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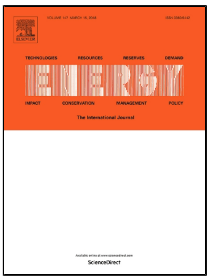

A Zone-Level, Building Energy Optimisation Combining an Artificial Neural Network, a Genetic Algorithm, and Model Predictive Control

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Abstract

Buildings account for a substantial proportion of global energy consumption and global greenhouse gas emissions. Given the growth in smart devices and sensors there is an opportunity to develop a new generation of smarter, more context aware, building controllers. Therefore, in this work, surrogate, zone-level artificial neural networks that take weather, occupancy and indoor temperature as inputs, have been created. These are used as an evaluation engine by a genetic algorithm with the aim of minimising energy consumption. Bespoke 24-hour, heating set point schedules are generated for each zone in a small office building in Cardiff, UK. The optimisation strategy can be deployed in two modes, day ahead optimisation or as model predictive control which re-optimises every hour. Over a February test week, the optimisation is shown to reduce energy consumption by around 25% compared to a baseline heating strategy. When a time of use tariff is introduced, the optimisation is altered to minimise cost rather than energy consumption. The optimisation strategy successfully shifts load to cheaper price periods and reduces energy cost by around 27% compared to the baseline strategy.

Keywords

Building energy management, Artificial neural network, Genetic algorithm, Model predictive control, HVAC control, Heating Set Point Scheduler