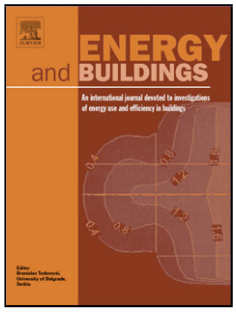

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Artificial Neural Network (ANN) based Model Predictive Control (MPC) and Optimization of HVAC Systems: A State of the Art Review and Case Study of a Residential HVAC System

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Abstract

In this paper, a comprehensive review of the artificial neural network (ANN) based model predictive control (MPC) system design is carried out followed by a case study in which ANN models of a residential house located in Ontario, Canada are developed and calibrated with the data measured from site. A new algorithm called best network after multiple iterations (BNMI) is introduced to help in determining the appropriate ANN architecture. The prediction performance of the developed models using BNMI algorithm was significantly better (between 6% and 59% better goodness of fit for various models) when compared to a previous study carried out by the authors which used the default single iteration ANN training algorithm of MATLAB®. The ANN models were further used to design the supervisory MPC for the residential HVAC system. The MPC generated the dynamic temperature set-point profiles of the zone air and buffer tank water which resulted in the operating cost reduction of the equipment without violating the thermal comfort constraints. When compared to the fixed set-point (FSP), MPC was able to save operating cost between 6% and 73% depending on the season.

Keywords: Artificial neural network (ANN), Model predictive control (MPC), ANN based MPC review, Optimization of HVAC System, Residential HVAC System