Development of calibrated energy models to assess HVAC plant configuration upgrades and efficient building control for Canada's military installations

MASc and PhD Positions available

Description:

1) **Investigation of HVAC plant configuration upgrade scenarios**
   - The objective of this activity is to reduce costs of building energy and associated GHG emissions of the central heating plants (CHPs) in Department of National Defense (DND) bases. To this end, this activity will build a simulation model of a CHP and calibrate it with metered heating demand from this facility. Subsequently, a number of decentralized to centralized plant upgrade scenarios will be investigated by using the model in terms of the initial cost of installation and integration, operating cost savings, and GHG emission reductions. To this end, a district energy simulation (DES) model of a CHP system will be developed in Matlab/Simulink. The DES model will be calibrated with the existing load characteristics of the CHP. The activity will assess the integration of various heat pump and renewable energy technologies from a techno-economic and environmental standpoint.
2) **Development of building energy models and assessment of control interventions prior to field deployment**
   - Absence of building performance simulation (BPS) models, which are capable of acting as digital twins, representative of DND buildings limits our ability to test and assess the suitability of technologies, algorithms, and retrofit solutions prior to field deployment. This activity will develop calibrated energy models in the BPS tool EnergyPlus for representative group A and C buildings within the DND portfolio. These models will act as digital twins for actual DND buildings. The models will be assembled from as-built drawings and unknown parameters will be estimated through calibration with measured metered data. These models will serve as a sandbox environment enabling control algorithm development, which includes activities such as debugging controls code, improving and fine-tuning sequences of operation, as well as assessing the impact of various technology upgrades on energy performance, GHG emissions, and indoor environmental quality.

The Research and Engineering Skills You Will Strengthen and Acquire:

Operating principles, design and numerical modelling of state-of-the-art building and HVAC systems; optimization and control for engineering applications; liaison and communication skills outside of academia (the project involves federal government partners).

Carleton UNIVERSITY
Canada's Capital University

BPRC
Building Performance Research Centre
Carleton University

The Ideal Candidate:

Bachelor (or Master) in Mechanical/Civil/Environmental/Building Engineering; exposure to systems modelling, and simulation; exposure to fluid mechanics, heat transfer, and thermodynamics; familiar and comfortable with Matlab and Simulink and/or other programming languages such as C++ and Python; motivated and willing to expand their array of technical and research skills; interest in developing a publication record in prestigious engineering journals and conferences; excellent communication skills in English; and three academic references.

What is Offered:

Qualified candidates will receive:

- a generous funding package which includes RA, TA, and scholarship contributions.
- Additional funds to cover travel to domestic and international conferences

Who to Contact:

Please email (in a single pdf file) your CV, transcripts, a writing sample, and a cover letter describing how your skills and qualifications fit the position to Prof. Jean Duquette (jeanduquette@cunet.carleton.ca) or Prof. Burak Gunay (burakgunay@cunet.carleton.ca).