論 文 の 英 文 要 旨

TITLE	Evolutionary Multi-objective Optimization of Air-conditioning Schedule in Office Building
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For office building management, the concern with reductions in energy consumption by an optimal air-conditioning control has been growing recently. The energy reduction by controlling the temperature setting often sacrifices the thermal comfort of office workers. The temperature setting has been conducted manually based on the building manager's experience or optimized as a single-objective optimization problem. This thesis proposes a design methodology of air-conditioning temperature setting optimization that considering both the energy consumption and thermal comfort in office buildings. Firstly, for an office room in the office building, this thesis presents a mathematical model to evaluate the temperature setting schedule and an evolutionary multi-objective optimization system with it. Secondly, for an entire office building, the thesis presents a simulation-based optimization system that evaluates the temperature setting schedule by using a building simulator. Experimental results show that the mathematical model-based and the simulation-based systems acquire multiple temperature setting schedules representing a trade-off between the energy consumption and the thermal comfort level. The results also show that the obtained schedules are better than the conventional constant temperature settings and ones obtained by a single-objective optimization. Thirdly, this thesis proposes a robust optimization system that simultaneously optimizes the thermal comfort level, the power consumption, and their differences when the air-temperature forecast involves errors. Experimental results show that the robust optimization system can acquire air-conditioning schedules robust for the uncertainty on the forecast of the outside temperature. Fourthly, this thesis proposes a surrogate optimization system that uses a computationally cheap surrogate evaluator based on a recurrent neural network with the time-series predictive long short-term memory instead of the computationally heavy building simulator. The experimental results show that the proposed surrogate optimization system is able to obtain practical schedule sets and accelerate the optimization process. This thesis's achievements provide each office building manager with optimized temperature setting schedules optimized for energy consumption and the thermal comfort level.