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MODEL-BASED DESIGN OPTIMIZATION AND PREDICTIVE CONTROL TO MINIMIZE ENERGY CONSUMPTION OF A BUILDING

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ABSTRACT In recent years, the investigation of the reduction of a building's energy consumption, both at the design stage and operational stage, has received great attention. Establishing a building energy model can help architects to optimize design decisions at the early design stage to minimize a proposed building design's energy consumption. Furthermore, the model can also be integrated with predictive control algorithms to improve the building's climate control strategy to minimize the energy consumption at the operational stage. This work focuses on the following goals: develop a relatively accurate energy model for building energy simulation, develop a model-based predictive control (MBPC) strategy, use experiments to validate the energy model, and demonstrate the energy-saving benefits of the proposed MBPC algorithm. In addition, a machine learning algorithm is developed to learn the hidden behavior patterns from the historic data of a building's occupants and predict the occupants' future temperature schedules. Such schedules are subsequently used as input to the MBPC algorithm.

Keywords: building energy model, model-based predictive control, experimental validations, machine learning.