Variable Structure Modeling for Vehicle Refrigeration Applications

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In this paper a variable-structure approach for Modelica models is presented. A variable-structure model is a model that can change its set of equations and variables during a simulation run. Common simulation environments like Dymola do not provide the means to model and simulate variable-structure models and therefore not many examples do exist right now. In this paper an approach is presented where Dymola is used to model the necessary models and Matlab is used to switch from one model (and therefore set of equations and variables) to another [1].

As a use case a simplified model of a thermal management system for Lithium ion batteries in a hybrid vehicle is introduced. This model consists of two parallel branches, where of the branches is not needed through the complete simulation time. This parallel branch can be removed from the model through the variable-structure approach when it is not needed. This has two main advantages. For once the simulation time can be reduced because no unnecessary calculations are done during the simulation phase. The needed simulation time of a simulation with only one model (with one set of equations) and from the model with the switch from one model to another is show in figure 1. It is apparent that the simulation time through this variable-structure approach was significantly reduced. Another advantage in this example is that the mass flow in the parallel branch can be set to exactly zero, which is not the case for the static structure model. This makes the simulations results more accurate. Therefore with this variable-structure approach it is possible to reduce simulation time and increase the simulation accuracy. Furthermore it will be presented how a model needs to be prepared for such an approach and which restrictions this approach has.

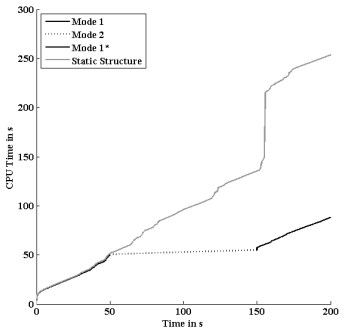

Figure 1: CPU time needed for simulation

References

[1] Mehlhase A. Varying the level of detail during simulation. In: Proceedings of ASIM 2011, Symposium Simulationstechnik, Winterthur, Swiss, 7-9 September 2011.