Wenqing Wang

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EDUCATION

The University of Texas at Dallas — Richardson, TX
Doctor of Philosophy, Mechanical Engineering — *Expected January 2024*

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
- **Stochastic Control Design**

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, Optimal Control and Dynamic Programming

The University of Texas at Dallas — Richardson, TX
Master of Science, Mechanical Engineering — *May 2022*

Beijing Technology and Business University — Beijing, China
Bachelor of Science, Automation — *Jun 2018*

WORK EXPERIENCE

The University of Texas at Dallas — Richardson, TX
Research Assistant & Teaching Assistant — *Aug 2019 - Present*

- Completed research projects 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. — Beijing, China
Technical Intern — *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.

PROJECTS

Hierarchical MPC Using Reduced Input Space — *June 2023 - Present*

- Achieved computational efficiency at the upper-level controller by reducing input space;
- Guaranteed operation constraint satisfaction using waypoint;
- Analysed the scalability of the proposed hierarchical controller with simulation length and system dimensions.

Set-based Hierarchical Control for Complex Multi-timescale Constrained Linear Systems — *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 online constraint tightening as a 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.

PUBLICATIONS

Journal Articles
- **Wang, W.**, Koeln, J. P. , Set-based hierarchical control architecture and MPC design for complex multi-timescale constrained linear systems, *Journal of Process Control* (Submitted).
- **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, 2022.

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

PROFESSIONAL ACTIVIES

Conference Manuscript Reviewer
- Modeling, Estimation, and Control Conference
- American Control Conference

Journal Manuscript Reviewer
- IEEE Control System Letter
- System and Control Letter

HONORS AND AWARDS

- Betty & Gifford Johnson Travel Award — Feb 2023
- ACC student travel grant — April 2022
- Outstanding League Cadres of BTBU (5 %) — Oct 2017
- Merit Student (5 %) — Nov 2016