Data Driven Predictive Control: A Dynamic Multi-Objective Optimization of Chiller and Boiler Pumps in HVAC Systems to Reduce Energy Consumption and Improve Thermal Comfort = Kontrol Prediktif Berbasis Data: Optimalisasi Multi-Objective Dinamis Pompa Chiller dan Boiler Dalam Sistem HVAC Untuk Mengurangi Konsumsi Energi dan Meningkatkan Kenyamanan Termal

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Abstrak

Tesis ini menyelidiki penerapan multi-ojective genetic algorithm untuk mengurangi konsumsi energi dalam sistem heating, ventilation dan air conditioning (HVAC) sekaligus meningkatkan kenyamanan termal melalui kontrol prediktif pengoperasian pompa. Penelitian ini memanfaatkan EnergyPlus dan OpenStudio untuk memodelkan kinerja energi Makara Art Center, sebuah gedung di Universitas Indonesia. Optimasi multi-objective dinamis kemudian dilakukan pada model tersebut, khususnya pada laju aliran massa pompa boiler dan pompa chiller. Simulasi Energyplus dan MATLAB dijalankan secara paralel di Building Control Virtual Test Bed (BCVTB) untuk menilai peningkatan kenyamanan termal sekaligus meminimalkan kebutuhan energi menggunakan model yang dioptimalkan. Hasilnya menunjukkan pengurangan konsumsi energi secara signifikan sebesar 32% tanpa mengurangi kenyamanan termal. Hal ini menunjukkan potensi optimasi multi-objective sebagai alat untuk meningkatkan efisiensi sistem HVAC di gedung.
.....This thesis investigates the application of multi-objective dynamic optimization to reduce energy consumption in Heating, Ventilation, and Air Conditioning (HVAC) systems while improving thermal comfort through pump operation predictive control. The study utilizes EnergyPlus and OpenStudio to model the energy performance of Makara Art Center, a building at the University of Indonesia. A dynamic multi-objective optimization is then conducted on the model, particularly in the boiler and chiller pumps mass flowrates. Co-simultion between Energyplus and MATLAB is run in Building Control Virtual Test Bed (BCVTB) to assess the improvememnt on thermal comfort while minimizing energy demand using the optimized model. The results demonstrate a significant 32% reduction in energy consumption without compromising thermal comfort. This highlights the potential of data driven multi-objective optimization as a valuable tool for improving HVAC system efficiency in buildings.