Dynamic Simulation of Residential Buildings Supporting the Development of Flexible Control in District Heating Systems

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Abstract

Load shifting, peak shaving and night-time setback are key demand-side management measures to make the operation of District Heating Systems (DHSs) more flexible and efficient. These goals can be achieved through appropriate control strategies exploiting the building's and space heating system's thermal inertia. To ease the development of such an advanced controller, we programmed a detailed dynamic Modelica simulator representative of French multi-stories radiator-heated residential buildings. We parametrized the simulator to vary the factors influencing the flexibility potential of a building (e.g. envelope properties, additional internal mass such as partition walls and furniture, the heating system…). This helped us designing a reduced-order building model relevant to our application and setting up a robust identification method for its parameters. We finally used the detailed simulator to test an optimal space-heating controller, thereby allowing many incremental improvements without jeopardizing end-users thermal comfort. This simulation work paves the way to considering the actual implementation of our advanced controller on a real building.

Keywords: District Heating System, Optimal Control, Building Simulation, Reduced-order building model