IV.   Abstract

The Cooper Union for the Advancement of Science and Art recently constructed a new academic building at 41 Cooper Square (41CS). The building was awarded a LEED Platinum rating for energy efficiency. In this thesis, two neural networks and a Least Mean Squares (LMS) model were built to model the energy consumption of the building, and to improve the efficiency of the HVAC system on the classroom level.

A neural network was used to predict the total energy consumption of 41CS. The model was validated to be accurate within an average absolute error of 33.4kW or, approximately 5.0% of the total electricity consumption of the building for weekdays when school was in session. The model therefore can be used to provide insight into how much energy Cooper Union should save as a result of the installation of new infrastructure upgrades. This also validates the use of neural networks for the assessment of power consumption in schools and commercial buildings. Innovations in this neural network model include the use of solar position as a variable, which was specifically incorporated in order to address 41CS's specific situation.

With the aim of improving classroom efficiency, a neural network model and an LMS model were used to simulate the temperature of a classroom given current various classroom conditions, including CO_2 concentrations. The use of CO_2 concentrations is shown to significantly increase the accuracy of the models, and can be incorporated into HVAC systems to improve performance. A new control system for the radiant panels in the classroom was simulated to remove some of the most significant causes of inefficiency at the classroom level, saving energy. Predictive control systems such as the one implemented in this thesis can be incorporated into existing HVAC systems at no extra cost, provided CO_2 concentration data is already available.