Integrated Modelica Model and Model Predictive Control of a Terraced House Using IDEAS

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Abstract

Modelica has been used extensively within the Thermal System Simulation (The SySi) research group at KU Leuven to simulate and optimize the control and design of building energy systems. Within this scope, the open source Modelica library IDEAS has been developed (Jorissen et al., 2018c) and papers have been published that explain how IDEAS can be used to develop fast simulation models and MPC. Jorissen et al. (2018a) describe the detailed Modelica model of an office building and a comparison with measured data. An MPC has been developed for this model using TACO, an MPC framework that is tailored to buildings (Jorissen et al., 2018b). In simulations the operational cost of the building was reduced by more than 50 %, however thermal depletion of the ground by passive cooling was not accounted for.

The presented approach for speeding up models was thus far demonstrated in papers but open-source practical examples of reasonable size are not yet available, which makes it harder for Modelica users to learn from these guidelines. Therefore, this paper presents an open-source simulation model of a 9 zones terraced house for which these earlier presented guidelines are applied and for which MPC results are made available. A heating system, ventilation system and controller are included in the model. A full-year simulation of the nine-zones model takes four minutes and energy savings of 12.8 % are reported compared to a current-practice rule-based controller, although MPC has thermal comfort violations of up to 0.4 K.

References

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