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Dymola 2021

Overview of new features

15 May 2020

3DEXPERIENCE®

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Executive Summary

Simulation

- Several key improvements in simulation performance and robustness of complex models.
- Possible to create snapshots of the result while simulating and to control the output interval from the model.
- Parameter sweeping can now handle more than two parameters.

User interface

- The model tabs have been moved to the top of the model window.
- Plotting capabilities have been generalized to allow a matrix of plots in each window, and to provide additional result documentation for each plot window.
- A Moving Average operator allows smoothing of plotted signals.

Simulation

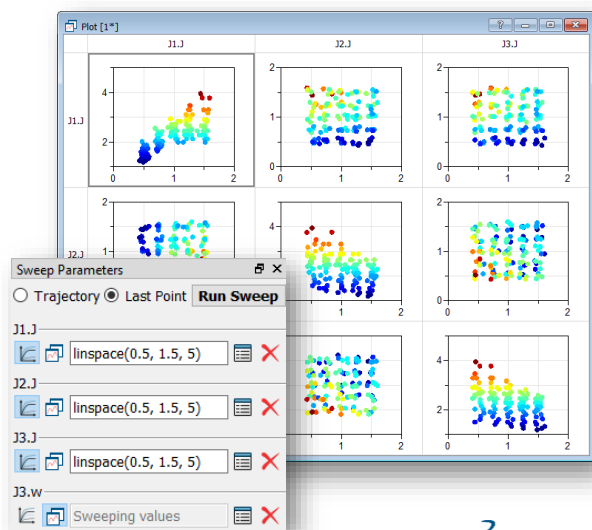
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Sweep parameters enhanced

- ▶ Sweeping of more than two parameters possible
 - ▷ Visualization using scatter plot
- ▶ Takes advantage of two new features
 - ▷ Array of plots in a window
 - ▷ Scatter plot



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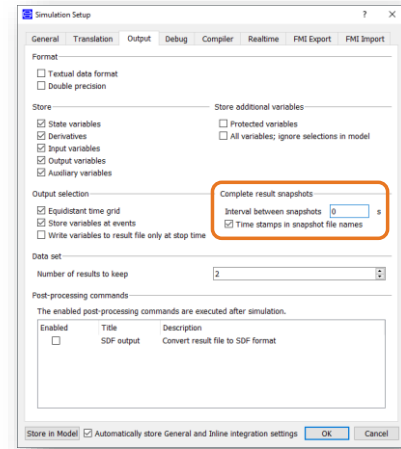


Simulation snapshot

- ▶ Save simulation result snapshot
 - ▷ Saves a snapshot at regular intervals
 - ▷ Complete result file saved
 - ▷ File named by timestamp

- ▶ Can be triggered from model

```
when x > 0 then
  Dymola.Simulation.TriggerResultSnapshot();
end when;
```

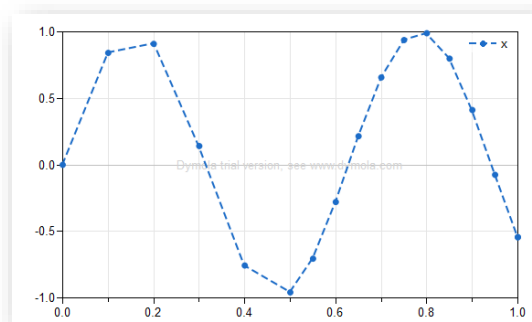


Variable output interval

- ▶ Control the interval between output points from the model
 - ▷ Adapt output to model dynamics
- ▶ Setup

Advanced.Simulation.VariableInterval=true

```
model VariableOutputInterval
  Real x;
  equation
    x = sin(10*time);
  when initial() then
    Dymola.Simulation.SetOutputInterval(0.1);
  end when;
  when time >= 0.5 then
    Dymola.Simulation.SetOutputInterval(0.05);
  end when;
end VariableOutputInterval;
```



Simulation efficiency

- ▶ Improvements in the solver for non-linear equation systems
 - ▷ More robust and accurate, hence faster
 - ▷ Can improve simulation speed, especially for models with algebraic loops and for inline integration using implicit methods
- ▶ More efficient event handling
 - ▷ Minor events do not require restart of the numerical integrator

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Simulation Analysis and Profiling

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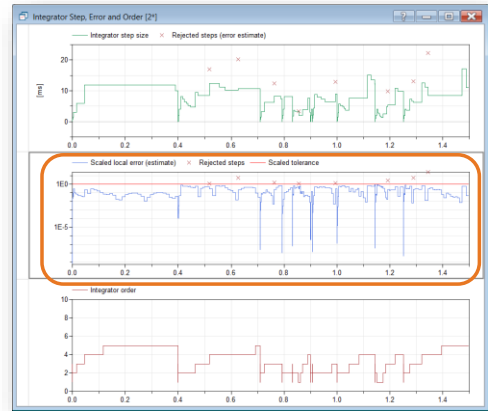
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Global integrator error

► Integrator error in Simulation Analysis

- ▷ Scaled global error estimate from the integrator, compared to the error tolerance
- ▷ Also step size and integrator order
- ▷ Is the step size limited by the error estimate or something else, such as, frequent events?



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Major/minor events

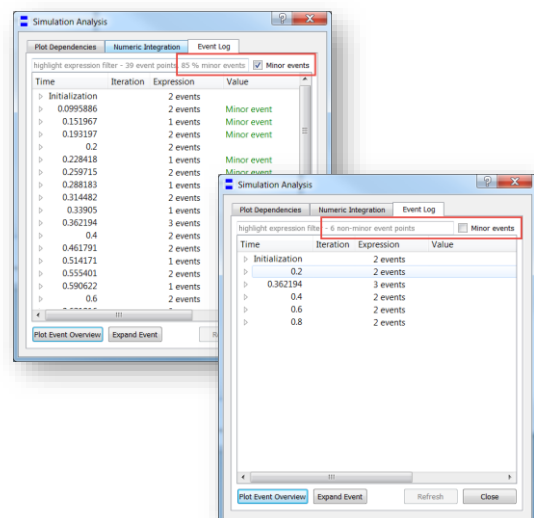
► Major event

- ▷ Affects states and derivatives
- ▷ Requires restart of numeric integrator (re-calculation of the Jacobian)

► Minor event

- ▷ Does not effect states/derivatives
- ▷ Can be handled without restarting the numeric integrator

► Big performance impact



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Function profiling

- ▶ New option to profile functions
 - ▷ Helps find performance bottlenecks
 - ▷ Especially external functions in C code and FMUs

Advanced.GenerateFunctionTimers = true

Profiling information for function calls and FMUs.

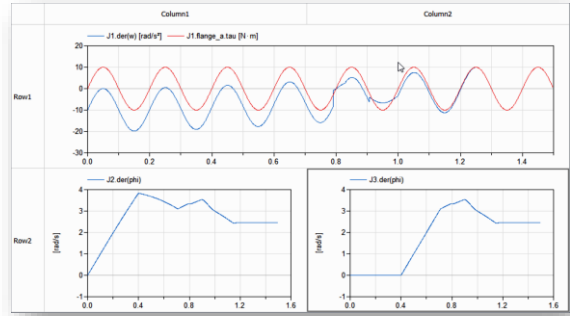
	Total CPU[us]	Mean[us]	(Min[us] to Max[us])	Called
DassaultSystemes	8.594	0.52	(0.00 to 1000.00)	16987324
Fluid	0.100	0.33	(0.00 to 1000.00)	306118
Utilities	0.010	0.10	(0.00 to 1000.00)	104740
splineDerivatives	0.000	0.00	(0.00 to 0.00)	1
monotonicSplineDerivatives	0.000	0.00	(0.00 to 0.00)	1
splineFunction	0.010	0.10	(0.00 to 1000.00)	102043
splineFunction_der	0.000	0.00	(0.00 to 0.00)	2499
Machines	0.090	0.45	(0.00 to 1000.00)	201378
Characteristic	0.090	0.45	(0.00 to 1000.00)	201378
PerformanceMapEvaluation	0.090	0.45	(0.00 to 1000.00)	201378
computePressure	0.034	0.53	(0.00 to 1000.00)	102045
computePressure_der	0.000	0.00	(0.00 to 0.00)	2499
computeEfficiency	0.034	0.37	(0.00 to 1000.00)	96439
Media	8.094	0.53	(0.00 to 1000.00)	14681206
Templates	1.849	0.10	(0.00 to 1000.00)	16283015
Incompressible	1.849	0.10	(0.00 to 1000.00)	16283015
TableBased	1.849	0.10	(0.00 to 1000.00)	16283015
Polynomials_Temp	1.849	0.10	(0.00 to 1000.00)	16283015
fitting	0.002	10.42	(0.00 to 1000.00)	192
integralValue	0.335	0.13	(0.00 to 1000.00)	26932246
evaluate	0.745	0.09	(0.00 to 1000.00)	8455145
evaluate_der	0.000	0.00	(0.00 to 1000.00)	3411459
IncompressibleLiquid	7.235	18.17	(0.00 to 1000.00)	398191
PropyleneGlycol47	7.235	18.17	(0.00 to 1000.00)	398191
T_h_1_Unique11	7.235	18.17	(0.00 to 1000.00)	398191
Battery	0.000	0.00	(0.00 to 0.00)	32
Common	0.000	0.00	(0.00 to 0.00)	32
Functions	0.000	0.00	(0.00 to 0.00)	32

IncompressibleLiquid	:	7.235,	18.17 (0.00 to	1000.00),	398191
PropyleneGlycol47	:	7.235,	18.17 (0.00 to	1000.00),	398191
T_h_1_Unique11	:	7.235,	18.17 (0.00 to	1000.00),	398191

Plotting and post-processing

Plot window layout

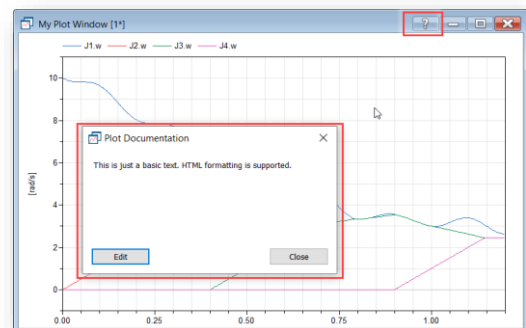
- ▶ Plot window can be split into a matrix of diagrams
 - ▷ Horizontal and vertical split
 - ▷ An alternative to creating multiple plot windows
- ▶ Simple extension of createPlot
 - ▷ Backwards compatible
- ▶ Possible to set row/col headings



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Plot window documentation

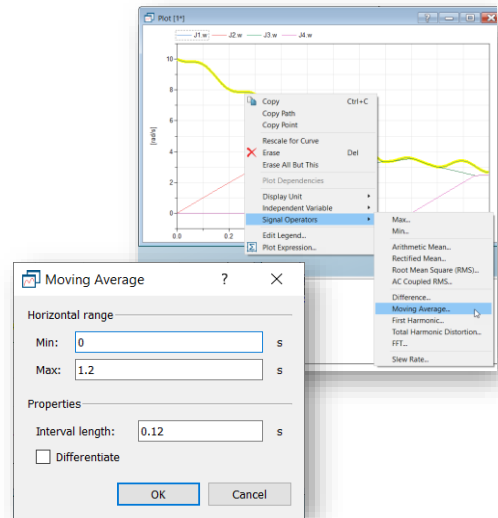
- ▶ Can set plot window heading
 - ▷ Different from diagram heading
- ▶ Can set plot window documentation
 - ▷ Available to user by pressing “?” button
 - ▷ Any HTML-formatted text
 - ▷ Interactive editing or set through script command



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Moving average

- ▶ New signal operator in the plot window
- ▶ Plots the centered moving average of the signal
 - ▷ Can be used for smoothing
 - ▷ Default interval is 1 % of the range
 - ▷ Uses linear interpolation if there are few data points
 - ▷ Alternatively plot the numerically differentiated moving average

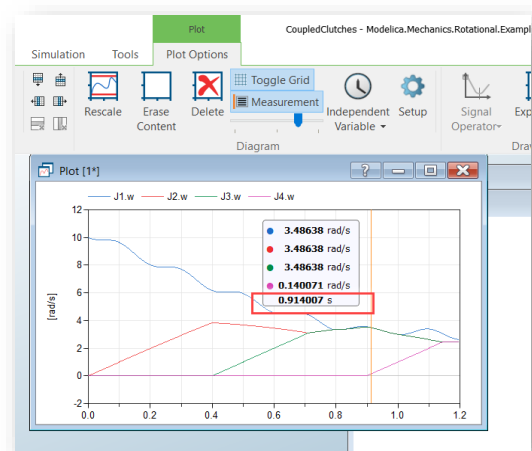


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Improved measurement cursor

- ▶ Time slider in plot window and animation ribbon too
- ▶ Possible to display time in the measurement cursor legend

Advanced.Plot.MeasurementTime=true

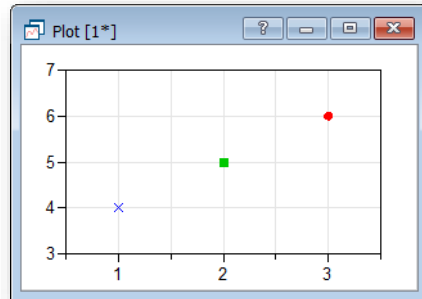


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Scatter plot

- ▶ Create scatter plot with choice of
 - ▷ Color, marker style
 - ▷ Legend, unit

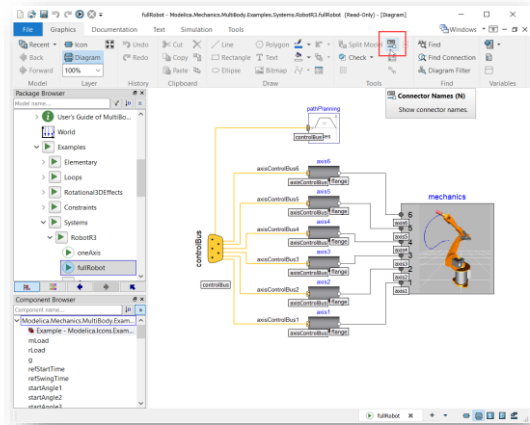
```
plotScatter(x={1,2,3}, y={4,5,6},
  colors={{0,0,255}, {0,200,0}, {255,0,0}},
  markers={MarkerStyle.Cross,
  MarkerStyle.FilledSquare,
  MarkerStyle.FilledCircle})
```



Other

Connector names

- ▶ Display boxes with the names of all connectors
 - ▷ Drawn under each connector
 - ▷ Fast on/off with a toggle button
- ▶ Helps understanding a large or complicated model



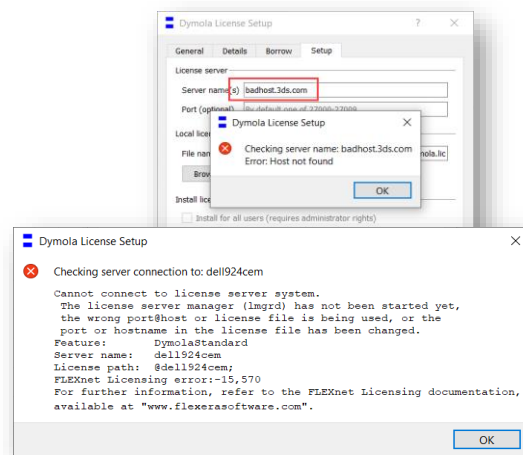
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Improved Dymola setup

- ▶ Additional checks are made when you setup the license server
 - ▷ DNS lookup of the server
 - ▷ Try to ping server
 - ▷ Try to check out a license
- ▶ Compiler setup
 - ▷ Detects too old VS compiler



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