



THE UNIVERSITY
OF BRITISH COLUMBIA
Okanagan Campus



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Project Title: Modeling and Model Validation of Distributed Energy Systems

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Project Type: Summer Research Assistantship with Stipend

Keywords: Robust MPC, Building control, Distributed Energy Systems

Application Deadline: 13:15 CET November 22, 2024

1 Posting

Buildings account for over 30% of the global energy demand, almost 40% in the EU and US, and are responsible for $\sim 30\%$ of CO₂ emissions globally. The majority of this energy is used for heating, cooling and ventilation. Despite this significant climate impact, most buildings function well below the efficiency they were designed for. UBC Okanagan's district energy system is no exception. The Energy Team estimates that, for example, the medium heat district energy system (MDES) functions at $\sim 68\%$ efficiency annually, while it has the potential to operate at $\sim 90\%$ efficiency. Model predictive control technology can improve efficiency, but is not commonly used in practice. Challenges include the need for trained personnel for commissioning and maintenance and the need for accurate models, which are prohibitively time-consuming and expensive to develop.

1.1 Description

This project aims to develop data-driven methods for modeling of district energy systems that are reliable and easy to apply in practice. To achieve this, we are developing a first principles model of the MDES and its connected buildings, which will be used as a benchmark for data-driven modeling and (distributed) control solutions. This benchmark model is essential for the development of data-driven methods, enabling analysis of identifiability under feedback operation and quantification of the informativity of data under varying experimental conditions.

The selected student will receive a stipend of CAD 6000 over the timeframe of 12 to 16 weeks.

1.2 Goals

The goals of the project are as follows:

1. Calibration and validation of the first-principles model using historical data.
2. In simulation, determine feasibility of data-driven modeling for optimization of the district energy system using realistic experimental conditions.
3. Time permitting, estimation of models for UBC Okanagan's district energy system from historical data.

Publications: If the final results are promising they can potentially be turned into a publication.

1.3 Qualification

We are looking for a talented, outstanding, highly motivated student with theoretical background and/or interest in data-driven modeling and control, advanced control or related field(s).

- No specific experience with building control is necessary
- Prior knowledge on MPC or estimation is desirable
- Some familiarity with Automatic Control and Convex Optimization will be helpful

1.4 How to Apply

Please send your resume/CV (including lists of relevant publications/projects) and transcript of records in PDF format via email to `klaske.vanheusden@ubc.ca` and `mathias.hudoba@its.uio.no`.

Application Deadline: 13:15 CET on November 22, 2024.

Start Date: Expected starting date is between April and June, but it is negotiable.

Stipend: The selected candidate will be awarded a scholarship stipend of CAD 6000.

1.5 Tasks list

1. Conduct a literature review on modeling and control of district energy systems and related works. Start a write up in $\text{\LaTeX}$;
2. Estimate unknown parameters of a first-principles model from historical data and validate the model using historical data in varying experimental conditions.
3. Using the model, analyze identifiability of the system under realistic experimental conditions, including feedback operation and excitation under normal operating conditions.
4. Estimate and validate data-driven models (or controllers) via simulations. If needed, experiment design can be considered.
5. Time permitting, apply the most promising approach identified in the simulation studies to estimate and validate a data-driven model (controller) based on historical data.