Yuanji Zou

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HIGHLIGHTS

Skills: Optimal control, Multi-agent System (AI), Deep Reinforcement Learning, Robotics, Optimization.

EDUCATION

University of Minnesota (U of M), Minneapolis, MN, U.S.A. **Expected May 2025**

- Ph.D. Candidate in Mechanical Engineering, Overall GPA: 3.9/4.0 Advisor: Dr. N. Elia

Tsinghua University (THU), Beijing, China **Jul 2019**

- B.E. in Automotive Engineering. Overall GPA: 3.7/4.0, Ranking 7th /71 (top 10%)
- Joint Degree (Honors Degree) in Xinya College

RESEARCH INTEREST

- Multi-agent AI, Networked control systems, Optimal control, Distributed gradient descent
- Stochastic systems, Stochastic differential equation, Robustness

PUBLICATION & PATENT

- [1] Y. Zou and N. Elia, "Algebraic Riccati equation approach for network distributed optimal H_2 synthesis," *2024 Conference on Decision and Control (CDC)*, Milan, Italy, 2024.
- [2] Y. Zou and N. Elia, "A synthesis approach for distributed H_2 control problems with communication delays," *2024 Allerton Conference*, Urbana, USA, 2024.
- [3] Y. Zou and N. Elia, "Robust mean square stability," *2022 European Control Conference (ECC)*, London, United Kingdom, 2022, pp. 1623-1628.
- [4] L. Meng, Y. Zou, Y. Qin, Z. Hou. A new electric wheel and optimization on its suspension parameters. *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering*. 2020;234(12):2759-2770.

RESEARCH EXPERIENCE

University of Minnesota, Minneapolis, MN, U.S.A. (Advisor: Dr. N. Elia) **Aug 2019 - Present**

Cooperative Multi-agent Policy Design [1][2] 2022 - Present

- Multi-Agent Systems Modeling: Developed mathematical models for multi-agent environment operating under observation noises and process disturbances, with a focus on distributed decision-making and shared objectives.
- Designed H2 Inspired Multi-agent Reinforcement Learning Framework: Formulated a dynamic programming-based recursive algorithm that blends optimal control principles with Markovian decision process to address cooperative regulation under communication delays.
- Achieved Networked Implementation: Implemented the regulator in network-distributed manner **with minimal memory usage**, enabling parallel execution.
- Multi-Robot Coordination Application: Validated the framework in a cooperative robotics task, achieving a 100% improvement in disturbance rejection compared to classical controllers.
- **Federated Learning Application:** Showcased the framework's effectiveness in enhancing

convergence rates within **distributed training scenarios**.

Robust Reinforcement Learning for Partially Observable Systems [3] 2020-2022

- Modeled Partially Observable Multi-Agent Systems: Developed a framework to analyze the stability and performance of agent-environment interactions under **uncertainty** and **partial observability**, reflecting real-world deployment constraints in RL settings.
- Introduced Robust Mean Square Stability (RMSS): Proposed RMSS as a new metric to assess robustness of learned policies against **unmodeled dynamics** and **intermittent observations**. Employed a frequency-domain analysis aligned with Lyapunov-based methods to quantify robustness margins.
- Synthesized and Evaluated Robust Policies: Designed suboptimal yet robust control policies via model-based techniques. Validated their performance on a partially modeled pendulum robot system, demonstrating improved resilience to unmodeled dynamics and observation dropout.

University of California, Berkeley, CA, U.S.A. **Jul 2018 - Sept 2018**

Simulation of Urban Driving Behavior Advisor: Dr. M. Tomizuka

- Modeled Vehicle Dynamics: Developed a discrete-time four-wheel vehicle dynamics model with full-car suspension to accurately capture **dynamic interactions across the chassis**, integrated into a ROS-based hardware-in-the-loop autonomous driving simulation platform. **Identified suspension parameters from real-world data** to ensure physical accuracy.
- Hardware fine-tuning: Optimized the translation of physical hardware inputs into virtual control commands to accurately replicate real-world driving haptic feedback.

Tsinghua University, Beijing, China **Dec 2017 - Jun 2019**

Electric Wheels Design [4] Advisor: Dr. Z. Hou

- Developed Prototype for Electric Wheel: Iteratively designed and fabricated a new electric wheel prototype using metal 3D printing for EV/HEV applications.
- Optimized Vibration Performance: Analyzed the frequency characteristics of the in-wheel motor's vertical vibration and optimized by nonconvex optimization approach.

ACTIVITIES

Teaching Assistant at U of M (ME 3221, 3281, 2021, 2011) **Aug 2019 – Present**

- Content includes control, numerical methods, microcomputer and machine design.

“Challenge Cup” National Undergraduate Scientific Competition, at THU **Nov 2019**

- Developed an in-wheel driving, all wheel steering vehicle chassis equipped with simple auto-driving system. The vehicle was able to do spin turn and lateral translation.

“Sunshine Boat” Volunteer Program, at THU **Jul 2016**

- Raised donations for orphaned children in the Hunan Province.
- Conducted research on the mental and physical health of orphaned children

MISCELLANEOUS

- Programming Languages & Frameworks: Python, C/C++, MATLAB, CUDA, PyTorch.
- Office Applications: Latex, Photoshop, SolidWorks, CoLab