

16th Annual OpenModelica Workshop

Feb 05, 2024

The screenshot displays the OpenModelica software interface. On the left is the 'Libraries Browser' showing a tree structure of libraries, with 'OpenModelica' selected. The central area contains a plot titled 'Plot : 1' showing a red oscillating signal labeled 'der(load.w) (s-2)' over a time range from 0 to 0.6 seconds. The y-axis ranges from 180 to 280. On the right is the 'Variables Browser' showing simulation parameters for 'load.w', including 'Simulation Time Unit' set to 's', 'Time: 0.0', and 'Speed: 1'. Below the plot, a 'Messages Browser' displays a 'Symbolic Notification' with statistics for the simulation, such as 'Single equations (assignments): 1330' and 'Linear Jacobian (size,density): 1 ((456,0.8%))'. The bottom status bar shows coordinates 'X: -241, Y: 98' and navigation buttons for 'Welcome', 'Modeling', 'Plotting', and 'Debugging'.

OpenModelica – Status and Directions

Francesco Casella – OSMC Director



Goals for the OpenModelica Effort

- Comprehensive **modeling, simulation and systems engineering** environment for research, teaching, and industrial usage
- **Open-source** for both **industrial** and **academic** usage
- Invitation for **open-source cooperation** around OpenModelica, tools, and applications
- **Increasing** emphasis on **industrial** usage

OpenModelica Releases in 2023

- Version **1.21.0** released 18 Apr 2023
- Version **1.22.0** released 8 November 2023
- Version **1.22.1** released 13 December 2023
 - Major improvements in the OMEdit GUI
 - New CMAKE-Based build system
 - Significant improvements in FMI export
 - Improved library coverage

Collaboration with LBL on Buildings/IBPSA

- Strategic partnership started in 2021 with LBL (US gov't laboratory in Berkeley)
 - Goal: provide open-source support for Modelica libraries (Buildings, IBPSA) involved in the Spawn of Energy Plus project
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- **100% Build success on Buildings and IBPSA**
 - **96% Simulation success on Buildings, 99% on IBPSA**
 - **Systematic categorization of remaining issues with Buildings and IBPSA**
 - **Overhauled testing infrastructure for FMI export**

Collaboration with RTE

- Four-year DFD contract signed Jul 2023 – June 2027
 - OMC maintenance and support
 - OMEdit enhancements
 - Efficient code generation for large-scale systems
 - Improved debugging
- **On-going work on all fronts**

Status of New Frontend

- OMC can now flatten **100% (*)** of the models in the following OS libraries:

Buildings, BuildSysPro, BuildingSystems, Chemical, ClaRa, DeltaRobot, EHPTLib, ExternalMedia, HanserModelica, HelmholtzMedia, IBPSA, IDEAS, IndustrialControlSystem, MEV, ModelicaByExample, Modelica (3.2.3 & 4.0.0), ModelicaTest, Modelica_DeviceDrivers, OpenHydraulics, OpenIPSL, PNLlib, PhotoVoltaics, PhotoVoltaics_TGM, PyhsioLibrary, PlanarMechanics, PowerGrids, PowerSysPro, PowerSystems, ScalableTestGrids, ScalableTestSuite, SystemDynamics, StewartPlatform, ThermoPower, TILMedia, ThermoFluidStream, VehicleInterfaces

() excluding models with illegal Modelica code*

- Array-preserving flattening
- Instance-based support for OMCedit graphical model editing
- Prototype BaseModelica output (`--BaseModelica`)

Status of Backend and Code Generation

- On-going work on **new backend**, with more rational structure and including array-preserving analysis and code generation
- The new backend can already handle simple array-based models with up to 2 million equations and is almost ready to hand large scale power grid models (see next talk)
- A CMAKE-based build system has replaced the old makefile-based one
 - Unified management of code compilation across different Oss
 - Cross-compilation of FMI code now available
- Updated MSYS2/MINGW32/54 to MSYS2/UCRT64 on Windows

Improvements to OMEdit GUI

- Major improvements to the OMEdit GUI usability
- OMEdit now uses an instance-based API to the new frontend to handle graphical editing
 - Full support for replaceable classes with parameter editing
 - Parameter-dependent conditional connector activation
 - Parameter-dependent enabling of parameter dialogs
 - DynamicSelect feature for displaying results in diagrams
- **150** closed issues on the master branch since Feb 6 2023
- Upcoming 1.22.2 patch release with the latest improvements and bug fixes

OSMC Plan of Operations for 2024 (1 of 2)

- Further increased library coverage, performance, and quality with special focus on the Buildings library in collaboration with LBL
 - Achieve 100% successful simulation of Buildings 11.x.x
 - Further FMI export reliability on Buildings models
 - Assess quality of simulation results and improve simulation performance
- New Backend enabling fast compilation of large-scale power system models & other large models (significant support by RTE)
 - Use and development of New Backend
 - Fast code generation with array-preserving methods
 - Support event handling and improve efficiency compared to old backend
- OMEdit new features:
 - Duplicate function with proper dependency refactoring
 - Rename function with refactoring
 - Hierarchical model editing
 - Re-designed Simulation Setup interface

OSMC Plan of Operations for 2024 (2 of 2)

- Integration of runtime data in the OMEdit debugger
- Improved support for commercial libraries
(Including libraries from Bosch-Rexroth, XRG, TLK-Thermo, etc.)
- Improved FMI export
- Full implementation of Base Modelica standard when released
- Continue the development of web-based GUIs for lightweight deployment of OpenModelica technology
- Continue work on the Julia-based OMC implementation
- Migrate state machines and MetaModelica support to NF
- Planned releases:
 - 1.22.2 February 2024
 - 1.23.0 April 2024
 - 1.24.0/2.0.0 December 2024

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.

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, Institute of Thermodynamics, Germany

OSMC 57 Organizational Members, Jan 2024

(initially 7 members, 2007)

Companies and Institutes

- ABB AB, Germany
- Berkeley Lab, California, USA
- Bosch Rexroth AG, Germany
- Creative Connections, Prague
- DHI, Aarhus, Denmark
- Dynamica s.r.l., Cremona, Italy
- EDF, Paris, France
- Fraunhofer IWES, Bremerhaven, Germany
- Fraunhofer FCC, Gothenburg, Sweden
- GSIMX Beijing Technology, China
- HOERBIGER Wien GmbH, Vienna, Austria
- INRIA, Rennes, France
- ISID Dentsu, Tokyo, Japan
- JSOL Corporation, Japan
- Juelich Forschungszentrum, Germany
- Maplesoft, Canada
- Metroscope, Paris, France
- Modelicon LLB, Bangalore, India
- REUSE, Madrid, Spain
- RTE France, Paris, France
- Saab AB, Linköping, Sweden
- Shanghai Duanyan Information Techn., China
- SmartFluidPower, Modena, Italy
- SRON Institute, The Netherlands
- Suzhou Tongyuan, China
- Swegon AB, Gothenburg, Sweden
- Talent Swarm, Spain
- TLK Thermo, Braunschweig, Germany
- Volvo Cars AB, Sweden
- VTI, Linköping, Sweden
- XRG Simulation GmbH, Hamburg, Germany

Universities

- Augsburg University, Germany
- Australian National University, Australia
- Hochschule Bielefeld, Bielefeld, Germany
- University of Bolivar, Colombia
- University of Buenos Aires, Discrete Sim. Lab, Argentina
- TU Braunschweig, Germany
- Univ Catalunya, Spain
- Chalmers Univ, Control, Sweden
- Chalmers Univ, Machine, Sweden
- TU Darmstadt, Germany
- TU Delft, Netherlands
- TU Dresden, Germany
- Université Laval, Canada
- TU Hamburg/Harburg Germany
- IIT Bombay, Mumbai, India
- K.U. Leuven, Belgium
- Univ Linnaeus, Sweden
- Linköping University, Sweden
- Univ of Maryland, Syst Eng USA
- Univ of Maryland, CEEE, USA
- Politecnico di Milano, Italy
- Mälardalen University, Sweden
- Univ. Pisa, Italy
- Rennsler Polytechnic Institute, Troy, USA
- Univ SouthEast Norway
- Vanderbilt Univ, Nashville, USA

Organizational Members Update 2023

- New members:
 - Berkeley Lab, California, USA
 - GSIMX Beijing Technology, China
 - HOERBIGER Wien GmbH, Vienna, Austria
 - Swegon AB, Gothenburg, Sweden

Open Source Modelica Consortium

Individual Members (73 individual members)

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

Open Source Modelica Consortium – OSMC

Board of Directors 2023

- **Rüdiger Franke**, OSMC Chairman; Manager, ABB AG, Germany
- **Oliver Lenord**, OSMC Vice Chairman; Project manager, Germany
- **Francesco Casella**, OSMC Director; Prof, Politec. di Milano, Italy
- **Peter Fritzson**, OSMC Vice Director; Prof, Linköping Univ, Sweden
- **Juha Kortelainen**, Manager, VTT, Finland
- **Gerhard Schmitz**, Prof, Univ. Hamburg, Germany
- **Adrien Guironnet**, Manager, RTE, France
- **Niklas Worschech**, Techn Specialist, Bosch-Rexroth, Germany.
- **Daniel Bouskela**, Manager, EDF, France
- **Bernhard Bachmann**, Prof, FH Bielefeld, Germany
- **Adrian Pop**, adjoined to the Board, Tech coordinator, OSMC

OSMC Board – 3 Meetings During 2023

Meeting dates

- 27/06/2023
- 17/10/2023
- 15/12/2023

Board Work

- Planning and prioritizing the OSMC work
- OSMC Business models
- Licensing issues
- Admitting new members
- Planning the workshop
- Budget
- etc.

Some Supporting Research Projects 2023

- PHyMoS - Proper Hybrid Models for Smarter Vehicles. German national project including Bosch, LTX, XRG, TLK, ESI ITI GmbH, Modelon, TU Braunschweig, Universität Augsburg, FH Bielefeld. 2021-2024
- Swedish project LargeDyn, 2019 – 2023
- Swedish project ELLIT Cloud Tooling for Large-Scale Cyber-Physical System Model-Based Development (one 5-yrs PhD)
- ITEA3 project EMBRACE, 2019-2023
- ITEA4 project OpenSCALING, “Open standards for Scalable Virtual Engineering and Operation”, 2023-2026

Special Thanks

- The developers who worked very hard during 2023 and modelers who tested and gave important feedback
- The OpenModelica consortium organizational members for their support
- RTE, LBL, Bosch-Rexroth, and University of Pisa for their extra support through DFD contracts
- Master students and PhD students who made important contributions.
- Online contributors to the code base that we never had a chance to meet in real life.

Conclusions and Summary 2023

- Apr 18, 2023. OpenModelica **1.21.0**
- Nov 8, 2023. OpenModelica **1.22.0**
- Dec 13, 2023. OpenModelica **1.22.1**
- Towards a standard **high performance, quality, compliant** open source Modelica implementation in Modelica, increased tool support for integrated systems engineering.
- **Expected OpenModelica 1.22.2, 1.23.0 and 1.24.0/2.0.0 in 2024**

Questions?

www.openmodelica.org