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Sustainable Building Energy Optimization Through Metaheuristic Algorithms and Neural Network Solutions

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Abstract:

The integration of metaheuristic algorithms with neural network models has emerged as a potent strategy for optimizing energy consumption in sustainable building designs. Metaheuristic techniques, such as genetic algorithms, particle swarm optimization, and simulated annealing, offer robust solutions for navigating complex, multidimensional design spaces, enabling the identification of optimal configurations for building systems. When combined with neural networks, which excel at modeling nonlinear relationships and predicting energy performance, these hybrid approaches facilitate precise control over heating, ventilation, and air conditioning (HVAC) systems, lighting, and other energy-intensive components. This synergy enhances the ability to forecast energy demands accurately and implement responsive control strategies, thereby reducing energy consumption and improving occupant comfort. The adoption of such integrated optimization frameworks supports the development of energy-efficient buildings, contributing to broader sustainability goals and compliance with stringent energy regulations.

Keywords: Sustainable Buildings, Energy Optimization, Metaheuristic Algorithms, Neural Networks, HVAC Control, Energy Efficiency

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