NSERC Smart Net-Zero Energy Buildings Strategic Research Network

Réseau de recherche stratégique du CRSNG sur les bâtiments intelligents à consommation énergétique nette zéro

Assessing simplified models for predictive control of space heating in houses

Project 4.3: Smart operating strategies for net-zero energy solar communities

Links: Projects 3.1, 3.3, 4.1, 5.2

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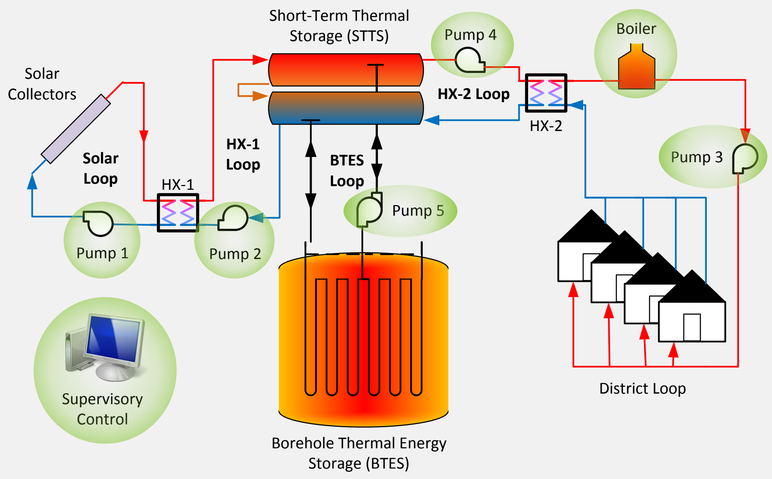
Context: Subproject 4.3a

Global objectives for the subproject

- Develop detailed models for community-scale energy systems
- Investigate the model resolution required for Model-Predictive Control and develop simplified models
- Develop a methodology to optimize the design and control of solar communities

Previous results

- Detailed TRNSYS model of Drake Landing Solar Community
- Calibrated with measured data
- Model-Predictive Control implemented to manage the BTES charging/discharging and the solar pumps
- MPC can deliver 5 % energy savings (current system already optimized!)
- Detailed TRNSYS model, long calculation times → offline MPC

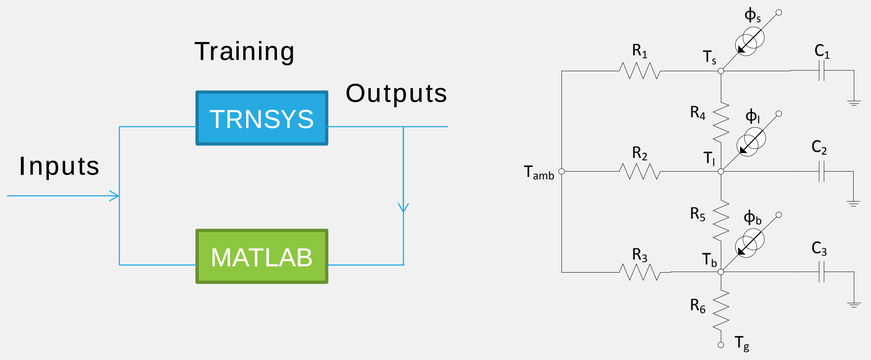


Current progress

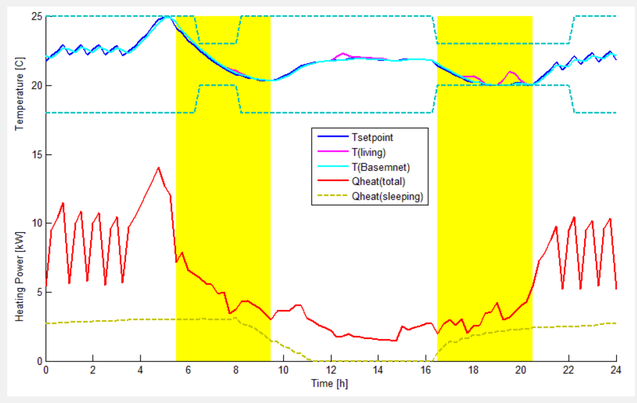
Objectives

- Assess simplified model for Model-Predictive Control of space heating in houses, compared to detailed model

Methodology

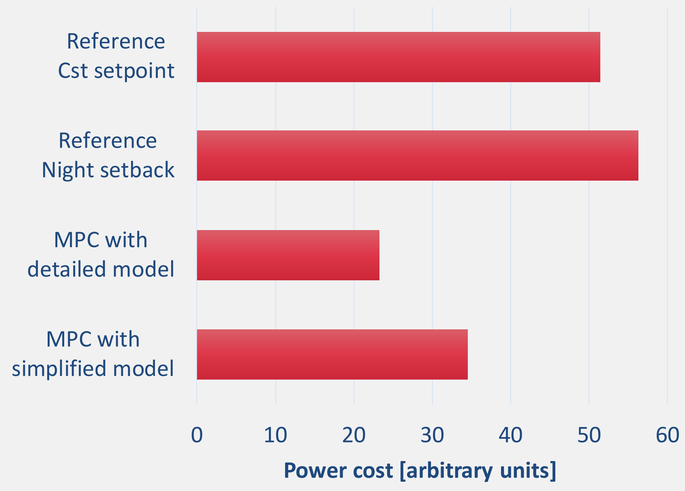


- Simplified approach, consider electric heating of houses
- Investigate potential to reduce power demand during peak times
- Power cost set to 1 during peak (yellow periods in Figure), 0 otherwise
- Perfect forecasts are assumed (occupants, weather)
- Temperature limits set to [20 °C; 23 °C] if occupied, [18 °C; 25 °C] otherwise



Results

- Testing environment successfully implemented, combines TRNSYS & Matlab
- Detailed and simplified models deliver functional MPC algorithms
- Cost savings for a very cold day (arbitrary cost, utility point of view)
  - Simplified model: 33 %
  - Detailed model: 55 %
- Computational times (1-day optimization)
  - Detailed model (TRNSYS + GenOpt): 16 h
  - Simplified model (Matlab MPC + TRNSYS simulation): 54 secs



Future tasks

- Expand work on simplified models to community level
- Improve Model-Predictive Control methodology, include real-time weather forecasts
- Develop methodology to optimize design and operation (consider advanced controls at design stage)

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