

Wenqing Wang

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EDUCATION

The University of Texas at Dallas

Doctor of Philosophy, Mechanical Engineering

Richardson, TX

Expected December 2023

- Research Interests:**
- **Dynamic Modeling:** Hybrid-electric Aircraft Elements Modeling
 - **Hierarchical Control Design:** Two-level Set-based Hierarchical Model Predictive Control (MPC)
 - **Robust Control Design:** Tube-based Robust MPC

Related Courses: Linear System, Nonlinear System, Engineering Optimization, Convex Optimization in Systems and Controls, Optimal Estimation and Kalman Filter, Numeric Analysis, Stability and Bifurcations of Switched Systems

Beijing Technology and Business University

Bachelor of Science, Automation

Beijing, China

Jun 2018

WORK EXPERIENCE

The University of Texas at Dallas

Research Assistant & Teaching Assistant

Richardson, TX

Aug 2019 - Present

- Completed research projects sponsored by National Science Foundation (NSF) and Office of Naval Research (ONR) focusing on dynamic modeling and advanced controller design for energy management systems;
- Guided lab experiments and simulations, lectured and assisted in undergraduate control courses.

Beijing Yanshan Petrochemical Co., Ltd.

Technical Intern

Beijing, China

Feb 2018 - Mar 2018

- Participated in designing a detection and alarming system for smoke, fire, and high temperature;
- Revised and validated the alarming system with programmable logic controller.

SKILLS

- **Languages:** C, C++, Python, Latex
- **Software:** Matlab, Eclipse, Labview, Optimization tools (Real-time Simulink, CVX, YALMIP, Mosek, Gurobi, FORCESPRO)

PROJECTS

Hierarchical MPC for coupled subsystems with optimal hierarchical clusterings

Sep 2022 - Present

- Identified system decompositions for less conservative non-centralized MPC designs;
- Decomposed control decisions vertically for multi-timescales and horizontally among each subsystem in the hierarchical MPC formulations;
- Coordinated the control decisions in different levels using adjustable tubes;
- Applied the proposed hierarchical MPC to complex multi-timescale systems.

Tube-based Robust MPC for Two-timescale Systems using Reduced-order Models

Oct 2021 - Sep 2022

- Formulated a tube-based MPC using a reduced-order, relatively large time step size, model and time-varying input change constraint sets;
- Proved recursive feasibility of the proposed robust MPC and constraint satisfaction of closed-loop state and input trajectories using the candidate solutions;
- Implemented on-line constraint tightening as linear program using zonotopes.

Data Acquisition and Real-time Simulation of Air Cycle Machine (ACM) Using Speedgoat

Jun 2021 - Oct 2021

- Wired up the ACM to connect with speedgoat;
- Built a model using real-time simulink and speedgoat toolboxes to collect data from ACM;
- Designed MPC controllers with Y2F interface using FORCESPRO software;

- Created a custom user interface in real-time simulink to display model information and sensor data.

Hierarchical clustering of constrained dynamic systems using robust positively invariant sets

Jun 2020 - Jun 2021

- Developed a systematic iterative Agglomerative Hierarchical Clustering (AHC) approach to determine the hierarchical decomposition structure of a system;
- Developed a set-based distance metric considering system dynamics and operation constraints simultaneously to quantify the distance between subsystems;
- Applied and validated the proposed system decomposition method via a 43-state complex mathematical graph model.

Hierarchical Multi-timescale Energy Management for Hybrid-Electric Aircraft

August 2019 - Jun 2020

- Modeled the key components and dynamic behaviors of onboard power systems for a range extender hybrid-electric aircraft;
- Formulated a two-level set-based hierarchical MPC to guarantee the operation constraints and real-time execution;
- Utilized wayset to coordinate the upper and lower level controller combining long prediction horizon and fast update rate;
- Validated the applicability of the two-level hierarchical MPC with 16 state hybrid-electric aircraft power system.

Project of Creative Star of Martial Arts Challenge of Robot

Nov 2016 - Nov 2017

- Led a project team and oversaw the design and assembling process of the robot;
- Improved programming and structure of robot to optimize the functionality of the robot with software Eclipse;
- Accomplished the testing and optimal demonstration on the stage.

JOURNAL PUBLICATIONS

- **Wang, W.**, Koeln, J. P , Hierarchical clustering of constrained dynamic systems using robust positively invariant sets, *Automatica*, vol. 147, pp. 110739, 2023.
- **Wang, W.**, Koeln, J. P , Tube-based Robust MPC for Two-timescale Systems using Reduced-order Models, *IEEE Control Systems Letters*, vol. 7, pp. 799-804, 2023.

CONFERENCE PUBLICATIONS

- **Wang, W.**, Koeln, J. P, Hierarchical Multi-Timescale Energy Management for Hybrid-Electric Aircraft. *ASME Dynamic Systems and Control Conference*, 2020.