



**3DEXPERIENCE®**

# Dymola 2016 FD01

Overview of new features

25 November 2015

 | The 3DEXPERIENCE® Company

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## Executive Summary

### Modeling and simulation

- Support for Scientific Data Format (SDF), using the portable HDF5 storage format, makes simulation results easy to process in other tools.
- User-defined post-processing commands can be executed after simulation, facilitating customized processes for managing experiments and simulation data.

### Functional Mockup Interface

- Simplified and more flexible FMU import in Dymola supports both FMI 1.0 and 2.0 in the same model.
- Tools to export and import FMUs into Simulink models increases the application of FMI. Support for both co-simulation and model exchange (FMI 1.0 & 2.0) maximizes interoperability.

### Major new Modelica libraries

- Battery library enables modeling of battery cells and packs for automotive, industrial equipment, processes.
- Engines library supports modeling of engines using mean value and crank angle resolved alternatives.
- Human Comfort library has been extended with a CFD-based air model for even greater versatility.

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## Support for Scientific Data Format (SDF)

- ▶ SDF is a straight-forward mapping to HDF5
  - ▷ <https://www.hdfgroup.org/HDF5>
- ▶ Easy post-processing using tools supporting HDF5
  - ▷ Dymola provides Matlab script files too
- ▶ Automatic conversion of simulation result file possible
  - ▷ Using new support for post-processing commands

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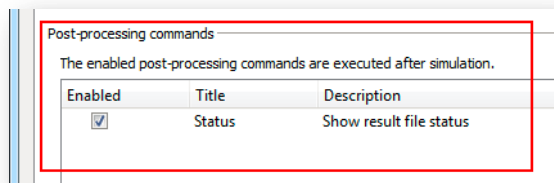
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## Post-Processing after Simulation

- ▶ Runs post-processing commands automatically after simulating a model
- ▶ Available commands setup using scripts
 

```
definePostProcessing("Status", "Show result file status",
"Modelica.Utilities.System.command(\"dir %RESULTFILE%. * & pause\")", true);
```
- ▶ Select which commands are executed on Simulation > Setup > Output



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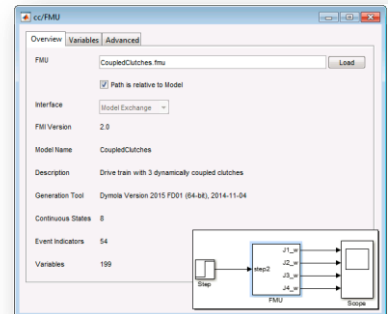


## Functional Mockup Interface

- ▶ FMI solutions for Simulink
  - ▷ No license required for usage
  - ▷ Full support offered to all Dymola customers
  - ▷ Supports Model Exchange and Co-Simulation (FMI 1.0 & 2.0)
- ▶ FMU export from Simulink (ver. 2.1.2)
  - ▷ Support for binary S-functions
  - ▷ Improved model desc. with structured names
  - ▷ Support for MATLAB R2010a to R2015b
- ▶ FMU import into Simulink
  - ▷ See next slide
- ▶ Simplified FMU import in Dymola
  - ▷ Common options set directly when importing FMU
- ▶ Import both FMI 1.0 and 2.0 in the same model
- ▶ Improved unit handling for imported FMUs
- ▶ Support for multiple instantiation of same FMU
- ▶ FMU export with MinGW GCC compiler
- ▶ Improved information for imported FMU
  - ▷ Model description attributes
  - ▷ ME and CS attributes/flags

## FMU import into Simulink

- ▶ Dymola introduces FMI Kit for Simulink
  - ▷ Import and embed FMUs into your Simulink models
  - ▷ Co-simulation and model exchange (FMI 1.0 & 2.0)
  - ▷ Supports MATLAB releases R2010a to R2015a, 32- and 64-bit
- ▶ Import of Dymola source code FMUs
  - ▷ Supports Dymola 2015 FD01 or later
  - ▷ Simulation targets Rapid Accelerator, RSIM, GRT, and dSPACE DS1005 / DS1006
- ▶ FMI Kit has same license conditions for re-distribution as exported FMU



# Modelica Libraries

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## Battery Library



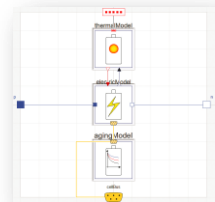
Modeling of battery cells and packs for automotive, industrial equipment, processes

### ► Applications

- ▷ Battery system performance studies under varying temperatures
- ▷ Ageing studies
- ▷ Control system development and evaluation

### ► Key features

- ▷ Variety of different cell types
- ▷ Customizable equivalent circuit approach – function or table based cell models
- ▷ Calculate electrical performance and thermal behavior for single cells and packs
- ▷ Consider variation of cell parameters in a battery pack
- ▷ Effects of temperature spread on cell capacity and performance in packs
- ▷ Generate look-up table parameters from measurement data



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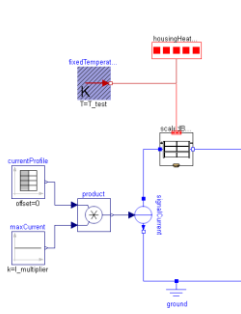
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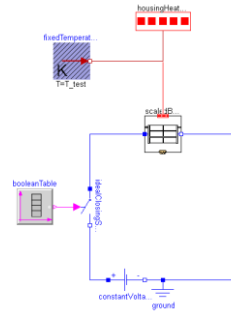
# Battery Library

## ISO12405-1/2

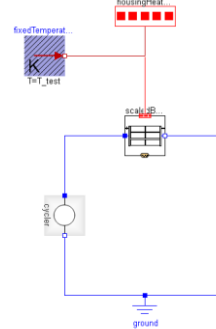
Power and internal Resistance  
Energy Efficiency



Cranking Power



Energy and Capacity



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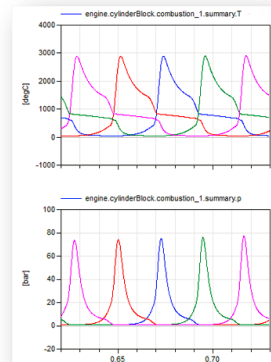


# Engines Library



Modelling SI and CI engines with multiple levels of fidelity

- ▶ Mean Value Engine Models: cycle averaged performance of the engine
- ▶ Crank Angle Resolved Engine Models: crank angle resolved combustion models to predict the instantaneous torque and air-flow
- ▶ Key features
  - ▷ Control system development using detailed physical models
  - ▷ Turbocharger and supercharger models for forced induction engines
  - ▷ Captures full transient response of the engine (air-flow, mechanics and thermal effects)
  - ▷ In-vehicle NVH and performance analysis when coupled to the Powertrain and Vehicle Dynamics libraries
  - ▷ Real-time capability
  - ▷ Animation is built-in to the models



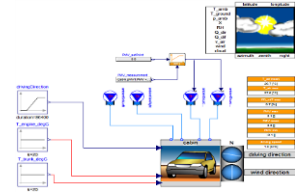
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## Human Comfort Library with CFD-based air model

Significant new enhancement of the library

- ▶ Using view factors, exact calculation of the thermal radiation between visible surfaces is supported.
- ▶ Uses finite-volume method to subdivide the air volume
  - ▷ Making it possible to reduce the number of required cells
- ▶ Calculation is made on the basis of Navier Stokes equations
  - ▷ Achieves conservation of momentum
- ▶ Allows simultaneous dynamic simulation of zones and air conditioning systems
  - ▷ With simultaneous simulation of air-conditioned zones (e.g. in buildings and vehicles) and the air conditioning system, it is possible to draw up an analysis of the interactions between the system and the comfort in the zone



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