Flow Network based Diagnostics for Incorrect Synchronous Models

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Abstract

Modelica 3.3 (released in 2012) added synchronous primitives that are intended to make it easier to model control systems that run on a sampled clock and connect to the continuous plant model. However, the synchronous primitives have seen limited use so far – and are not even used in the Modelica Standard Library.

We have found that one barrier preventing users from starting to use the synchronous primitives are unclear diagnostics in case of errors. This presentation reduces this barrier by demonstrating how the separation into clocked and continuous parts can be diagnosed, including a possible correction.

The underlying idea is to transform the model to a flow network, and the error then corresponds to a "leak-flow" between the partitions, which can be efficiently found using max-flow/min-cut techniques.

The new method is efficient, easy-to-adapt, and gives diagnostics focused on correcting the issue. In particular, it is possible to handle both normal clocked partitions and clocked partitions with solverMethod.

The ideas in this paper were introduced in Dymola 2019 (released in June 2018) and also in 3D Experience Platform 2019x.

Example

The new method is best illustrated by a small example.

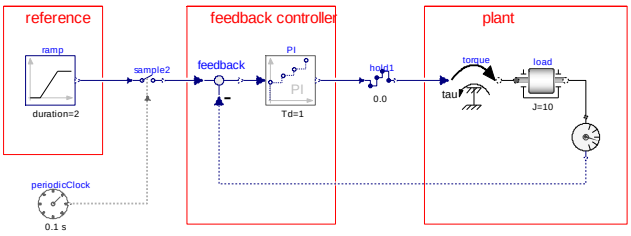

Figure 1 Incorrect textbook controller

Diagnostics for the incorrect synchronous model in Figure 1, showing that the new method correctly identifies the problem.

Continuous time parts and discrete parts don't decompose, when there is no solverMethod attached to the clock.

It is necessary to introduce sample or hold elements replacing:

connect(speed.w, feedback.u2);