

Integrated Modelica Debugging

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```
model ChatteringEvents1 "Exhibits chattering after t = 0.5";
  Real x(start = 1, fixed = true);
  Real y;
  Real z;
equation
  z = if x > 0 then -1 else 1;
  y = 2 * z;
  der(x) = y;
  annotation(Documentation(info = "<html>
<p>After t = 0.5, chattering takes place, due to the discor
<p>Chattering can be detected because lots of tightly space
</html>"), experiment(StopTime = 1));
end ChatteringEvents1;
```

Debugging a Modelica model

- ▶ Many things influence simulation
- ▶ No unique translation of equations to executable code
- ▶ Selection of state variables
- ▶ Sorting, matching
- ▶ Numerical methods
- ▶ Mapping errors back to source code

Creating a model with an error

```
model ChatteringEvents1 "Exhibits chattering after t =
  0.5, with generated events"
  Real x(start = 1, fixed = true);
  Real y;
  Real z;
equation
  z = if x > 0 then -1 else 1;
  y = 2 * z;
  der(x) = y;
  annotation(Documentation(info = "<html>
<p>After t = 0.5, chattering takes place, due to the
  discontinuity in the right hand side of the first
  equation.</p>
<p>Chattering can be detected because lots of tightly
  spaced events are generated. The feedback to the user
  should allow to identify the equation from which the
  zero crossing function that generates the events
  originates.</p>
</html>"), experiment(StopTime = 1));
end ChatteringEvents1;
```

Simulating models with errors

- ▶ No error-message
- ▶ Cryptic error-message
- ▶ Simulation progressing slowly
 - ▶ Even fixed-step Euler solver is affected!
- ▶ Debugging is time-consuming



Simulating models with errors

- ▶ No error-message
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- ▶ Simulation progressing slowly
 - ▶ Even fixed-step Euler solver is affected!
- ▶ Debugging is time-consuming
- ▶ **You might not even find the error**



Compiler generates XML of performed transformations

```
<solved>
  <lhs>revolute2.frame_b.t[2]</lhs>
  <rhs>-0</rhs>
</solved>
<simplify>
  <before>-revolute2.frame_b.t[2] = 0.29290799999999999 *
    0.0 + 0.0083159999999999999 * boxBody2.body.w_a[3] *
    0.0 + 0.25 * -0 + -0.29290799999999999 * 0.0 *
    boxBody2.body.w_a[3]</before>
  <after>-revolute2.frame_b.t[2] = 0.0</after>
</simplify>
<!-- most things snipped -->
<flattening>
  <original>frame_a.t = I * z_a + cross(w_a, I * w_a) +
    cross(r_CM, frame_a.f);</original>
  <flattened>boxBody2.body.frame_a.t[2] = boxBody2.body.I
    [2,1] * ... - boxBody2.body.r_CM[1] * boxBody2.body.
    frame_a.f[3];</flattened>
</flattening>
```

Simulating a model with an error

Running Simulation of `Debugging.Chattering.ChatteringEvents1`.
Please wait for a while.



Cancel Simulation

OMEdit - `Debugging.Chattering.ChatteringEvents1` Simulation Output

Output | Compilation

```
/tmp/OpenModelica/OMEdit/Debugging.Chattering.ChatteringEvents1 -  
port=50212 -logFormat=xml -w -lv=LOG_STATS  
stdout | info | Chattering detected around time  
0.500000005..0.500000995001 (100 state events in a row with a total time  
delta less than the step size 0.002). This can be a performance  
bottleneck. Use -lv LOG_EVENTS for more information. The zero-crossing  
was: x > 0.0 Debug more
```



The Transformations Browser (Equations)

The screenshot shows the Transformations Browser window with the following components:

- Title Bar:** Transformations Browser
- Navigation:** Variables View | Equation View
- File Path:** /tmp/OpenModelica/OMEdit/Debugging.Chattering.ChatteringEvents1_info.xml
- Search:** Equation Index: Search
- Table Structure:**

Defines		Depends	Equation Operations
Variable /	Variable /		Operations
z	x		<ul style="list-style-type: none">solved: $z = \text{if } x > 0.0 \text{ then } -1 \text{ else } 1.0$original: $z = \text{if } x > 0 \text{ then } -1 \text{ else } 1;$ => flattened: $z = \text{if } x > 0.0 \text{ then } -1 \text{ else } 1.0;$
- Bottom Panel:** Operation : solved: $z = \text{if } x > 0.0 \text{ then } -1 \text{ else } 1.0$

The Transformations Browser (Variables)

The screenshot shows the 'Transformations Browser' window with the 'Equation View' tab selected. The window title is '/tmp/OpenModelica/OMEdit/Debugging.Chattering.ChatteringEvents1_info.xml'. The interface is divided into several panes: 'Variables', 'Variable Types', 'Variable Operations', 'Defined In Equations', and 'Used In Equations'. The 'Variables' pane lists 'der(x)', 'x', 'y', and 'z', with 'z' highlighted in orange. The 'Variable Types' pane shows 'Real' for 'z'. The 'Defined In Equations' pane shows 'z' defined in equation 4 with a 'regular' type, also highlighted in orange. The 'Used In Equations' pane shows 'z' used in equations 2 and 5. A status bar at the bottom provides details for the selected variable 'z': Index : 4, Type : regular, and Equation : (assignment) z = if x > 0.0 then -1 else 1.0.

Variables		Variable Types		Variable Operations		Defined In Equations		Used In Equations	
Variable	Cor	Types		Operations	Index	Type	Index	Type	
der(x)		Real			1	initial	2	initial	
x					4	regular	5	regular	
y									
z									

Index : 4
Type : regular
Equation : (assignment) z = if x > 0.0 then -1 else 1.0

Integration of Tools

- ▶ OpenModelica Compiler, info.xml files
- ▶ Simulation executables, xml output format
- ▶ OMEdit, reads simulation output and info.xml. Generates and opens the correct view

Future Work

- ▶ More specialised views (nonlinear/etc)
- ▶ Better diffs (colour-coded/etc)
- ▶ Trace more operations (tearing/etc)
- ▶ Integration with plotting / result-files
- ▶ Integration with the profiler

