Francesco Casella, Filippo Donida, Jens Frenkel, Mahder Gebremedhin, Pavel Grozman, Daniel Hedberg, Michael Hanke, Zoheb Hossain, Alf Isaksson, Kim Jansson, Daniel Kanth, Tommi Karhela, Juha Kortelainen, Abhinn Kothari, Petter Krus, Alexey Lebedev, Oliver Lenord, Ariel Liebman, Rickard Lindberg, Håkan Lundvall, Abhi Raj Metkar, Eric Meyers, Tuomas Miettinen, Afshin Moghadam, Maroun Nemer, Hannu Niemistö, Peter Nordin, Kristoffer Norling, Lennart Ochel, Karl Pettersson, Pavol Privitzer, Reino Ruusu, Per Sahlin,Wladimir Schamai, Gerhard Schmitz, Anton Sodja, Ingo Staack, Kristian Stavåker, Sonia Tariq, Mohsen Torabzadeh-Tari, Parham Vasaiely, Niklas Worschech, Robert Wotzlaw, Björn Zackrisson, Azam Zia

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Open Source Modelica Consortium – OSMC Board of Directors

- **Oliver Lenord**, OSMC Chairman; Manager, Siemens PLM, USA
- **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)
- **Lars Mikelsons**, Manager, Bosch-Rexroth, Germany (expected member from Feb 6, 2012.

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OSMC Board – 5 Meetings Jan 1 2011 – Dec 31 2011

Meeting dates

- 110315
- 110518
- 110629
- 110920
- 111115

Board Work

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

OPENPROD –OpenModelica related Project

- Duration: June 2009 – Sept 2012 (3.3 years)
- Budget: approx 11 Meuro, 94 Manyears
- 28 partners
- Very important for OpenModelica development
- Successful review Sept 2011 after 2 years
- Final review fall 2012 including most application demos
- (New project MODRIO approved, starting fall 2012)

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

Special Thanks

- The developers (Especially Adrian) who worked very hard during 2011. Adrian Pop, Martin Sjölund, Per Östlund, Jens Frenkel, Willi Braun, Lennart Ochel, Alexey Lebedev, and many others.

- The 38 OpenModelica consortium organizational members for support, especially Bosch-Rexroth, with OSMC Chairman Oliver Lenord (now at Siemens PLM); ABB, Siemens, etc...

- Master students and PhD students who made important contributions.

Conclusions and Summary 2011

- OSMC expanded from 32 to 38 organizational members.

- April 2011, OpenModelica 1.7 release. Improved OMC compiler. OMOptim subssystem.

- Nov 2011, OpenModelica 1.8 release. Flattening of Media library and part of Fluid. New Efficient Algorithmic Modelica debugger.

- Jan 2012. OpenModelica 1.8.1 Beta. Operator overloading. Factor 10 faster flattening for some models. ModelicaML

- 2012. 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