Using BCVTB for Co-Simulation between Dymola and MATLAB for Multi-Domain Investigations of Production Plants

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Nowadays it has become more and more important to be able to simulate models with partial models of different complexity and differing requirements regarding solver algorithms, step sizes and other model-specific properties. To meet these requirements, models of such complexity are approached via co-simulation. Co-simulation stands for "Cooperative Simulation". One can tell from the name that its purpose is to simulate separate models and let them communicate and synchronize to certain points in time given by an overall simulation which lets all partial models cooperate.

The aim of this paper is to optimize the energy consumption in cutting factories. Therefore it's necessary to simulate the thermal processes in production halls. Since all different machines in one production hall require individual modelling approaches, certain solvers and even different software, this problem is approached with co-simulation. Via the Ptolemy-based co-simulation tool BCVTB (Building Controls Virtual Test Bed), a room model implemented in Modelica, machines implemented in Modelica, Simscape and Simulink as well as a MATLAB data model of the measured heat emission of a machine are co-simulated.

At the first impression, BCVTB seems like a quite advanced tool to enable cooperative simulation in a rather easy way. On the other hand it's not possible to let models communicate with BCVTB at variable time steps with the given BCVTB blocks. In Simulink the communication at time steps which aren't known before can be realized by activating a subsystem containing the BCVTB block. To also achieve this in Dymola, most parts of the given BCVTB block would have to be rewritten.

What's more is that between two synchronization time steps all values from BCVTB are extrapolated uniformly so depending on the actual graph and the synchronization step size, the single errors could sum up to an amount which causes the model to fail any validation. For the described use in thermal systems which react very slowly, co-simulation with BCVTB might be considered sufficiently accurate, but to achieve a valid co-simulation which requires precise or at least reliable approximations with arbitrarily small errors, other possibilities of co-simulation will have to be considered.

References

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