SIMULATION ASSISTED ADAPTION OF A MODEL BASED CONTROL PARAMETER FINE-TUNING METHODOLOGY FOR A NONRESIDENTIAL BUILDING WITH A COMPLEX ENERGY SYSTEM

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Modern non-residential buildings have to mediate the trade-off between high energy efficiency and quality of the indoor climate, as the first is imposed by the current environmental policies and the latter has a direct influence on the workers' productivity. The problem gets more challenging in the case of buildings with complex energy systems using renewables as no clear methodology for designing their control strategy exists. In this paper we present the way simulation can assist in devising controllers for such buildings using a model-assisted control parameter fine-tuning methodology. The results presented were generated in the project PEBBLE funded through the Seventh Framework Program of the

European Union. PEBBLE is an international project which aims to achieve maximal net energy produced for buildings by using an intelligent control process. The challenge lies in the ability of the building's control system to make (almost) real-time decisions under the constraints of unpredictable user-behavior, occupancy scheduling or weather conditions. Seven partners from Austria, France, Germany, Greece and Switzerland are involved in the project, including the RWTH Aachen University. The new building of the E.ON Energy Research Center (ERC) will be used as a demonstration building in the project, being the most complex of all three demonstration buildings. For this project the north concrete core activation area of the building was chosen, which stretches over all three floors of the building and has 45 offices. The base load for heating or cooling is covered by the concrete core activation, whereas the peak load and the air quality are achieved in each office with a façade ventilation unit. A detailed simulation model for the selected area is a prerequisite for the building's optimization and control process. The model takes into account geometries, building physics, installed HVAC and energy generation systems. It has a degree of detail that allows a thorough validation, as well as acceptable simulation durations. The model was developed using the modelling language Modelica and it was validated using monitoring data. The proposed approach produces a new control strategy every three hours, using a stochastic optimization algorithm and the building thermal simulation model, along with weather and occupancy forecasts as well as past sensor data. The set temperatures of each façade ventilation unit and the heating curve of the concrete core activation will be set by the control algorithm. The optimization algorithm was implemented in MATLAB and the simulation was done in the simulation environment Dymola. The two programs were coupled using the software Building Controls Virtual Test Bed. The work presents the way the initial algorithm was adapted to the building in question by use of simulation: choosing the states to calculate the new set points, making sure the algorithm converges to an optimum independently of the start point, achieving satisfactory simulation durations.