

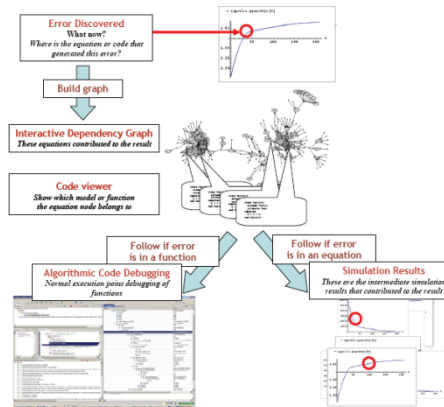
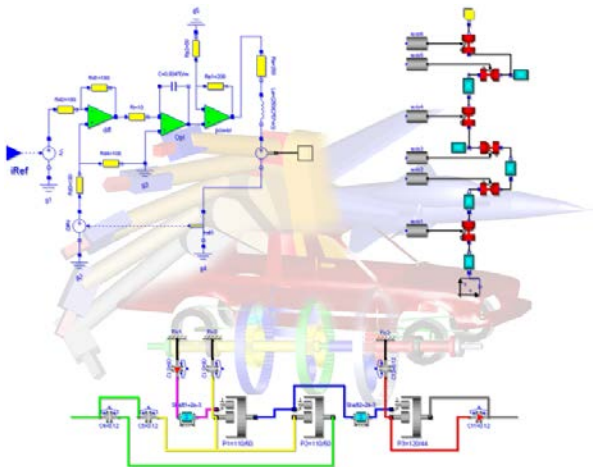
# OpenModelica.org

## Presentation, Status and Future Developments

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2022-01-31

Open Source Modelica Consortium  
PELAB, Linköping University  
RISE, Research Institutes of Sweden



$$\tau_2 = \frac{1}{k_2} \tau_1$$

$$e = \omega_{ref} - \omega_{out}$$
$$u = K \left( e + \frac{1}{T_I} \int_0^t e dt \right)$$
$$v = u \quad u_R = R i \quad u_{emf} = k_1 \omega_{emf}$$
$$J_1 \frac{d^2 \theta_1}{dt^2} = \tau_{emf} + \tau_1$$
$$J_2 \frac{d^2 \theta_2}{dt^2} = \tau_2 + \tau_3$$
$$J_3 \frac{d^2 \theta_3}{dt^2} = -\tau_4 - \tau_{load}$$
$$v = u$$
$$\theta_2 = k_2 \theta_1$$
$$u_L = L \frac{di}{dt}$$
$$u = K \left( e + \frac{1}{T_I} \int_0^t e dt \right)$$
$$e = \omega_{ref} - \omega_{out}$$
$$v - u_R - u_L - u_{emf} = 0$$
$$u_{emf} = k_1 \omega_{emf} \quad i = \frac{1}{k_1} \tau_{emf}$$
$$J_1 - J_2 k_2^2 \frac{d^2 \theta_2}{dt^2} = \tau_{emf} - k_2 \tau_3$$

- OpenModelica
  - What is OpenModelica?
  - The past
- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook, OMEdit, ModelicaML, OMSimulator, OMPython, OMJulia, OMMatlab
- OpenModelica Development Environment
  - MetaModelica
  - The Eclipse Environment (MDT)
- OpenModelica Latest Developments (2021-2022)

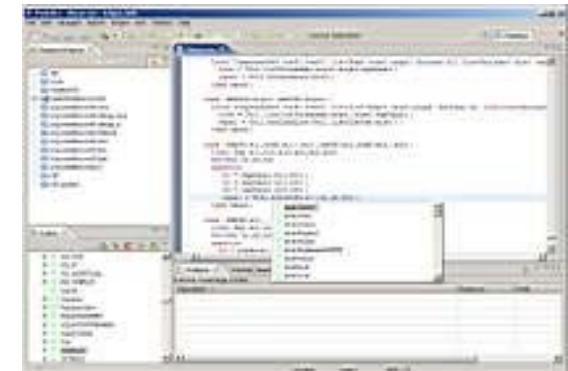
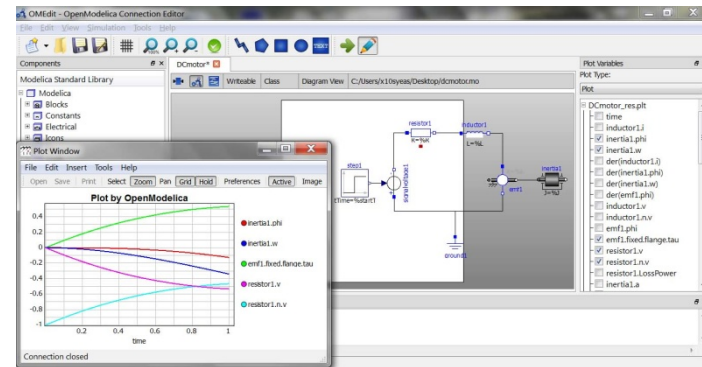
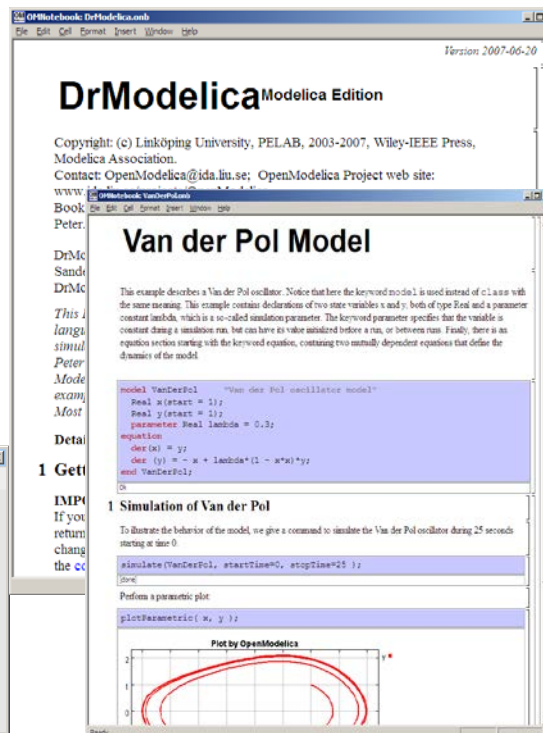
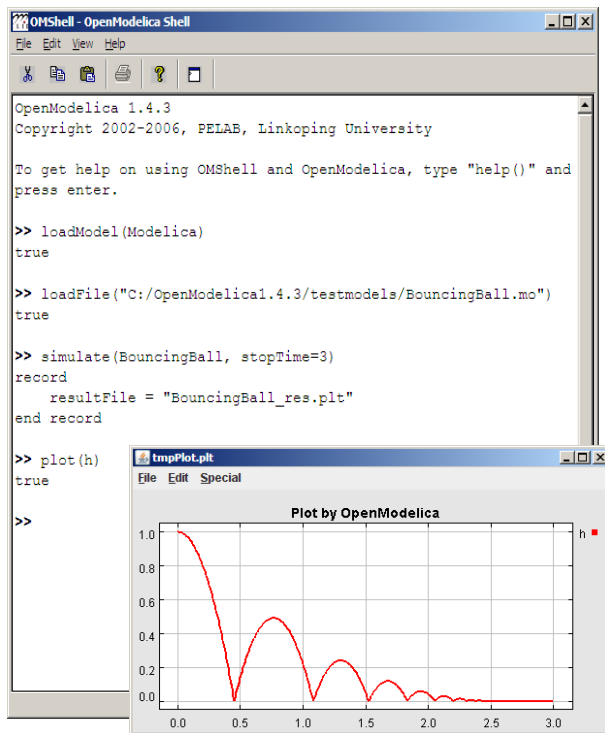
OpenModelica is ... its developers,  
testers, bug reporters, contributors  
and OSMC members

**Thank you!**

*asodja, sjoelund.se, sebco011, lochel, wbraun, niklwors, hubert.thieriot,  
petar, perost, Frenkel TUD, Unknown, syeas460, adeas31, ppriv, ricli576,  
haklu, dietmarw, levsu, mahge930, x05andfe, mohsen, nutaro, x02lucpo,  
florosx, x06hener, x07simbj, stebr461, x08joekl, x08kimja, Dongliang Li,  
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x02kajny, g-pavgr, x05andre, vaden, jansilar, ericmeyers, x05simel, andsa,  
leist, choeger, Ariel.Liebman, frisk, vaurich, mwalther, mtiller, ptauber,  
casella, vitalij, hkiel, jank, rfranke, mflehmg, crupp2, kbalzereit,  
marchartung, Andreas, Karim, phannebohm, adrpo*

# What is OpenModelica? (I)

- **Advanced Interactive Modelica compiler (OMC)**
  - Supports MSL v. 3.2.1/3.2.2/MSL trunk
- **Basic and advanced environments for creating models**
  - OMShell - an interactive command handler
  - OMNotebook - a literate programming notebook
  - OMEdit - Connection Editor, *Transformational and Algorithmic Debugger*, 3D Viewer
  - OMPlot - OpenModelica Plotting
  - OMOptim - OpenModelica Optimization Editor
  - OMPython/OMJulia/OMMatlab - OpenModelica Python/Julia/Matlab Environment
  - MDT - an advanced textual environment in Eclipse
  - OMSimulator - co-simulation of composite models using FMUs or via TLM



# What Is OpenModelica? (II)

- Advanced Eclipse-based Development Environment
- Modelica Development Tooling (MDT) - started in 2005
  - Code Assistance, Debugging, Outline & a lot more
  - *Used heavily for OpenModelica development*
  - Used in many OpenModelica Development Courses
  - *Should be replaced by OMEdit*
- ModelicaML UML/SysML integration

① System Modeling with ModelicaML

② Modelica Code Generation

③ System Simulation with Modelica Tools

# What is OpenModelica? (III)

- Open-source community services
  - Website and Support Forum
  - Source versioning (github.com)
  - Trac with bug database (->Github)
  - Development courses
  - Mailing lists

Welcome to OpenModelica <https://openmodelica.org>

**OpenModelica** Login Create an account

HOME DOWNLOAD TOOLS & APPS USERS DEVELOPERS FORUM EVENTS RESEARCH search...

### Top information

- OMEdit**  
Enhanced OpenModelica Connection Editor.
- OMPYthon**  
The new OpenModelica Python Interface.

### Modelica/OpenModelica Videos

- Overview of Modelica, an C...
- Modelica Cyber Physical M...

### Registration

Here is an overview presentation about Modelica and OpenModelica.

### Introduction

OPENMODELICA is an open-source Modelica-based modeling and simulation environment intended for industrial and academic usage. Its long-term development is supported by a non-profit organization – the Open Source Modelica Consortium (OSMC).

The goal with the OpenModelica effort is to create a comprehensive Open Source Modelica modeling, compilation and simulation environment based on free software distributed in binary and source code form for research, teaching, and industrial usage. We invite researchers and students, or any interested developer to participate in the project and cooperate around OpenModelica, tools, and applications.

### Donate

Please consider supporting our efforts.

Amount:  SEK

**Donate**

Latest news

- CFP OpenModelica Workshop February 2014
- October 09: OpenModelica 1.9.0 released
- September 27: OpenModelica 1.9.0 RC1 released
- February 1: OpenModelica 1.9.0 Beta4 released
- October 19: OpenModelica 1.9.0 Beta2 released
- Oct 16 : CFP OpenModelica/MODPROD Workshops February 2013
- August 31: OpenModelica 1.9.0 Beta released
- April 4: OpenModelica 1.8.1 released

github.com/OpenModelica

OpenModelica  
Linköping, Sweden <https://openmodelica.org> [openmodelica@ida.liu.se](mailto:openmodelica@ida.liu.se)

Overview Repositories Packages People Teams Projects Settings

Pinned

- OpenModelica** Public  
OpenModelica is an open-source Modelica-based modeling and simulation environment intended for industrial and academic usage.
- OMSimulator** Public  
The OpenModelica FM-B SVP-based co-simulation environment.
- OMJulia.jl** Public  
Julia scripting OpenModelica interface.

Repositories

OMPackagesManager Python 2 4

OpenModelica / OpenModelica

Code Issues Pull requests Discussions Actions Projects Wiki Security Insights

Label issues and pull requests for new contributors  
Now, GitHub will help potential first-time contributors discover issues labeled with **good first issue**.

Go to labels

### OpenModelica Project

1,960 Open 4,785 Closed

- Unit multiples in plots should not be used when powers are involved **bug** **COMPLETED**
- Incorrect behaviour of drop-down unit menu for parameter inputs **COMPLETED** **enhancement**
- displayUnits as axis labels **bug** **COMPLETED**
- dropdown for replaceable functions not shown in parameter window
- Modelica Compliant Libraries  
We have made a list of...  
To write compliant libraries

### Contribute

You can report a bug by adding a new ticket. Please have a look at all the open tickets first.

### Testing

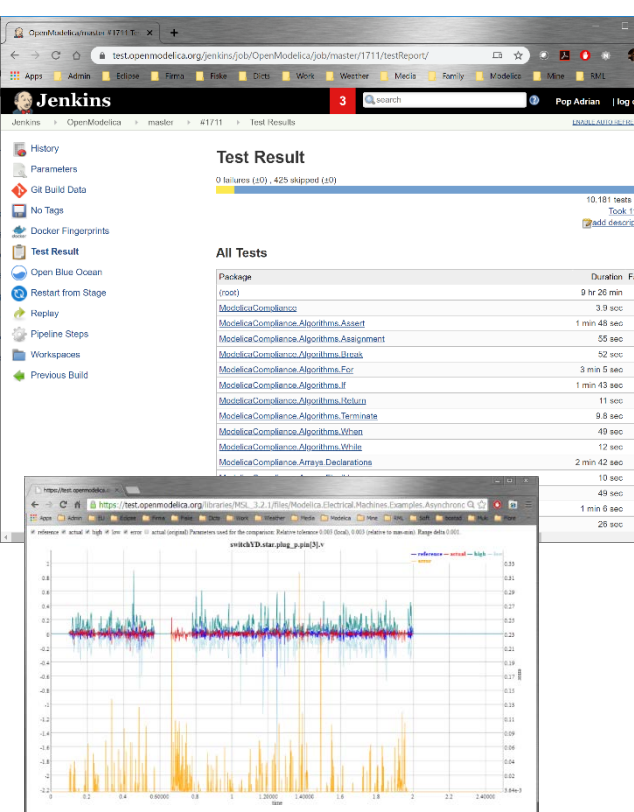
We run builds and tests using Hudson. Check the latest **build and test status**.  
Check the status of the (in development) **compliance suite** of the Modelica specification.  
Check the latest **MSL 3.2.1 coverage**.  
Check the latest **ModelicaTest 3.2.1 coverage**.  
Check the **historical MSL coverage** or **trend of all tested libraries**.  
Check the **directory** of all tested libraries.

### MSL 3.2.1 Coverage

### ModelicaTest 3.2.1 Coverage

# What is OpenModelica? (IV)

- Open-source community services
  - Extensive testing (unit & library coverage: 80 libraries, 15267 models) with interactive result comparison. 10+ test servers currently
    - <https://libraries.openmodelica.org/branches/overview-combined.html>
    - Linux (GCC & CLANG), Windows (MinGW GCC), Mac OS (GCC) - (deprecated after 1.16)
    - Platforms: x86, x86\_64, ARM
    - 3 runtimes: FMI, C runtime, C++ runtime
  - ~10,449 tests ran on each pull request via Hudson
  - Automatic nightly builds for Window & Linux & Mac OS (deprecated after 1.16)



OpenModelica Library Testing

Statistics  
Number of libraries 77  
Number of models 17001

Tested branches

Branch	Version	Build time	Execution time	# Simulate	Total
v1.8.1-rml	1.8.1 (r11645+2)	2019-04-06 07:30:16 2 days, 7:02:18	1461	12322	12322
v1.9.0-rml	1.9.0 (r17627)	2020-11-15 08:03:08 3 days, 19:57:56	6259	16395	16395
v1.9.1	1.9.1 (r22929) (Bootstrapping version)	2021-01-23 04:24:29 16:19:29	742	16441	16441
v1.9.2	1.9.2 (r25115 C++)	2021-01-23 04:37:39 2 days, 1:48:43	4291	16441	16441
v1.9.3	OpenModelica 1.9.3	2018-06-09 07:30:59 2 days, 1:36:35	5762	10832	10832
v1.9	v1.9.7-v1.9.7.3-g634761f81	2021-01-23 04:51:36 1 day, 15:49:42	5267	16441	16441
v1.11	v1.11.0-v1.11.0.8-g8d6991e5b	2021-01-23 05:05:06 1 day, 11:43:55	5395	16441	16441
v1.12	OMCCompiler v1.12.0-v1.12.0.7 ga21325026	2021-01-23 05:18:16 2 days, 1:51:22	5598	16441	16441
v1.13	OMCCompiler v1.13.2	2021-01-23 05:31:29 2 days, 20:44:05	12372	15079	15079
v1.14	OMCCompiler v1.14.2-v1.14.2.6-g5c25d2477	2021-01-22 10:41:08 3 days, 0:34:32	12575	15079	15079
v1.16	OMCCompiler v1.16.1-v1.16.1.15-gfd2a6c15b	2021-01-22 12:40:03 3 days, 2:17:46	12408	15079	15079
master	OMCCompiler v1.18.0-dev.-g263a0c58c8	2021-01-29 21:59:28 2 days, 15:46:18	13692	16441	16441

Advanced Noise

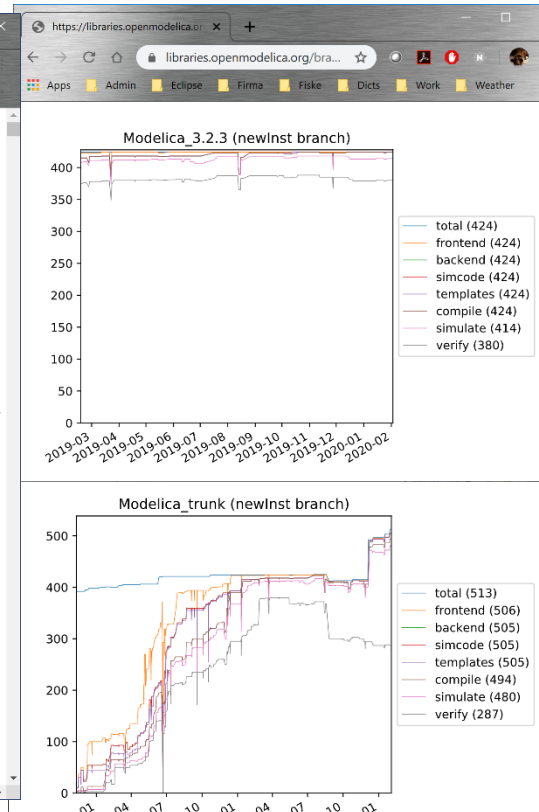
Version	v1.8.1-rml	v1.9.0-rml	v1.9.1	v1.9.2	v1.9.3	v1.9	v1.11	v1.12	v1.13	v1.14	v1.16	master
Version	1.0.0	1.0.1 (revision 1.0.0-35-g7036d68)	1.0.1	1.0.1	1.0.0	1.0.1	1.0.1	1.0.1	1.0.1	1.0.1	1.0.1	1.0.1
Revision		1.0.1-20190515-172471-git-master	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac	1.0.0-5-gaa44378	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac	1.0.1-rc1-3-g5ce57ac

Branch Total Parsing Frontend Backend SimCode Templates Compilation Simulation Verification

Branch	Total	Parsing	Frontend	Backend	SimCode	Templates	Compilation	Simulation	Verification
v1.8.1-rml	15	15	0	0	0	0	0	0	0
v1.9.0-rml	15	15	0	0	0	0	0	0	0
v1.9.1	15	15	0	0	0	0	0	0	0
v1.9.2	15	15	0	0	0	0	0	0	0
v1.9.3	15	15	1	1	1	1	1	1	1
v1.9	15	15	0	0	0	0	0	0	0
v1.11	15	15	0	0	0	0	0	0	0
v1.12	15	15	0	0	0	0	0	0	0
v1.13	15	15	2	2	2	2	2	2	2
v1.14	15	15	2	2	2	2	1	1	0
v1.16	15	15	2	2	2	2	2	2	2
master	15	15	2	2	2	2	4	4	0

Branch Total Parsing Frontend Backend SimCode Templates Compilation Simulation Verification

Branch	Total	Parsing	Frontend	Backend	SimCode	Templates	Compilation	Simulation	Verification
v1.8.1-rml	0.0127	30.88	15.06	0.00	0.00	0.00	0.00	0.00	0.00
v1.9.0-rml	0.4550	54.70	0.4403	0.06	0.00	0.04	0.36	0.00	0.00
v1.9.1	8.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
v1.9.2	8.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



# What is OpenModelica? (V)

- **An incubator platform for research**
  - 9 PhDs since 2004 (Debugging, Parallelization, PDEs Extensions)
  - 36 Master's theses since 2004
  - Both the students and the project benefit
- **Master theses at PELAB 2006-2018**
  - Refactoring/Parsing and Language extensions
  - UML/SysML view of Modelica code
  - 2D and 3D visualization tools
  - Static and runtime debugging tools
  - Advanced code generation and parallelization of simulation code
  - Bootstrapping and Java Interface
  - Function pointers
  - NVIDIA for Cuda and OpenCL parallel simulation
  - OMEdit - Modelica Connection Editor
  - OMWeb - server based Modelica simulation for teaching
  - OMCcc parser
  - PDE-solver using ParModelica
- **External Master theses**
  - Model based diagnostics at ISY (Dep. Of Electrical Engineering)
  - Monte-Carlo simulation of Satellite Separation Systems at SAAB
  - Interactive Simulations (EADS)
  - Additional Solvers + Event handling (FH-Bielefeld)
  - EADS - ModelicaML
- **A Base for commercial and open source products**
  - MathCore AB, Bosch Rexroth, VTT, Equa, Evonik, ABB



# OpenModelica Roadmap - Past

1997 - started as a master thesis

2003 - first usable internal version

2004 - first external version: OpenModelica 1.1

2005 - more development: OpenModelica 1.3.1

2006 - major milestone

- Translated the whole compiler to MetaModelica
- Integrated Development Environment for the compiler
- OpenModelica website started
- Moved the code repository to Subversion management
- Extended the OpenModelica environment with new tools
- 4 versions released during the year
- External people start using OpenModelica
  - ~ 200 downloads/month
  - first development course at INRIA

# OpenModelica Roadmap - Past

2007 - continued development and community involvement

- Improvement in website, support and documentation
- Answered ~1000 questions on the forum
- Portability is highly improved, ported to 4 platforms
  - Linux, Mac, Solaris, Windows (version 1.4.3)
- Improvement of the compiler development tools in Eclipse
- OpenModelica Community starts to react
  - contribute code & report bugs & request enhancements & participate in answering questions in the OpenModelica forum
  - participate at courses and workshops
- New server acquired for better community services
- Increased usage: ~600 downloads/month
- Open Modelica Consortium created in December 4
  - 4 months of work
  - 9 organizations as members already (3 Universities, 6 Companies)
  - discussions are ongoing with other 6 companies

## 2008 - Further work on the compiler

- Release 1.4.4 and 1.4.5
  - Linux, Mac, Solaris, Windows
- New Solver Interface
- Refactoring
- Dynamic loading of functions
- Merging of MathCore front-end code
- 744 commits in Subversion
- Other things I don't remember

## 2009

- Work mainly happened in OSMC (partially on a non-public branch)
- **Front-end**
  - Refactoring (OSMC)
  - Enumerations (OSMC)
  - Java Interface and Bootstrapping (Martin Sjölund)
  - MultiBody flattening (OSMC)
  - Constraint connection graph breaking (VTT + OSMC)
  - Support for Modelica 3.x and 3.x annotations (OSMC)
- **Back-end**
  - Tearing in the back-end (Jens Frenkel)
  - Template Code Generation and CSharp backend (Pavol Privitzer, Charles University Prague)
  - Interactive Simulations (EADS)
  - C++ Code generation (Bosch Rexroth)
  - Java Interface and Bootstrapping (Martin Sjölund)
  - Additional Solvers + Events (Willi Braun, FH-Bielefeld)
- **General**
  - New ModelicaML + SysML prototype (EADS)
  - 1144 commits in subversion (Since 2009 to February 8, 2010)
  - Bug fixes (OSMC)
  - Release 1.5.0 and 1.5.0-RC\_X (Linux, Mac, Solaris, Windows)
- **More things I don't remember**

# OpenModelica Roadmap - Past

## 2010 - 2011

- Support for Modelica Standard Library 3.1 (Media & Fluid in works)
- **Front-end**
  - MultiBody flattening (OSMC)
  - Support for Modelica 3.x and 3.x annotations (OSMC)
  - Performance Enhancements
  - Stream connectors
  - Media & Fluid work is on the way
- **Back-end**
  - Back-end redesign (Jens, Willi, Martin, Per, Adrian, Kristian, Filippo)
  - Tearing in the back-end (Jens Frenkel)
  - Template Code Generation and CSharp backend (Pavol Privitzer, Charles University Prague)
  - Interactive Simulations (EADS)
  - C++ Code generation (Bosch Rexroth)
  - Additional Solvers + Events + Linearization (Willi Braun, FH-Bielefeld)
- **General**
  - OMEdit - new connection editor
  - Bootstrapping OMC (90% finished)
  - 2550 commits in subversion from 2010 to Feb. 7, 2011 (double than 2009-2010)
  - Bug fixes ~300+ (OSMC)
  - Release 1.6.0 (Linux, Mac, Windows)
  - Downloads Windows (~16434) , Linux (~8301), Mac (~2816)
- **More things I don't remember**

# OpenModelica Roadmap - Past

2012 - 2013

- Support for Modelica Standard Library 3.2.1 including Media & Fluid
- **Front-end**
  - Performance Enhancements
  - Media & Fluid work
  - Operator overloading
  - New instantiation module started
- **Back-end**
  - Modular back-end with more optimization modules (Jens, Willi, Martin)
  - New simulation runtime redesign (Willi, Lennart, Jens, Martin, Adrian)
  - C++ Code generation (Bosch Rexroth)
  - FMI export & import
  - Initialization, Jacobians (Lennart Lochel, Willi Braun, FH-Bielefeld)
  - Support for parallelization (Martin)
  - Parallel extensions in functions
- **General**
  - Uncertainties support (OpenTURNS connection & Data reconciliation)
  - MDT GDB debugging based on GDB and the bootstrapped compiler
  - OMEdit - improvements
  - Bootstrapping OMC (100% finished) using Boehm GC
  - 3909 commits in subversion from 2012 to Feb. 4, 2013
  - 2000 forum posts (questions and answers)
  - Bug fixes ~247+ (OSMC)
  - Release 1.9.0 (Linux, Mac, Windows)
  - Downloads Windows (~45307) , Linux (~15543), Mac (~5367)
- **More things I don't remember**

# OpenModelica Roadmap - Past

- 2014 - 2017 - Most focus on libraries support & performance
  - MSL 3.2.1 (100% build/98% simulate), ModelicaTest 3.2.1, PetriNet, Buildings, PowerSystems, OpenHydraulics, ThermoPower, and ThermoSysPro
  - Switch to bootstrapped compiler
- Front-end, Back-end, Simulation Runtime, Graphical Clients
  - Development switched to bootstrapped compiler since November 2014
  - Partially new graph-based front-end with better support for libraries
  - Improved back-end: initialization, system solving, parallelization, cse optimization, dynamic optimization
  - Faster and much more user friendly OpenModelica Connection editor
- General
  - ~9000 commits in subversion from Feb. 2014 to Feb., 2016
  - Bug fixes
  - Release 1.9.2 (Linux, Mac, Windows)

# OpenModelica Roadmap - Past

- 2018 - 2019 - focus on performance, scalability, bug fixes
- OMC & Clients
  - Performance & scalability improvements
  - Bug fixes to OMC, OMCedit, FMI
- OMSimulator
  - Combined FMI & TLM support, SSP support
  - OMCedit GUI support
- OMJulia
  - API to access OpenModelica from Julia
- General
  - From Feb 2018 - Feb 2019
    - 30+ contributors
    - 800 commits (OMCompiler)
    - 969 commits (OMSimulator)
    - 213 commits (OMCedit)
  - Releases 1.13.0, 1.13.1, 1.13.2



- 2018 - 2019 - focus on performance, scalability, bug fixes
- **New Front-End - status**
  - The new front-end ~90% complete, (see #4138 on Trac)
  - 100+ times faster, 5+ times less memory consumption (no array expansions, no expansion of for loops in equations)
  - The new front-end also brings better support for libraries
  - Developed in line with MCP-0019: Flattening
  - Currently 423/424 models from MSL 3.2.3 pass the new front-end
  - Last year 107/387 models from MSL 3.2.3 passed the new front-end
- **New Front-End - remaining work**
  - Expandable connectors (add virtual nodes)
  - Making the backend cooperate with the new way the DAE is produced
  - Support for state machines
  - (Support for MetaModelica)

# OpenModelica Roadmap - Past

- 2018 - 2019 - focus on performance, scalability, bug fixes
- OMEdit - better Modelica support
  - Much more stable OMEdit, a lot of bug fixes and new usability features
  - Auto completion support
  - Support for OMSimulator
- Redeclare and Replaceable Support
  - Waiting for the new front-end to become mature enough so we don't frustrate users

- 2019 - 2020 - focus on performance, scalability, bug fixes
- OMC & Clients
  - Performance & scalability improvements
  - Bug fixes to OMC, OMCedit, FMI
- OMSimulator
  - Combined FMI & TLM support, SSP support
  - OMCedit GUI support
- General
  - From Feb 2019 - Feb 2020
    - 30+ contributors
    - 929 commits (OpenModelica/OMCompiler/OMCedit)
    - 100 commits (OMSimulator)
  - Releases 1.13.2, 1.14.1

# OpenModelica Roadmap - Past

- 2020 - 2021 - focus on performance, scalability, bug fixes
- OMC & Clients
  - Performance & scalability improvements
  - Bug fixes to OMC, OMCedit, FMI
  - First replaceable support in OMCedit
  - New Fronted by default in 1.16.x
  - Better FMI export
- OMSimulator
  - Combined FMI & TLM support, SSP support
  - OMCedit GUI support
- General
  - From Feb 2020 - Feb 2021
    - 33+ contributors
    - 878 commits (OpenModelica/OMCompiler/OMCedit)
    - 139 commits (OMSimulator)
  - Releases 1.16.x

## ■ Testing procedure

- <https://libraries.openmodelica.org/branches/overview-combined.html>
- Run tests on previous OpenModelica version until 1.12.x
- Detect both model regression and performance regression, all information saved in a database
- 80 libraries, 15267 models with interactive result comparison.
  - 10+ dedicated test servers
  - Linux (GCC & CLANG), Windows (MinGW GCC), Mac OS (GCC) (deprecated)

## Statistics

- Platforms: x86, x86\_64, ARM
- 5 runtimes: FMI, C runtime, C++ runtime, oldInst, daeMode

Number of libraries 80

Number of models 15267

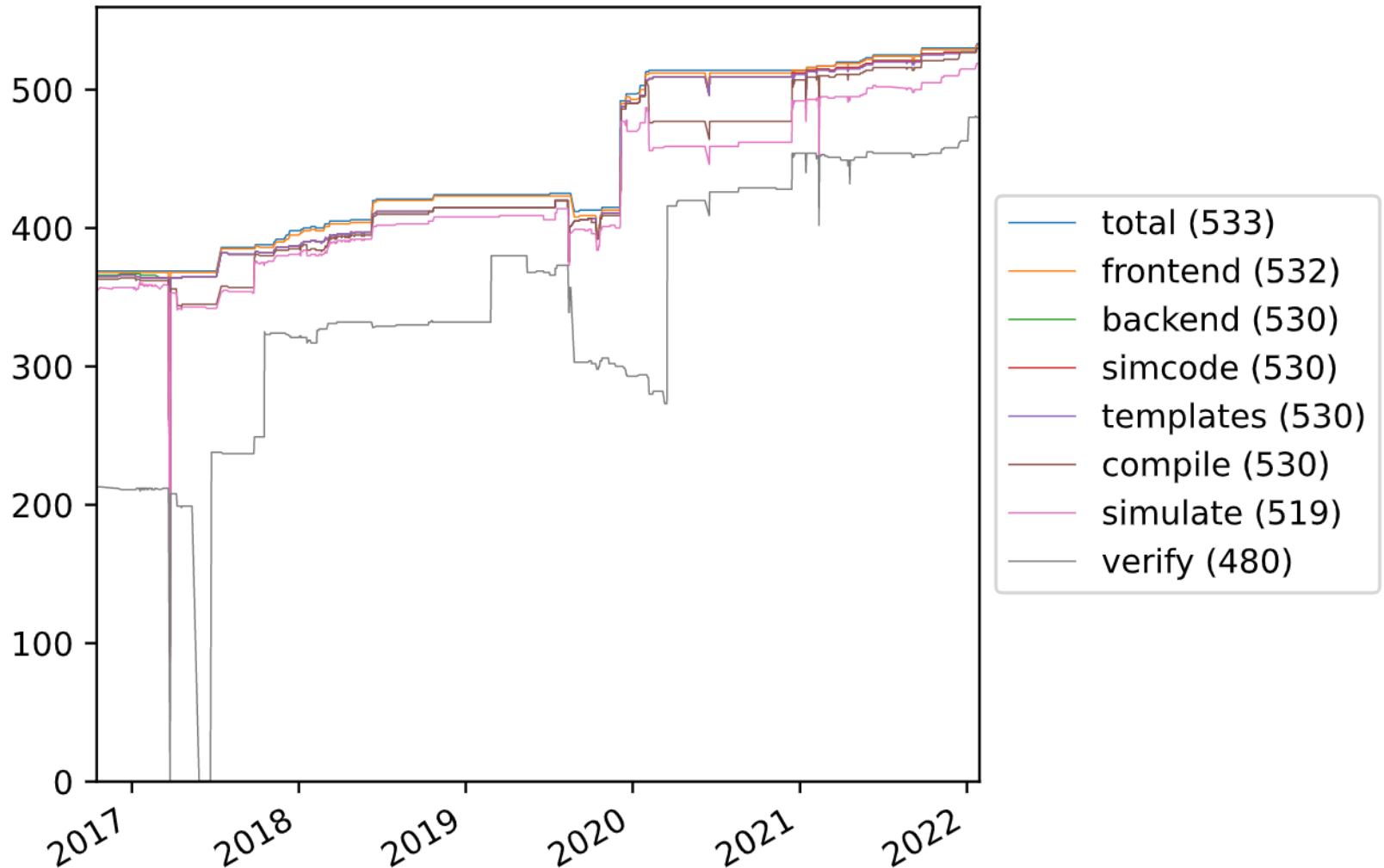
## Tested branches

Branch	Version	Build time	Execution time	# Simulate	# Total
v1.12	OMCompiler v1.12.0-v1.12.0.7+ga21325026	2022-01-29 03:46:20	6 days, 8:21:58	11623	15267
v1.13	OMCompiler v1.13.2	2022-01-29 07:45:05	2 days, 16:20:04	11947	15267
v1.14	OMCompiler v1.14.2-v1.14.2.6+g5c52d52477	2022-01-29 08:25:11	2 days, 20:35:49	12053	15267
v1.16	OMCompiler v1.16.5-v1.16.5.1+g6adae6a043	2022-01-29 09:11:54	2 days, 22:41:44	11860	15267
v1.17	OMCompiler v1.17.0-v1.17.0.10+g03f0da6bf5	2022-01-29 09:56:51	2 days, 2:38:13	12229	15267
v1.18	OMCompiler v1.18.0-v1.18.0.38+ga767f054d8	2022-01-30 21:15:33	1 day, 20:33:03	12952	15267
master	OMCompiler v1.19.0-dev.551+g1772c4b421	2022-01-30 21:18:09	2 days, 10:28:56	13457	15267

# OpenModelica Testing (II)

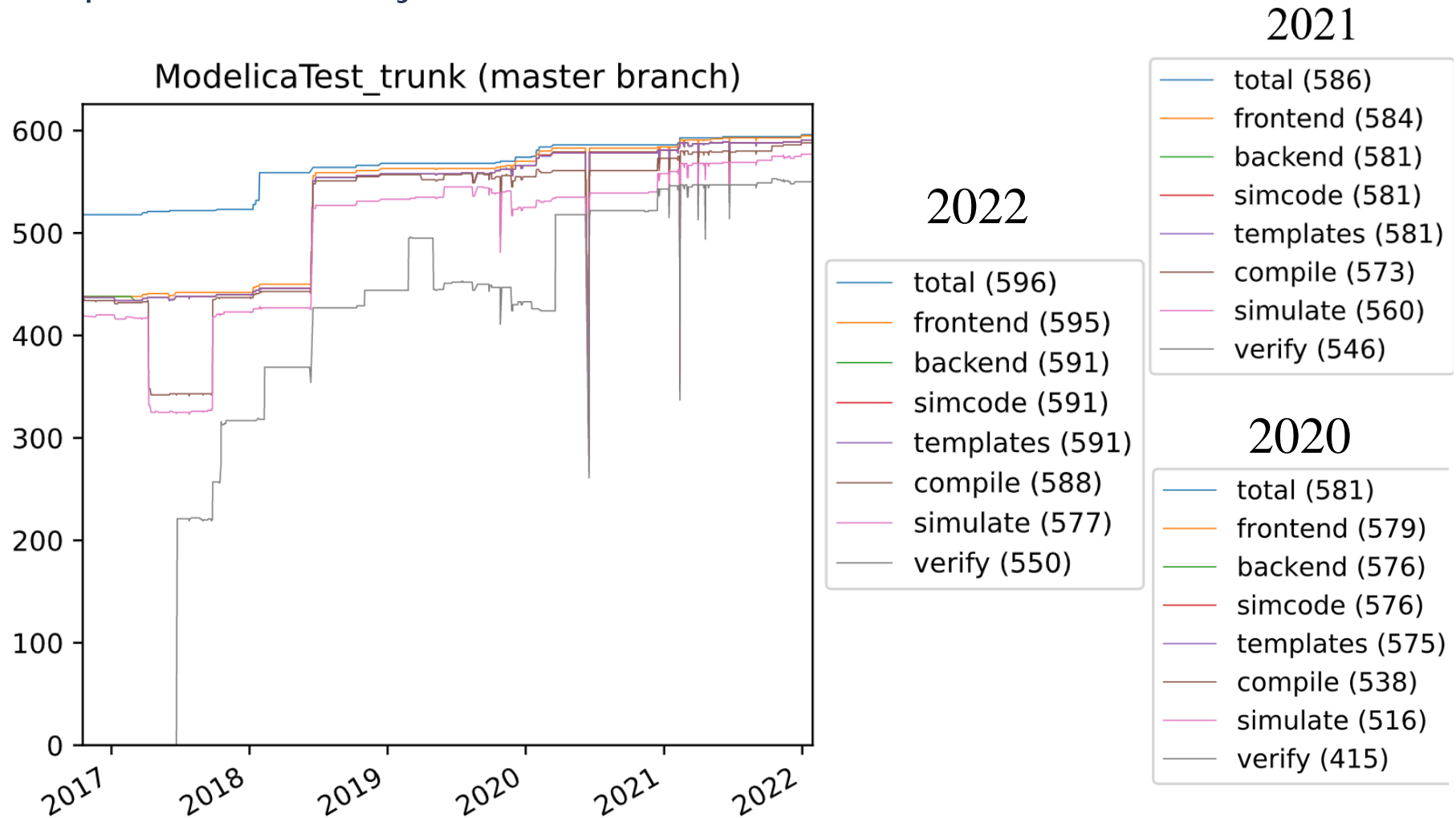
- 2022-31-01 v1.19-dev - total 533 - build 530 (99%) - sim 519 (97%)
- Up 2% since last year

Modelica\_trunk (master branch)



# OpenModelica Testing (III)

- 2022-01-31 v1.19-dev - total 596 - build 588 (99%) - sim 577 (96%)
- Up ~1% since last year



- Moved the source code to github May 2015
- Mature code base: <https://github.com/OpenModelica>
- ~9000K+ lines of code and tests
  
- From Feb 2017 - Feb 2018
  - 20 contributors
  - 794 commits (OMCompiler)
  
- From Feb 2018 - Feb 2019
  - 30+ contributors
  - 800 commits (OMCompiler)
  - 969 commits (OMSimulator)
  - 213 commits (OMEdit)
  
- From Feb 2019 - Feb 2020
  - 30+ contributors
  - 800 commits (OMCompiler)
  - 459 commits (OMSimulator)
  - 213 commits (OMEdit)

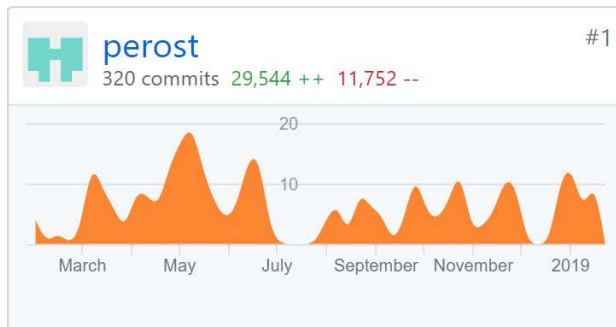
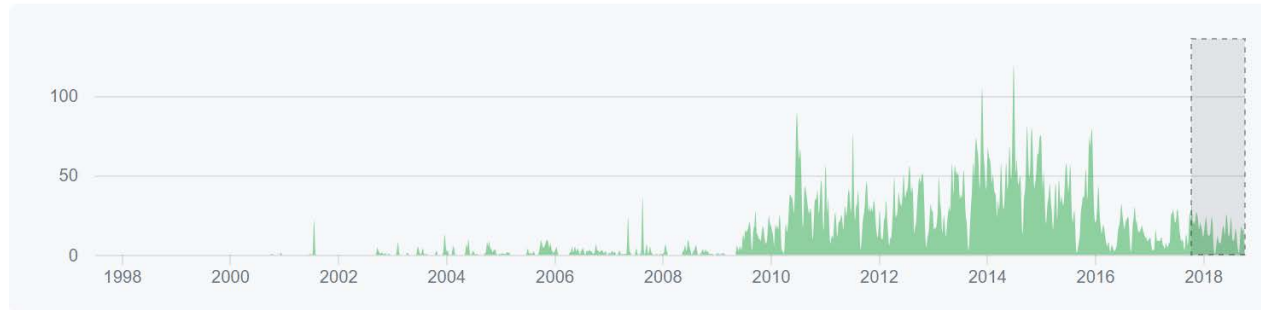


# OpenModelica Statistics (II)

Feb 5, 2018 – Feb 3, 2019

Contributions: Commits ▾

Contributions to master, excluding merge commits

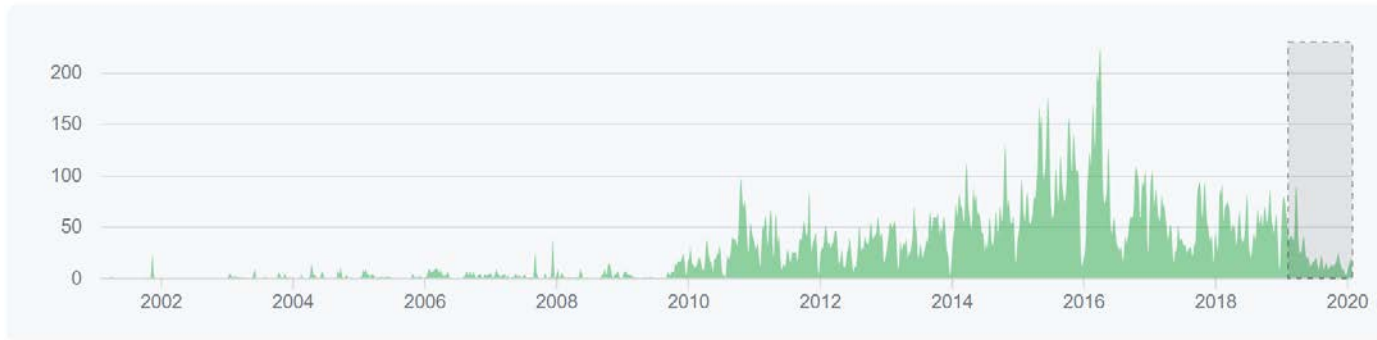


# OpenModelica Statistics (III)

Feb 12, 2019 – Feb 3, 2020

Contributions: Commits ▾

Contributions to master, excluding merge commits

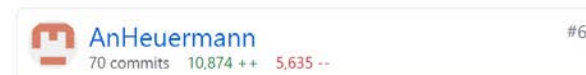
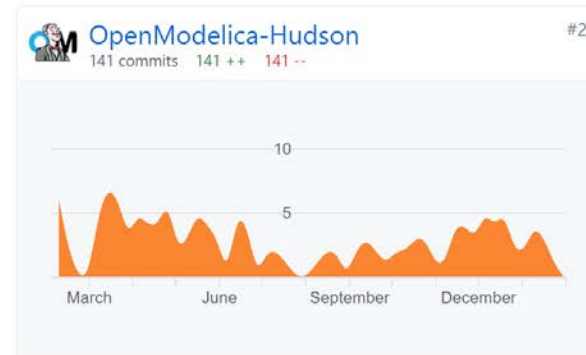
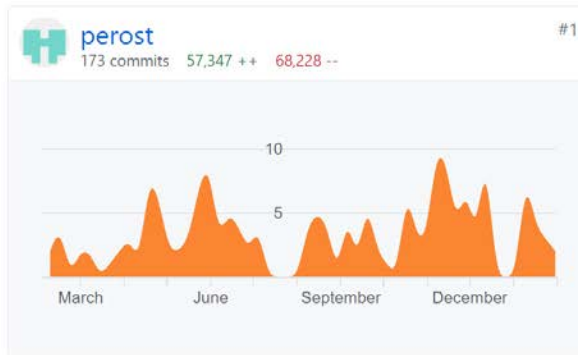
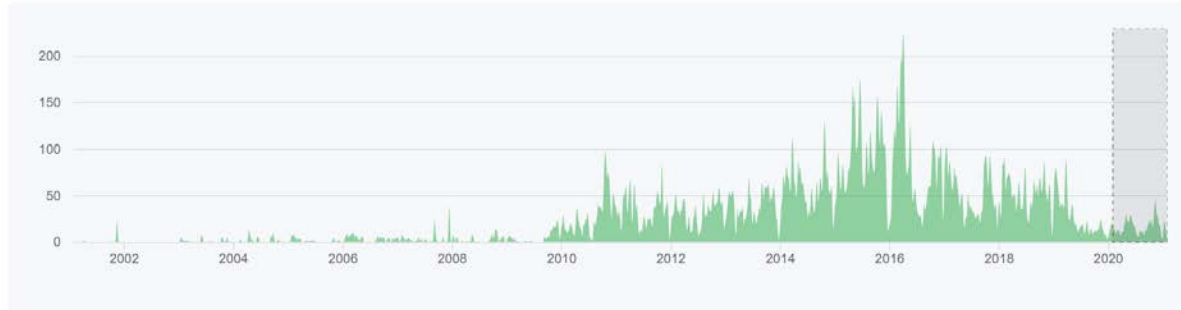


# OpenModelica Statistics (IV)

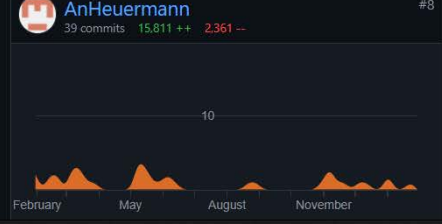
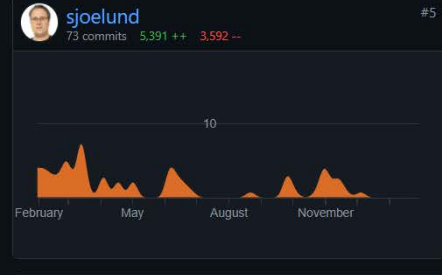
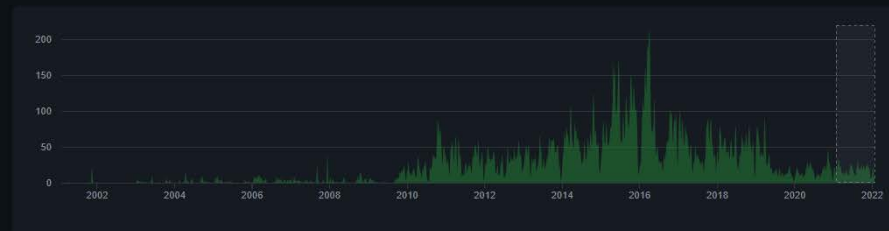
Feb 3, 2020 – Feb 1, 2021

Contributions: Commits ▾

Contributions to master, excluding merge commits

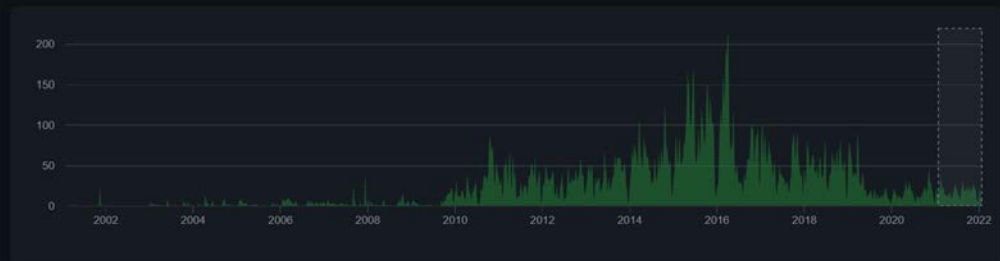


Contributions to master, excluding merge commits and bot accounts

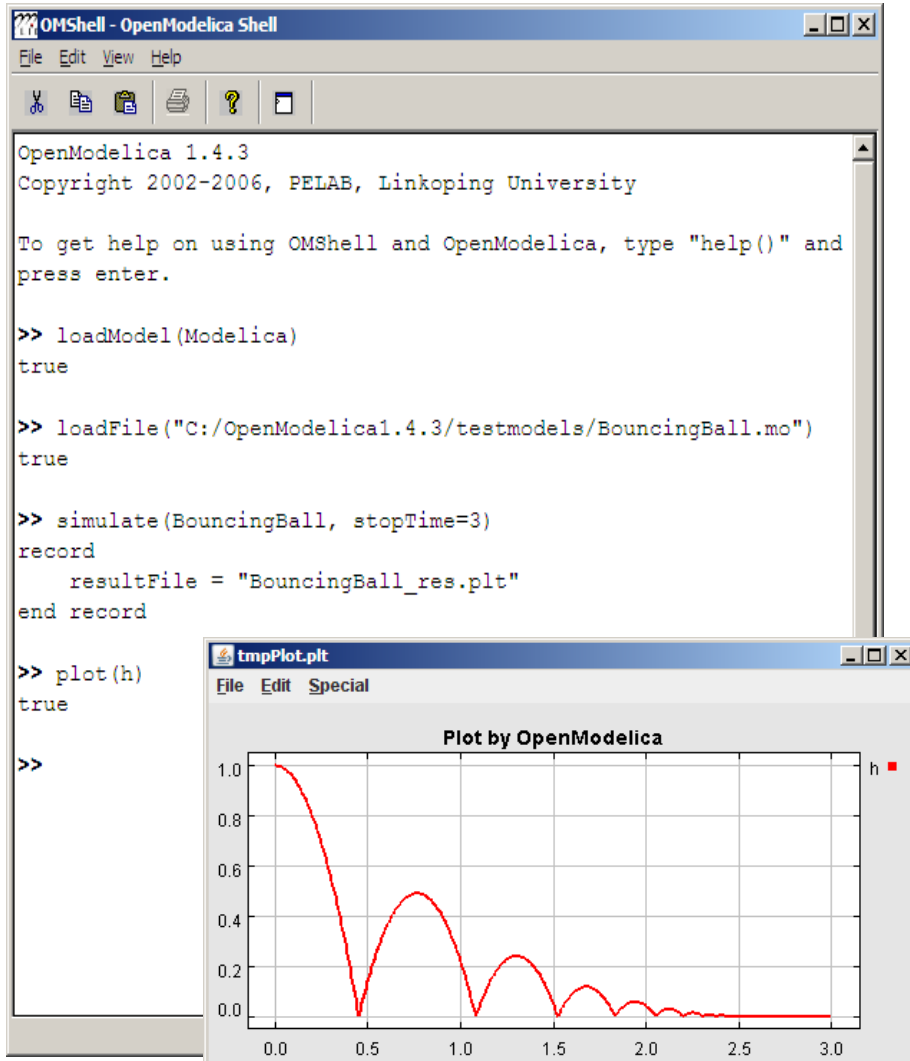


# OM Statistics (V)

Contributions to master, excluding merge commits and bot accounts



- OpenModelica
  - What is OpenModelica?
  - The past
- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook, OMEdit, ModelicaML, OMSimulator, OMPython, OMJulia, OMMatlab
- OpenModelica Development Environment
  - MetaModelica
  - The Eclipse Environment (MDT)
- OpenModelica Latest Developments (2021-2022)



OMShell - OpenModelica Shell

File Edit View Help

OpenModelica 1.4.3  
Copyright 2002-2006, PELAB, Linköping University

To get help on using OMShell and OpenModelica, type "help()" and press enter.

```
>> loadModel(Modelica)
true

>> loadFile("C:/OpenModelica1.4.3/testmodels/BouncingBall.mo")
true

>> simulate(BouncingBall, stopTime=3)
record
  resultFile = "BouncingBall_res.plt"
end record

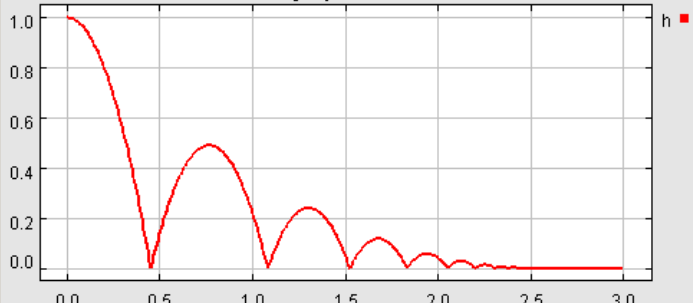
>> plot(h)
true

>>
```

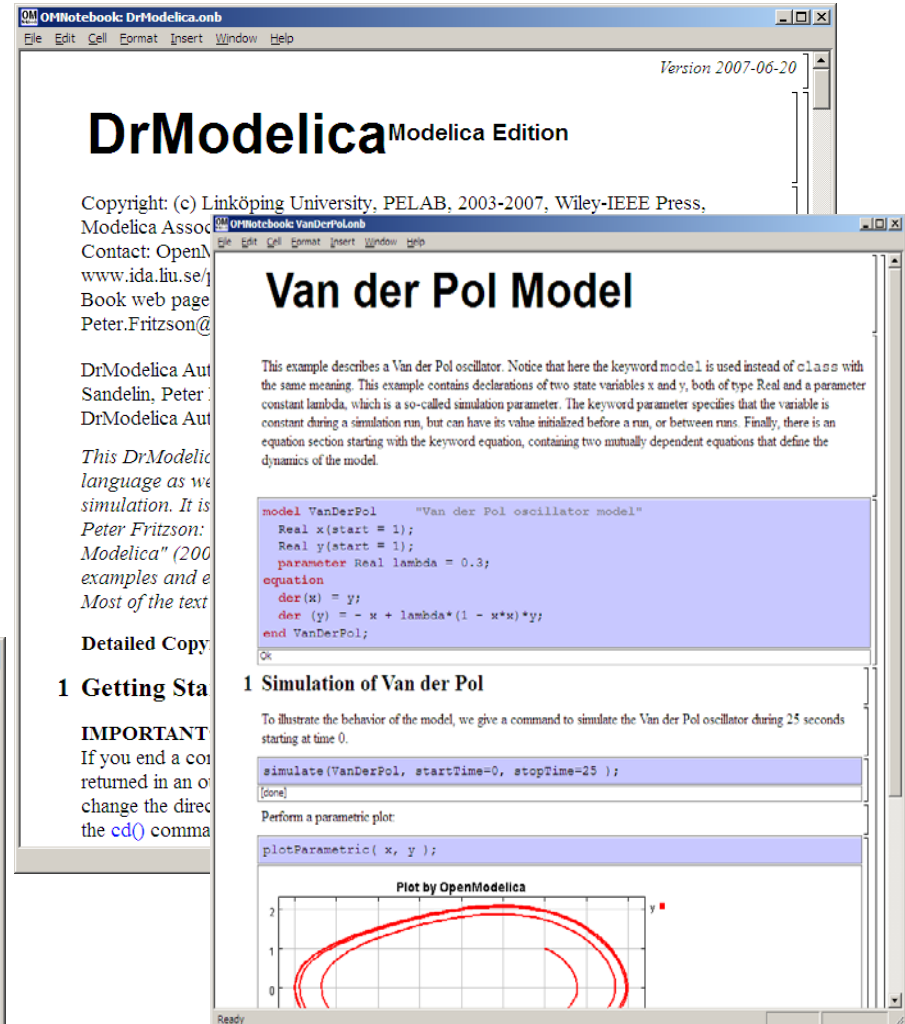
tmpPlot.plt

File Edit Special

Plot by OpenModelica



Time (s)	Height (h)
0.0	1.00
0.5	0.00
1.0	0.50
1.5	0.25
2.0	0.12
2.5	0.06
3.0	0.03



OMNotebook: DrModelica.onb

File Edit Cell Format Insert Window Help

Version 2007-06-20

## DrModelica Modelica Edition

Copyright: (c) Linköping University, PELAB, 2003-2007, Wiley-IEEE Press,  
Modelica Assoc. [www.ida.liu.se/](http://www.ida.liu.se/)  
Book web page  
Peter.Fritzson@

### Van der Pol Model

This example describes a Van der Pol oscillator. Notice that here the keyword `model` is used instead of `class` with the same meaning. This example contains declarations of two state variables `x` and `y`, both of type `Real` and a parameter constant `lambda`, which is a so-called simulation parameter. The keyword parameter specifies that the variable is constant during a simulation run, but can have its value initialized before a run, or between runs. Finally, there is an equation section starting with the keyword `equation`, containing two mutually dependent equations that define the dynamics of the model.

```
model VanDerPol "Van der Pol oscillator model"
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
equation
  der(x) = y;
  der(y) = -x + lambda*(1 - x*x)*y;
end VanDerPol;
```

Ok

### 1 Simulation of Van der Pol

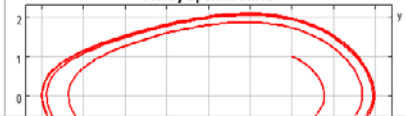
To illustrate the behavior of the model, we give a command to simulate the Van der Pol oscillator during 25 seconds starting at time 0.

```
simulate(VanDerPol, startTime=0, stopTime=25 );
```

[done]

Perform a parametric plot:

```
plotParametric(x, y);
```



Plot by OpenModelica

x	y
1.0	1.0
2.0	1.5
3.0	1.8
4.0	1.5
5.0	1.0
6.0	0.5
7.0	0.0
8.0	0.5
9.0	1.0
10.0	1.5

# OMEdit- OpenModelica Connection Editor

The screenshot displays the OMEdit - OpenModelica Connection Editor window. The title bar shows the application name and standard window controls. The menu bar includes File, Edit, View, Simulation, FMI, Export, Debug, QMSimulator, Git, Tools, and Help. The Libraries Browser on the left lists various libraries, with 'Elementary' > 'DoublePendulum' selected. The main workspace shows a mechanical diagram of a double pendulum system. It consists of a 'world' frame with a coordinate system (x, y) and gravity vectors. A 'damper' block with  $d=0.1$  is connected to the first joint. The system includes two joints, each labeled with 'a' and 'b' and a normal vector  $n=\{0, 0, 1\}$ . Two rectangular blocks, 'boxBody1' and 'boxBody2', are attached to the joints, with their center of mass positions given as  $r=\{0.5, 0, 0\}$ . The Messages Browser at the bottom is currently empty.

- Implemented mainly in MetaModelica (401 packages) and a C/C++ runtime
- Is available as a dynamic library (faster than CORBA/ZMQ)
- Used from OMEdit, OMNotebook, OMShell, OMOptim, OMPython, MDT
- Automatically generated API that can be used from QT



- OpenModelica
  - What is OpenModelica?
  - The past and present
- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook, OMEdit, ModelicaML, OMSimulator, OMPython, OMJulia, OMMatlab
- OpenModelica Development Environment
  - MetaModelica
  - The Eclipse Environment
- OpenModelica Latest Developments (2019-2020)

- **OMC**
  - Implemented mainly in MetaModelica and C/C++
- **Modelica**
  - classes, models, records, functions, packages
  - behavior is defined by equations or/and functions
  - equations
    - differential algebraic equations and conditional equations
- **MetaModelica extensions**
  - local equations
  - pattern equations
  - match expressions
  - high-level data structures: lists, tuples, option and uniontypes

# MDT - Creating Modelica projects (I)

The image shows the Eclipse IDE interface with the 'File' menu open and 'Project...' selected. A 'New Project' wizard dialog is open, showing a tree of project types with 'Modelica Project' selected. A 'New Modelica Project' dialog is also open, showing the project name 'demo' and navigation buttons. Red arrows indicate the flow from the menu to the wizard and then to the project name field.

**File** Edit Refactor Navigate Search Project Run Window Help

New Alt+Shift+N ▶ Project...  
Open File...  
Close Ctrl+F4  
Close All Ctrl+Shift+F4  
Save Ctrl+S  
Save As...  
Save All Ctrl+Shift+S  
Revert  
Move...  
Rename... F2  
Refresh F5  
Convert Line Delimiters To  
Print... Ctrl+P  
Switch Workspace...  
Import

**New Project**  
Select a wizard  
Create a new Modelica project.

Wizards:

- Plug-in Project
- C
- C++
- CVS
- Eclipse Modeling Framework
- EJB
- Functional Programming
- J2EE
- Java
- Modelica
- Modelica Project
- Plug-in Development
- Simple
- Web
- Examples

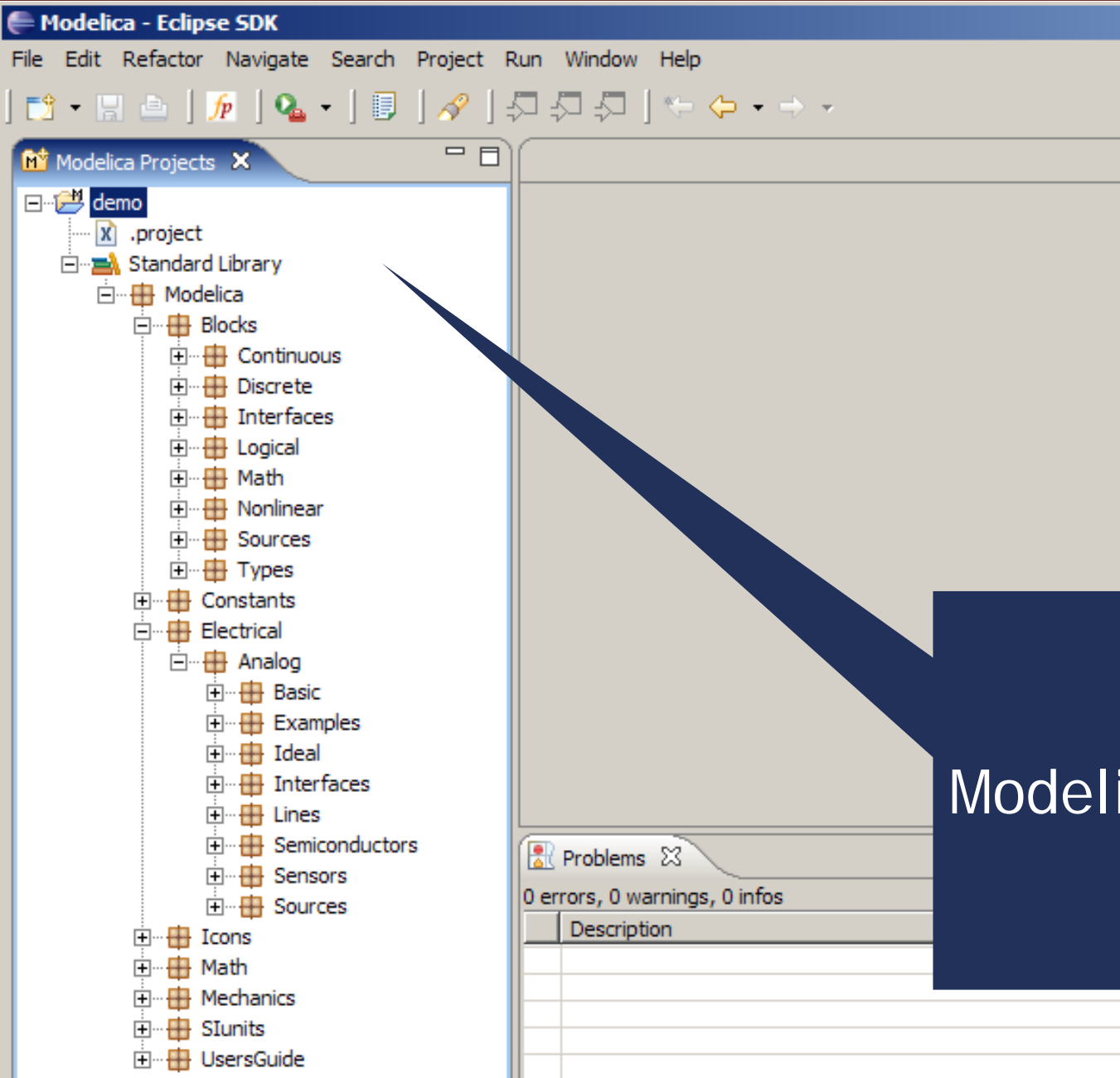
**New Modelica Project**  
Create a Modelica project  
Create a Modelica project in the workspace.

Project name: demo

< Back Next >  
< Back Next > Finish Cancel

Creation of Modelica projects using wizards

# Creating Modelica projects (II)



Modelica project

# Creating Modelica packages

The image shows the Eclipse IDE interface for creating a Modelica package. The 'New' menu is open, and 'Modelica Package' is selected. The 'New Modelica Package' wizard is displayed, with the following fields filled:

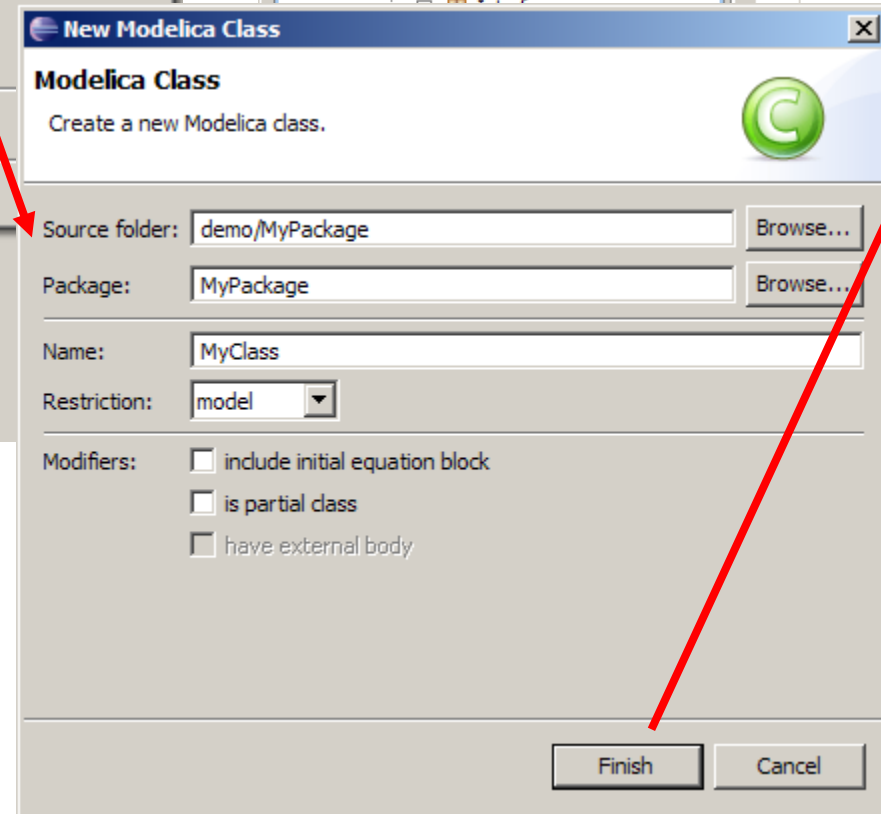
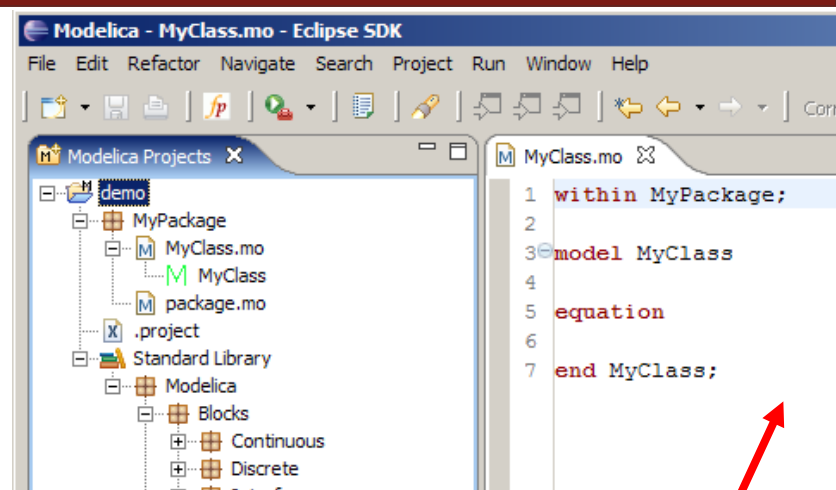
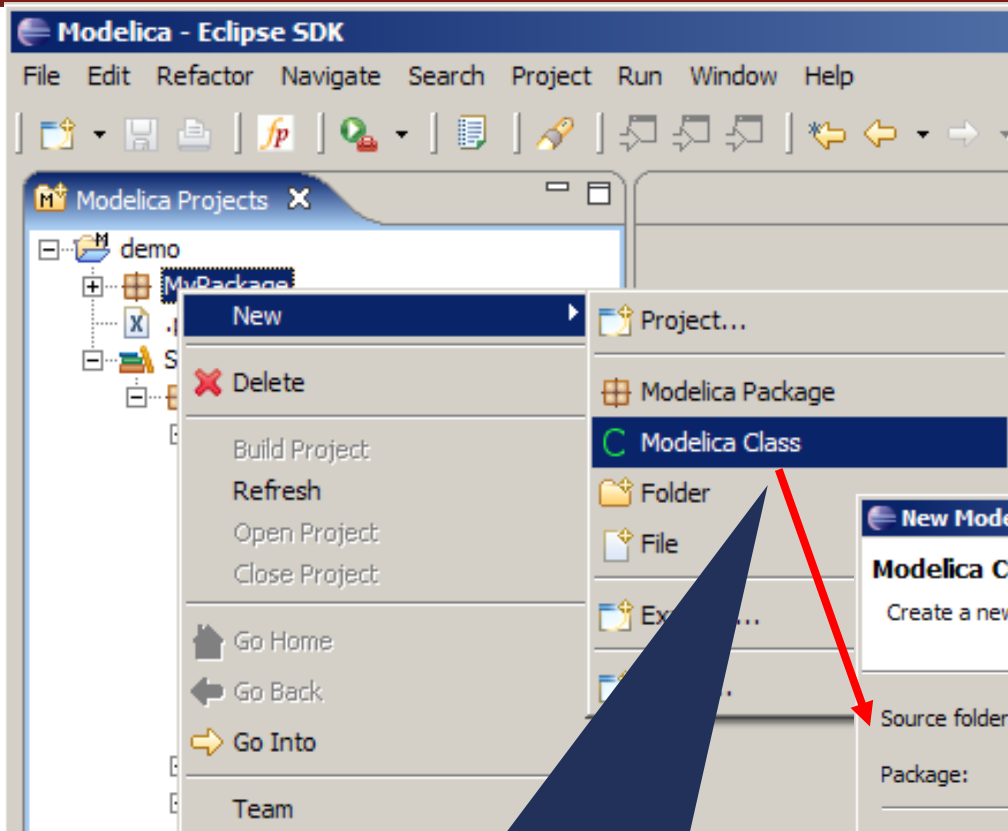
- Source folder: demo
- Package: (empty)
- Name: MyPackage
- Description: A Modelica Package
- is encapsulated package

The 'Finish' button is highlighted with a red arrow, which points to the 'Modelica Projects' view in the background. The 'Modelica Projects' view shows the following structure:

- demo
  - MyPackage
    - package.mo
  - .project
- Standard Library
  - Modelica
    - Blocks
    - Continuous

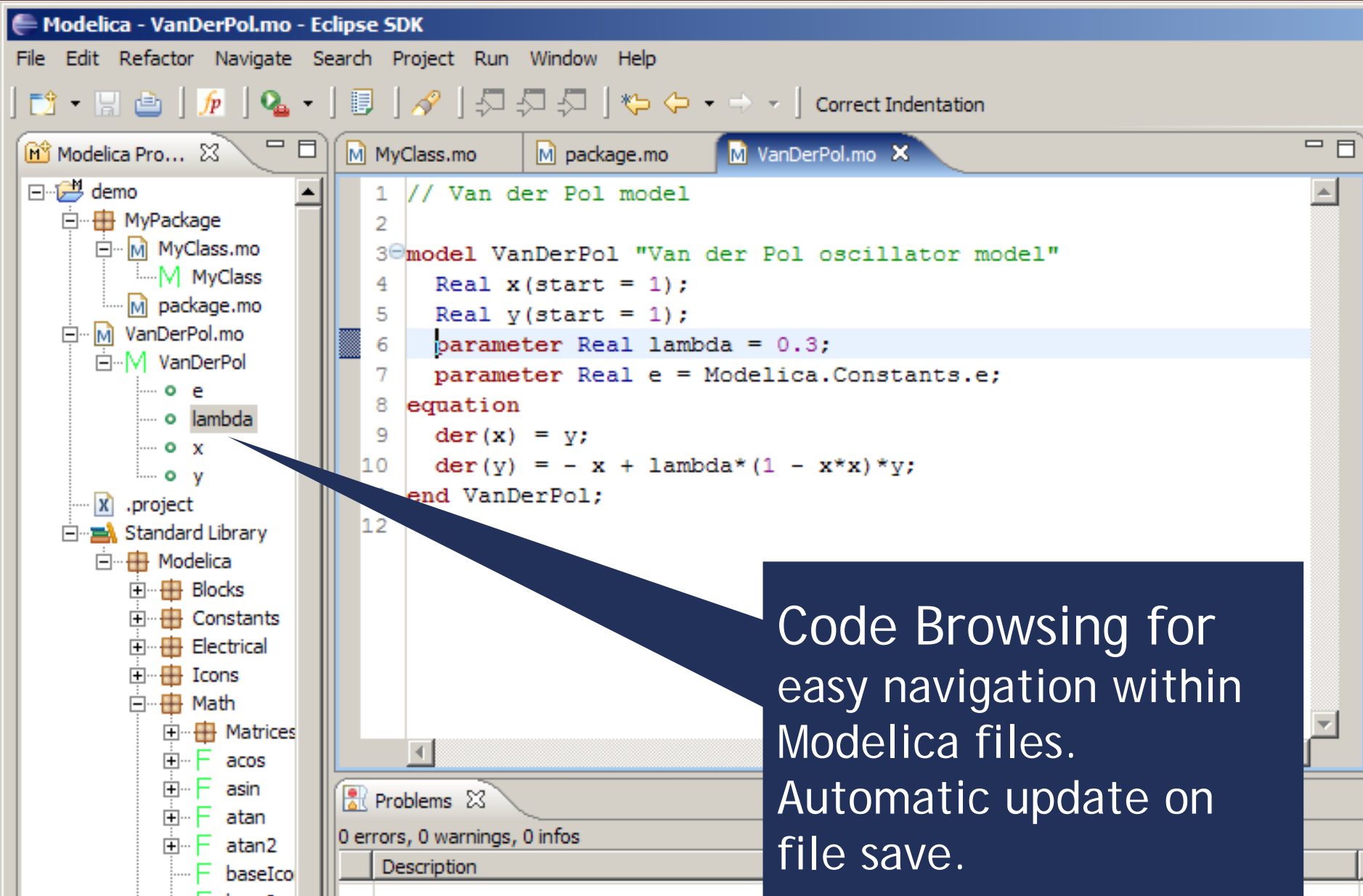
Creation of Modelica packages using wizards

# Creating Modelica classes



Creation of Modelica classes, models, etc, using wizards

# Code browsing



The screenshot shows the Eclipse IDE interface with the following components:

- Menu Bar:** File, Edit, Refactor, Navigate, Search, Project, Run, Window, Help.
- Toolbar:** Includes icons for file operations and a 'Correct Indentation' button.
- Project Explorer (Left):** Shows a project named 'demo' with a package 'MyPackage' containing files 'MyClass.mo', 'package.mo', and 'VanDerPol.mo'. The 'VanDerPol' model is expanded, showing parameters 'e', 'lambda', 'x', and 'y'. The 'lambda' parameter is selected, and a callout points to its definition in the code editor.
- Code Editor (Center):** Displays the source code for 'VanDerPol.mo'. The code is as follows:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   Real x(start = 1);
5   Real y(start = 1);
6   parameter Real lambda = 0.3;
7   parameter Real e = Modelica.Constants.e;
8 equation
9   der(x) = y;
10  der(y) = - x + lambda*(1 - x*x)*y;
11 end VanDerPol;
12
```

Line 6, 'parameter Real lambda = 0.3;', is highlighted in blue. A callout box points from this line to the 'lambda' parameter in the Project Explorer.
- Problems View (Bottom):** Shows '0 errors, 0 warnings, 0 infos'.

**Code Browsing for easy navigation within Modelica files. Automatic update on file save.**

# Error detection (I)

The screenshot shows the Eclipse IDE with the following components:

- Project Explorer:** Shows a project named 'demo' containing a package 'MyPackage' with files 'MyClass.mo', 'package.mo', and 'VanDerPol.mo'. The 'VanDerPol' model is expanded to show variables 'e', 'x', and 'y'.
- Code Editor:** Displays the content of 'VanDerPol.mo'. The code is as follows:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   Real x(start = 1);
5   Real y(start = 1);
6   parameter Real lambda = 0.3;
7   parameter Real e = Modelica.Constants.e;
8 equation
9   der(x) = y;
10  der(y) = - x + lambda*(1 - x*x)*y;
11 end VanDerPol;
12
```
- Problems Window:** Shows 1 error, 0 warnings, and 0 infos. The error details are:

Description	Resource	In Folder	Location
unexpected token: lambda, parsing resumed at token ';' on line 6, column 29	VanDerPol.mo	demo	line 6

Parse error  
detection on  
file save



# Error detection (II)

The screenshot shows the Eclipse IDE interface with the following components:

- Modelica Projects:** A tree view on the left showing a project structure with folders like 'Compiler', 'absyn\_builder', 'doc', 'modpar', 'omc\_debug', 'omc\_release', 'report', 'rml2mmo', 'rml2sig', 'runtime', 'scripts', 'test\_codegen', 'tools', 'VC7', 'winruntime', and files like 'Absyn.mo', 'Algorithm.mo', 'Builtin.mo', 'Ceval.mo', 'ClassLoader.mo', 'Codegen.mo', 'Connect.mo', 'Corba.mo', 'DAE.mo', 'DAEEXT.mo', 'DAELow.mo', 'Debug.mo', and 'Derive.mo'.
- Absyn.mo Editor:** The main editor window shows the following code:

```
69 public
70 uniontype Program "- Programs, the top level construct
71 A program is simply a list of class definitions declared at top
72 level in the source file, combined with a within statement that
73 indicates the hieractical position of the program.
74 "
75 record PROGRAM
76 list<Class> classes "classes ; List of classes" ;
77 Withi within_ "within ; Within statement" ;
78 end PROGRAM;
79
```

Line 77 is highlighted in blue, and a red 'X' icon is visible in the left margin next to it.
- Problems/Console:** The bottom panel shows the console output of a compilation process. The error message is: `Absyn.mo:77.5-77.9 Error: unbound type constructor Withi`. Other messages include `make[2]: Leaving directory ...` and `make[1]: Leaving directory ...`.

Semantic error  
detection on  
compilation

# Code assistance (I)

The screenshot shows the Eclipse IDE interface with the following components:

- Project Explorer (Left):** Shows a project named 'demo' containing a package 'MyPackage' with files 'MyClass.mo', 'package.mo', and 'VanDerPol.mo'. The 'VanDerPol.mo' file is expanded to show a class 'VanDerPol' with parameters 'e', 'lambda', 'x', and 'y'. Below it is a 'Standard Library' containing 'Modelica' with sub-packages like 'Blocks', 'Constants', 'Electrical', 'Icons', 'Math', 'Matrices', and 'acos'.
- Editor (Center):** Displays the code for 'VanDerPol.mo'. The code is:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   import Modelica.
5   Real x(start = 1
6   Real y(start = 1
7   parameter Real l
8   parameter Real e
9   equation
10    der(x) = y;
11    der(y) = - x + 1
12 end VanDerPol;
13
```

Line 4 is highlighted, and a code assistance popup is visible.
- Code Assistance Popup (Right):** A list of packages from the 'Standard Library' is shown, including 'Blocks', 'Constants', 'Electrical', 'Icons', 'Math', 'Mechanics', 'SIunits', and 'UsersGuide'.
- Problems View (Bottom):** Shows '0 errors, 0 warnings, 0 infos'.

Code Assistance on imports

# Code assistance (II)

The screenshot shows the Eclipse IDE with the following components:

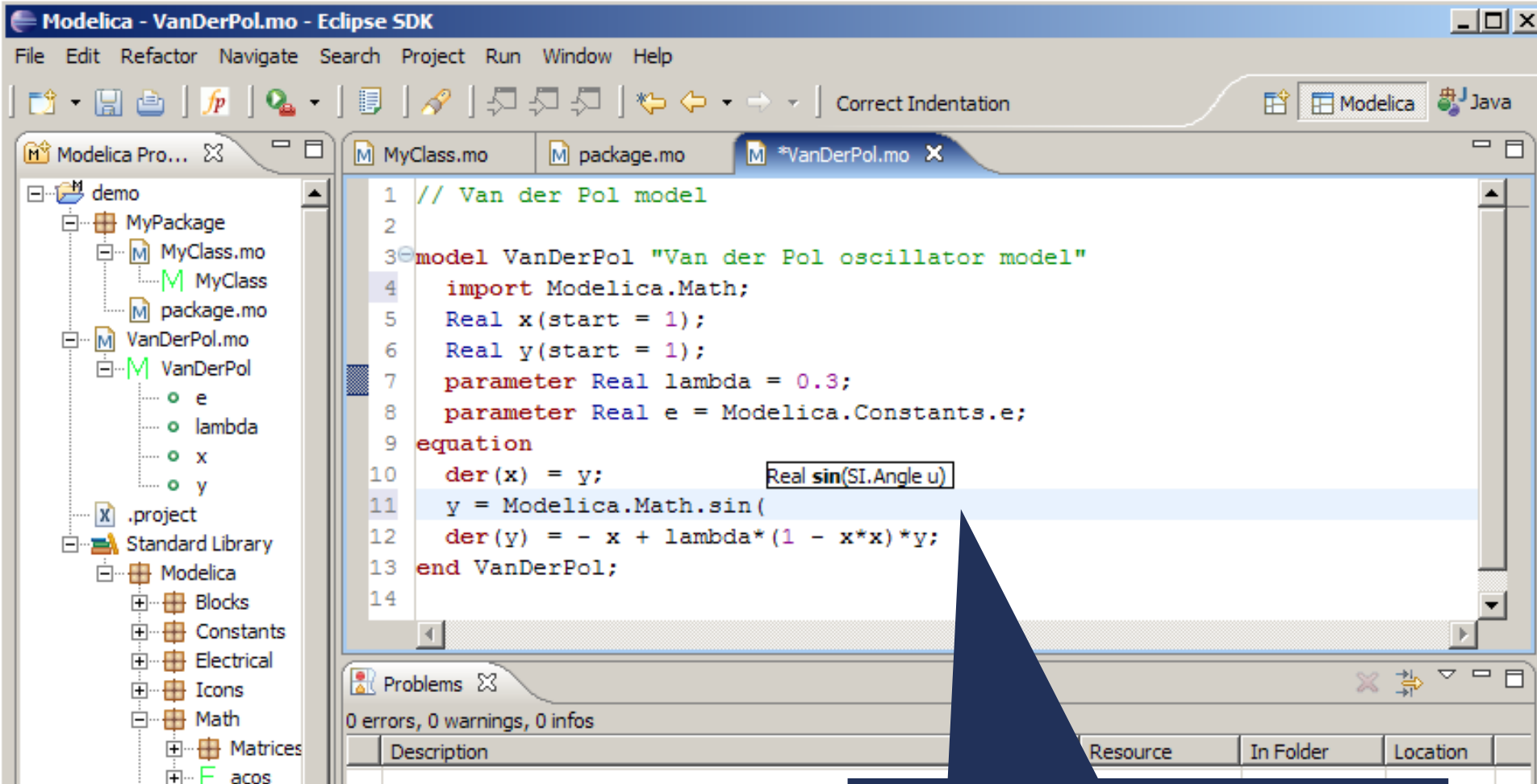
- Project Explorer:** Shows a project named 'demo' with a package 'MyPackage' containing 'MyClass.mo', 'MyClass', and 'package.mo'. A sub-package 'VanDerPol' contains 'VanDerPol.mo', 'e', 'lambda', 'x', and 'y'. There is also a 'Standard Library' containing 'Modelica' (with sub-packages 'Blocks', 'Constants', 'Electrical', 'Icons', 'Math', 'Matrices') and functions 'acos' and 'asin'.
- Editor:** Displays the file '\*VanDerPol.mo' with the following code:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   import Modelica.Math;
5   Real x(start = 1);
6   Real y(start = 1);
7   parameter Real lambda = 0.3;
8   parameter Real e = Modelica.Constants.
9 equation
10  der(x) = y;
11  der(y) = - x + lambda*(1 - x*x)*y;
12 end VanDerPol;
13
```

Line 8 is selected, and a completion list is shown on the right with 'e' highlighted.
- Problems View:** Shows '0 errors, 0 warnings, 0 infos'.
- Table:** A table with columns 'Description', 'Resource', 'In Folder', and 'Location' is visible at the bottom.

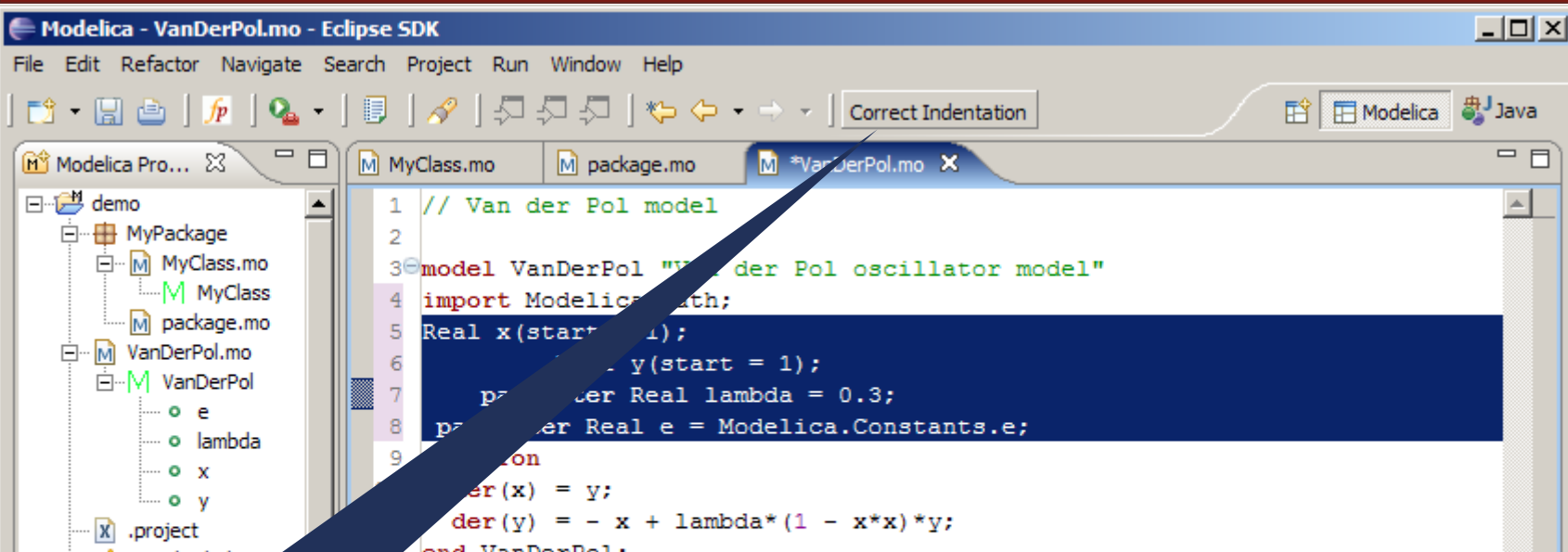
Code Assistance on assignments

# Code assistance (III)



Code Assistance on  
function calls

# Code indentation

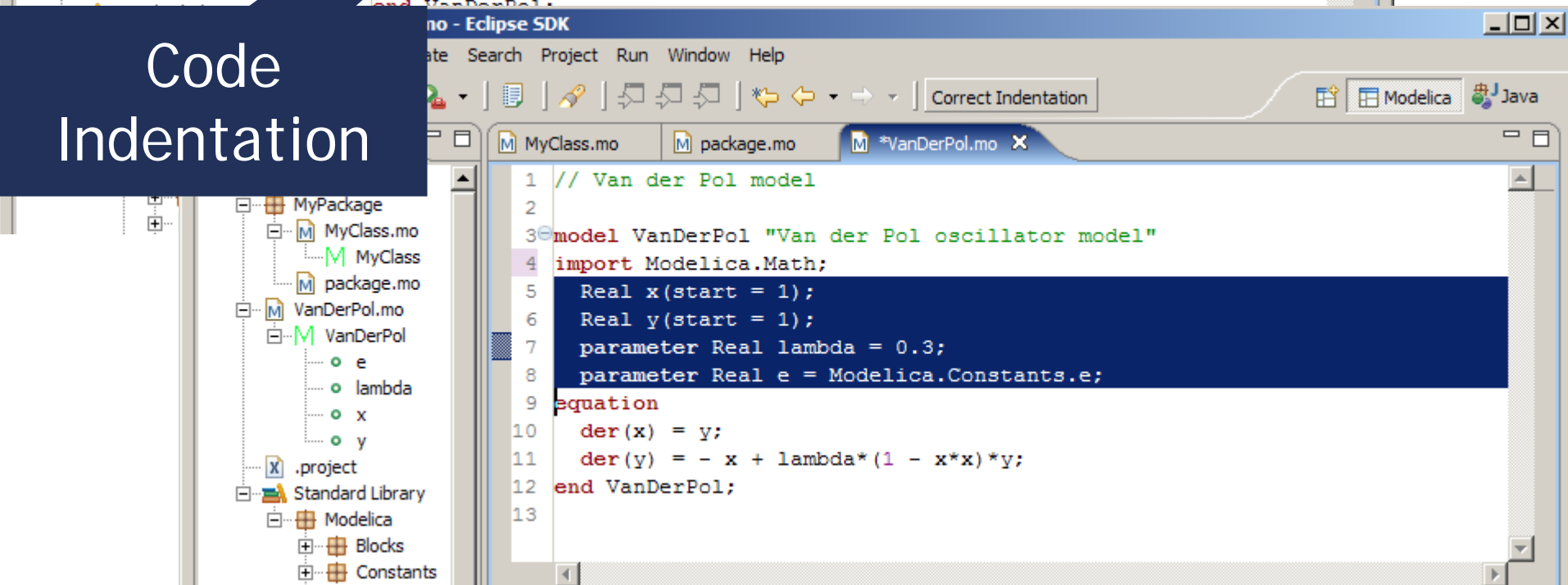


The screenshot shows the Eclipse IDE with a Modelica file named `VanDerPol.mo`. The code is as follows:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4 import Modelica.Math;
5 Real x(start = 1);
6 Real y(start = 1);
7 parameter Real lambda = 0.3;
8 parameter Real e = Modelica.Constants.e;
9 equation
10   der(x) = y;
11   der(y) = - x + lambda*(1 - x*x)*y;
12 end VanDerPol;
```

The code is not properly indented. A blue arrow points from the text 'Code Indentation' to the code.

Code  
Indentation



The screenshot shows the same Eclipse IDE with the `VanDerPol.mo` file, but now with correct indentation:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4 import Modelica.Math;
5   Real x(start = 1);
6   Real y(start = 1);
7   parameter Real lambda = 0.3;
8   parameter Real e = Modelica.Constants.e;
9 equation
10   der(x) = y;
11   der(y) = - x + lambda*(1 - x*x)*y;
12 end VanDerPol;
```

The code is now properly indented, with the `equation` block and its contents indented under the `equation` keyword, and the `end` keyword aligned with the `model` keyword.

# Code Outline and Hovering Info

The screenshot displays the Eclipse IDE environment for the Modelica compiler. The top toolbar contains standard IDE icons and the text "Correct Indentation" and "C/C++". The Project Explorer on the left shows a tree of Modelica projects, with "Absyn.mo" selected. The Code Editor in the center shows the source code of "Absyn.mo", featuring a `case` expression with `MATRIX` and `RANGE` branches. A tooltip is displayed over the `getCrefFromExp` function definition, providing its signature and a description: "Returns a flattened list of the component references in an expression". The Outline view at the bottom left lists the contents of the "Absyn" package, including various algorithmic constructs like `ADD`, `ALG_ASSIGN`, `ALG_BREAK`, etc. The Problems view at the bottom center shows 113 errors, with a list of error messages such as "The identifier at start and end are different". The Console view at the bottom right shows a list of error messages, including "ken ';' on line rml2mod" and "ken ';' on line rmltomod".

Code Outline for easy navigation within Modelica files

Identifier Info on Hovering

64M of 254M

Ctrl Contrib (Bottom)

# Eclipse Debugging Environment

The screenshot displays the Eclipse IDE with the following components:

- Breakpoints**: Shows a list of breakpoints.
- Variables**: A table showing the current state of variables in memory.
- Console**: Displays the output of the program, including a message: "Parsed program".
- Outline**: Shows the project structure and the current file being edited.
- Source Editor**: Shows the source code of the file being debugged.

Name	Value	Declared Type
p	Absyn.Program	Absyn.Program
[record]	Absyn.PROGRAM[2]	((Absyn.Class list, Absyn.Within) :
classes	LIST	Absyn.Class list
[0]	Absyn.CLASS[7]	((string, bool, bool, bool, Absyn.R
name	"Bla"	string
partial_	false	bool
final_	false	bool
encapsulated_	false	bool
restriction	1:enum:Absyn.R_MODEL	Absyn.Restriction
body	Absyn.PARTS[2]	((Absyn.ClassPart list, string optio
classParts	LIST	Absyn.ClassPart list
[0]	Absyn.PUBLIC[1]	((Absyn.ElementItem list) => (Abs
contents	LIST	Absyn.ElementItem list
[0]	Absyn.ELEMENTITEM[1]	((Absyn.Element) => (Absyn.Elen
comment	NONE[0]	string option
info	Absyn.INFO[6]	((string, bool, int, int, int, int) =>
within_	Absyn.TOP[0]	Absyn.Within
f	string	string
->	"Bla.mo"	string

```
model Bla
  Integer z[10];
end Bla;
```

```
local String s;
equation
  isModelicaFile(f);
  p = Parser.parse(f);
  Debug.fprint("dump", "\n----- Parsed program
  Debug.fcall("dumpgraphviz", DumpGraphviz.dump, p);
  Debug.fcall("dump", Dump.dump, p);
```

- Type information for all variables
- Browsing of complex data structures
- GDB based

# OMEdit Debugging Environment

The screenshot displays the OMEdit - Transformational Debugger interface. The main window shows a debugging session for a solver failure in a nonlinear simulation. The interface is divided into several panes:

- Variables Browser:** Shows a list of variables with columns for Variables, Comment, Line, and Location. Variables include A, Kv, T0, T1, and Tref.
- Equations Browser:** Shows a list of equations with columns for Index, Type, and Equation. Equations 1-10 are listed, including initial assignments and a nonlinear equation.
- Source Browser:** Shows the source code for the model, with line numbers 126-141. The code defines parameters like cp, T0, Tref, and variables like h0, W, y, eta, T1, tau, dp\_pump, and dp\_valve.
- Defined In Equations / Used In Equations:** Shows the relationship between variables and equations. For example, variable h0 is defined in equation 1 and used in equations 3, 4, 5, 6, 7, and 10.
- Equation Operations:** Shows the operations performed on equations, such as solving for h0 in equations 3 and 4.

The Source Browser shows the following code snippet:

```
enthalpy computation";
parameter
SI.SpecificHeatCapacity
cp=4186 "Cp of the fluid";
SI.MassFlowRate w_pump
"Mass flow rate from the
pump";
SI.Pressure p1 "Pump
discharge pressure";
SI.Pressure p2 "Storage
tank inlet pressure";
SI.Pressure dp_pump
"Pump dp";
SI.Pressure dp_valve
"Valve dp";
Real sqrt_dp
"Regularized sqrt(dp)";
SI.SpecificEnthalpy h0
"Pump inlet specific
enthalpy";
SI.SpecificEnthalpy h1
"Pump discharge specific
enthalpy";
SI.Power W;
SI.Length y(start=40,
fixed=true) "Reservoir
level";
Real eta(final
unit="1") = (p1 -
patm)*w_pump/rho/W "Pump
efficiency";
SI.Temperature T1 "Pump
discharge temperature";
SI.Time tau=1 "Time
constant of temperature
sensor";
equation
dp_pump = p1 - patm
dp";
```

Tutorial 1 - tomorrow at ModProd 2022!





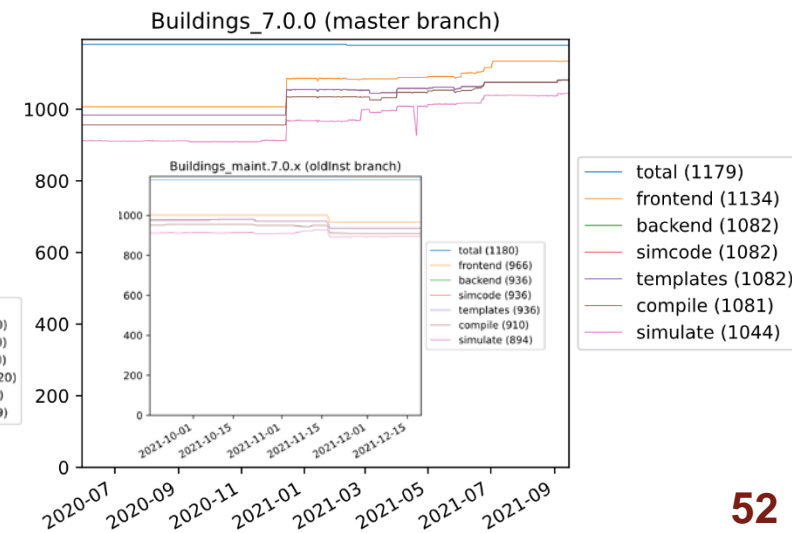
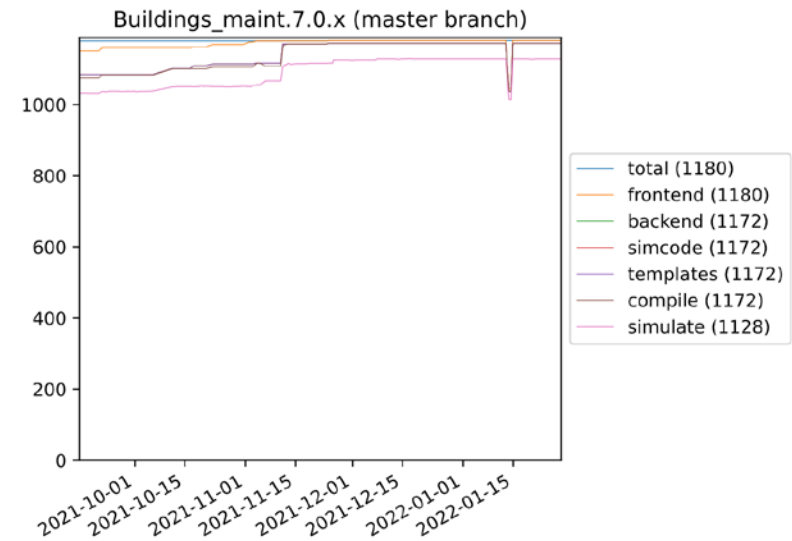
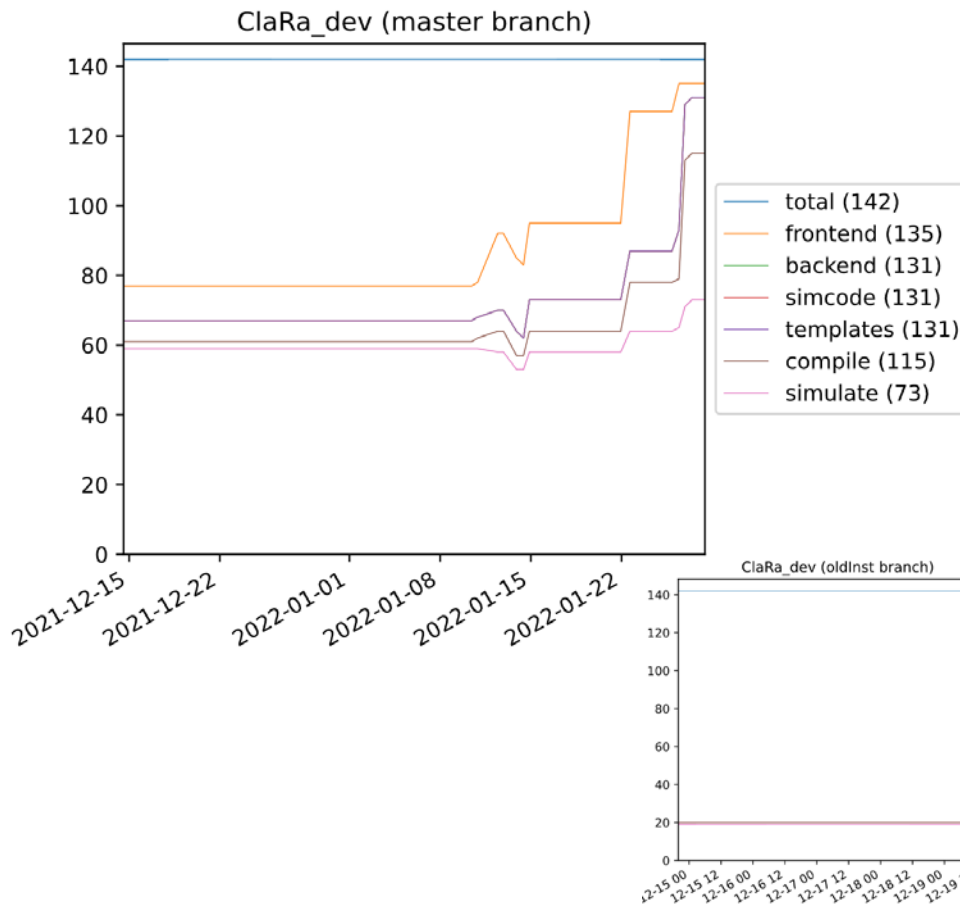
- OpenModelica
  - What is OpenModelica?
  - The past
- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook, OMEdit, ModelicaML, OMSimulator, OMPython, OMJulia, OMMatlab
- OpenModelica Development Environment
  - MetaModelica
  - The Eclipse Environment (MDT)
- OpenModelica Latest Developments (2021-2022)

# Latest Developments (2021-2022) (I)

- 2021 - 2022 - focus on library coverage, mostly Buildings
- OMC & Clients
  - Performance & scalability improvements
  - Bug fixes and enhancements to OMC, OMCedit, FMI, Runtime, Backend, etc.
  - Replaceable support in OMCedit
  - New Fronted by default in 1.16.x in OMCedit, 1.17.x by default in OMC
  - Some FMI export fixes and enhancements
  - Fixes and improvements in the C++ runtime - better coverage  
<https://libraries.openmodelica.org/branches/overview-c++.html>
  - Reimplementation of synchronous features
- OMSimulator
  - Improved SSP support better OMCedit integration
- General
  - From Feb 2021 - Feb 2022
    - 33+ contributors
    - 930 commits (OpenModelica/OMCompiler/OMCedit)
    - 135 commits (OMSimulator)
  - Releases 1.17.x, 1.18.x

# Latest Developments (2021-2022) (II)

- **New Front-End - now default in OMEdit and OMC**
  - Much better coverage for libraries (Buildings, BoschR, ClaRa)
  - Faster and more scalable
  - Starting looking into commercial libraries



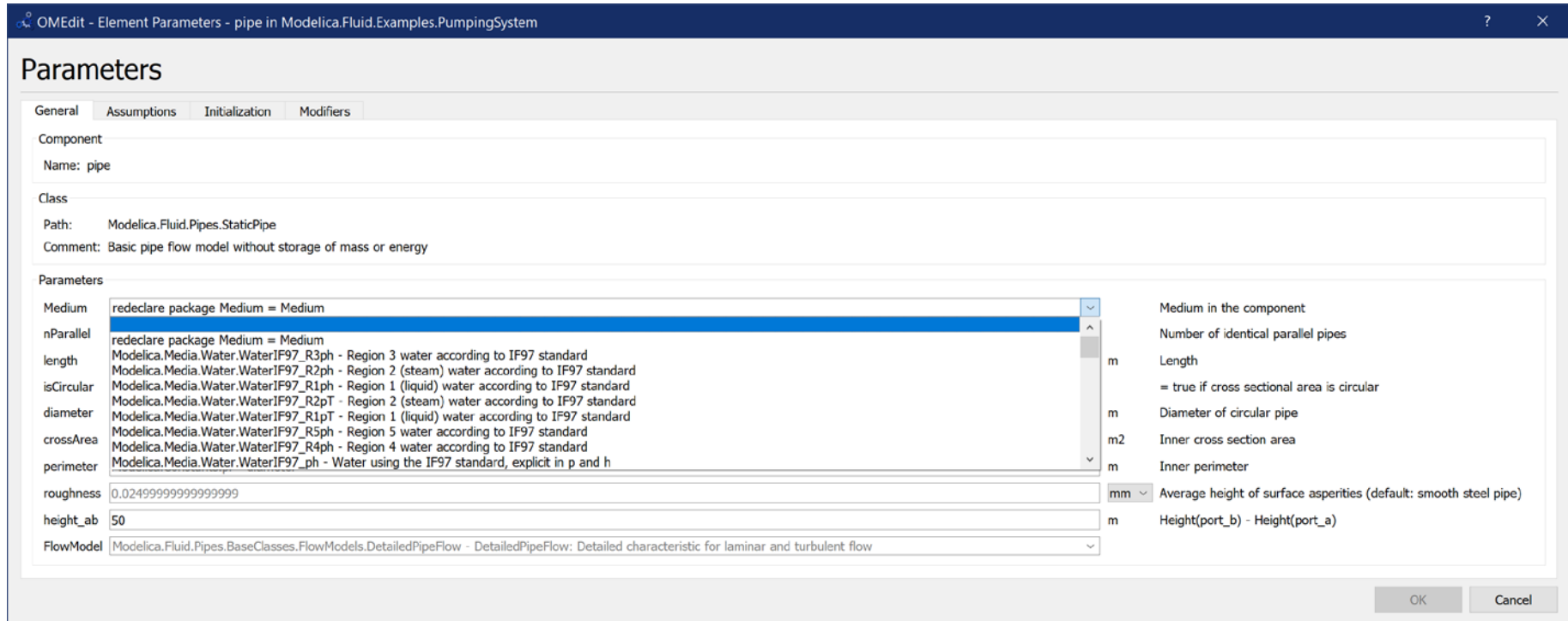
# Latest Developments (2021-2022) (III)

- **OMEdit**
  - Faster OMEdit using the new frontend
  - A lot of bug fixes and new usability features
  - Better GUI for OMSimulator, SPP
  - Encryption support for commercial libraries
  - Data reconciliation functionality
- **OMSimulator**
  - Better OMEdit support
  - Improved SSP support

# Latest Developments (2021-2021) (IV)

## ■ OMEdit - Redeclare and Replaceable Support

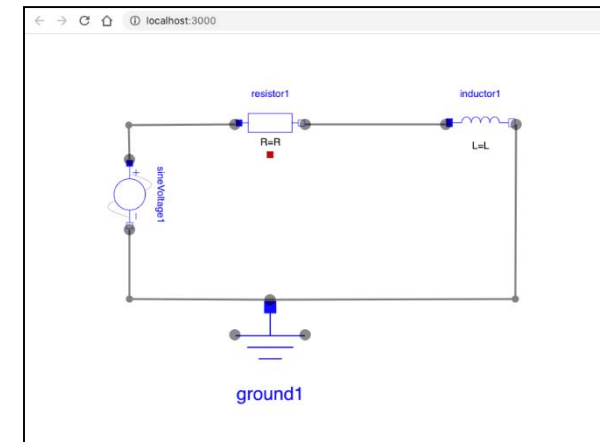
- Support for redeclare/replaceable is available since 1.16.x
- The new front-end is mature enough to not frustrate users
- Edit the parameters of replaceable will be available in 1.20.x



## ■ OpenModelica on Windows

- Use clang to speed up builds and compile bigger models - available with 1.17.x

- OMC / OMCedit - new API for instance hierarchy editing
  - Faster model display and graphical editing
  - Use the new front-end to instantiate the Model (once!)
  - Give the instance tree (including typed annotations) to OMCedit
    - automatically generated C++ classes for walking the tree
  - Allow OMCedit to edit the instance tree directly
    - Propagate the instance tree edits to the top level class
    - Build a simulation from the changed instance tree
  - Finally we will work on this (P & A) and be able to solve 5+ yrs old issues
  
- Web Browser Editor and OMSimulator in the cloud
  - Part of HUBCAP project
  - First PoC was unusable, new one ongoing
  - Collaboration with Perpetual Labs
  
- Julia instead of MetaModelica?
  - OpenModelica front-end translated to Julia
  - Back-end in Julia, support for VSS has now a PoC
  - Talk by John Tinnerholm (already presented)



# Thank You!

## Questions?

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 x05andfe, mohsen, nutaro, x02lucpo, florox, x06hener, x07simbj,  
 stebr461, x08joekl, x08kimja, Dongliang Li, jhare950, x97davka,  
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 ericmeyers, x05simel, andsa, leist, choeger, Ariel.Liebman, frisk,  
 vaurich, mwalther, mtiller, ptauber, casella, vitalij, hkiel, jank,  
 rfranke, mflehmg, crupp2, kbalzereit, marchartung, Andreas,  
 Karim, phannebohm,  
 adrpo*

**OpenModelica Project**

**<http://www.OpenModelica.org>**