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Optimal energy management system for residential buildings considering the time of use price with swarm intelligence algorithms

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Highlights

- Proposed an improved model for the building energy management system (BEMS)
- Flexibility to respond to environmental conditions results in less energy consumed
- 46 swarm intelligence algorithms are used to assess the proposed model's performance
- The proposed BEMS considers the internal heat generations and outdoor illuminance
- The proposed model has been economically assessed with and without BEMS

Abstract

Revolutions in human activities and lifestyles result in a transition from conventional to intelligent residential building infrastructure. Conventional heating, ventilation, and air conditioning (HVAC), refrigerator and lighting system challenges are addressed without taking into account building heat gains, outdoor illuminance, and temperature. Based on these parameters, a mathematical model for cost estimation of residential building energy consumption, considering indoor heat gains, outdoor temperature, outdoor illuminance, and TOU price has been developed. A total of 46 swarm intelligence based optimization algorithms are used to optimize different building parameters. These swarm intelligence algorithms (SIA) are compared using the convergence curves, statistical and box-plot analysis and the Bald Eagle search (BES) algorithm is found to be the best algorithm among all 46 SIAs. The mean energy consumption costs of the best algorithm, BES, and the worst algorithm, fireworks algorithm (FA) are found to be Rs. 8.85 and Rs. 12.98, respectively. In addition, economic analysis has been conducted for the proposed study and it is compared with the existing models with building energy management systems (BEMS) and conventional model