Multi-Mode DAE Systems with Varying Index

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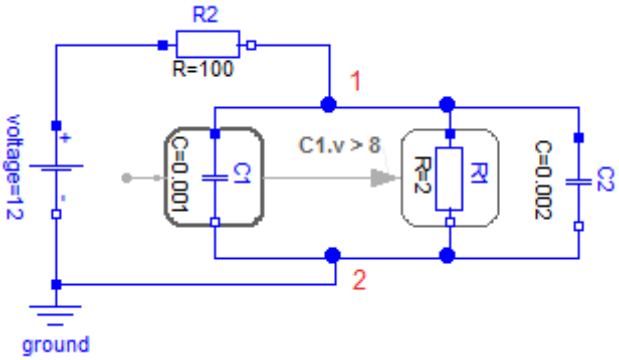
This paper discusses an approach to handle multi-mode DAE systems described by continuous-time state machines where mode-dependent state constraints are present. The goal is to perform static symbolic analysis and to generate efficient run-time code. This technique extends the class of multi-mode systems that can be handled by Modelica tools.



An example is shown in the figure to the right: This circuit describes a capacitor C1 that is destroyed when the voltage becomes too large. The destroyed capacitor is modelled with a small resistor R1. The switching between C1 to R1 is described by an acausal continuous-time state machine. When C1 is active, there are two capacitors in parallel, C1 and C2, and therefore there is a constraint between the states of these two elements. When R1 is active, there is no such constraint. The paper describes a new method to handle such systems by generalizing the Pantelides algorithm to multi-mode systems. The technique has been evaluated and tested with several examples using a Dymola prototype.

In the figure below another example is shown modeling a breaking shaft: In the beginning two inertias are rigidly connected together. When the absolute value of the cut-torque tau = inertia2.flange_b.tau becomes too large, the shaft breaks and two not-connected inertias remain. Such systems can also be analyzed with the multi-mode Pantelides algorithm and simulated with the Dymola prototype.