Universität Stuttgart
Institut für Gebäudeenergetik, Thermotechnik und Energiespeicherung

Lehrstuhl für Heiz- und Raumlufttechnik
Prüfer: Prof. Dr.-Ing. Konstantinos Stergiaropoulos

Open Thesis

Type: MA

Development of a Framework for Model Predictive Control with Event-Triggered Model Adaptation for Control Optimization of a Data Center's Liquid Cooling System

The cooling systems within data centers, while vital for keeping critical hardware components from overheating, often contribute to more than 30% of the energy demands of these centers. To improve the operational efficiency of these systems, the implementation of advanced control strategies is necessary. Model Predictive Control (MPC) is a promising approach for optimizing cooling operations, but traditional MPC relies on a fixed prediction model, which may lose accuracy over time due to system changes, sensor noise, and varying conditions. To address this, an event-triggered model adaptation mechanism is proposed in an ongoing project. Unlike adpative MPC, this method selectively updates the prediction model when a predefined condition is met.

This thesis aims to develop a framework for MPC with event-triggered model adaptation based on an existing plant and prediction model of a liquid-cooled data center. The key tasks include:

1. **Literature Review:** Review control approaches related to event-triggered MPC and data center cooling. Identify limitations and areas for improvement in current strategies.

2. **Control Framework Development**: Develop a framework with consideration of measurement noise, define event-based trigger conditions for model adaptation, and design model transition mechanisms.

3. **Simulation and Assessment:** Utilize simulations to evaluate the effectiveness and robustness of the developed framework.

Prerequisites:

- Background in thermodynamics and control theory
- Interests in theoretical problems

Beginning: now

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