UNIVERSITY OF CALIFORNIA MERCED | SCHOOL OF ENGINEERING

Electrical Engineering and Computer Science Technical Seminar Series

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Deep Reinforcement Learning for Holistic Smart Building Control

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Faculty Host: Wan Du

Abstract

Recently, significant efforts have been done to improve quality of comfort for commercial buildings' users while also trying to reduce energy use and costs. Most of these efforts have concentrated in energy-efficient control of the HVAC (Heating, Ventilation, and Air conditioning) system, which is usually the core system in charge of controlling buildings' conditioning and ventilation. However, in practice, HVAC systems alone cannot control every aspect of conditioning and comfort that affects buildings' occupants. Modern lighting, blind and window systems, usually considered as independent systems, when present, can significantly affect building energy use, and perhaps more importantly, user comfort in terms of thermal, air quality and illumination conditions. In this talk, we take a holistic approach to deal with the trade-offs between energy use and comfort in commercial buildings. We developed a system called OCTOPUS, which employs a novel deep reinforcement learning (DRL) framework that uses a data-driven approach to find the optimal control sequences of all building's subsystems, including HVAC, lighting, blind and window systems. The DRL architecture includes a novel reward function that allows the framework to explore the trade-offs between energy use and users' comfort, while at the same time enable the solution of the high-dimensional control problem due to the interactions of four different building subsystems. In order to cope with OCTOPUS 's data training requirements, we argue that calibrated simulations that match the target building operational points are the vehicle to generate enough data to be able to train our DRL framework to find the control solution for the target building. In our work, we trained OCTOPUS with 10-year weather data and a building model that is implemented in the EnergyPlus building simulator, which was calibrated using data from a real production building

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Biography

Xianzhong Ding is a second-year Ph.D. student of Electrical Engineering and Computer Science at the University of California Merced, under the advisement of Professor Wan Du. He previously received his master's degree from Shandong University. His research interest includes building control, reinforcement learning and edge computing.