

United Technologies Corporation (Carrier) & Modelon Master's Thesis Project

Nonlinear Model Predictive Control Evaluation for HVAC Optimal Control

Summary

This Master Thesis topic is a collaboration between the Department of Automatic Control, Modelon and Carrier Corporation. The intent is to obtain problem formulations for the optimal control of HVAC equipment that captures operating constraints and performance targets and evaluates model characteristics, workflows and different tool environments.

Carrier Background and Importance of Control

UTC Commercial Businesses, comprised of OTIS and Climate Controls and Security, are the world's largest provider of building technologies. Its elevator, escalator, fire safety, security, building automation, heating, ventilation, air conditioning and refrigeration systems and services promote integrated, high performance buildings that are safer, smarter and sustainable. CCS and OTIS are units of United Technologies Corp., a leading provider to the aerospace and building systems industries worldwide.

Building systems, and HVAC systems in particular, are dynamic by nature. In addition this type of equipment is subject to a number of hard constraints in operation due mainly to the protection of components including the compressor. This project will carry out trade studies to evaluate elements of a control design workflow that combines steady state information for set point determination and dynamic information for protection of the equipment and dynamic performance optimization.

The intent is to fully utilize Modelica models and to survey design methods and tools including but not limited to CasADi, Pyomo and OCT.

The objective of the project will be to create problem formulations for HVAC designs in collaboration with the industrial partner Carrier, to create workflows and to evaluate and implement nonlinear model predictive control (NMPC) to show the efficacy, advantages and trades for different problem formulations and models. In addition model requirements (fidelity, characteristics as smoothness) will be included in the trade study.

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