

# Yang Hu

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## EDUCATION

**B.E. of Computer Science and Technology** 2018 ~ 2022 (expected)  
*Tsinghua University, Beijing, PRC* (GPA: 3.95; rank: 1 / 54)

- Affiliation: Institute of Interdisciplinary Information Sciences (IIIS), known as “Yao Class”.

## RESEARCH INTERESTS

My research interests lie in the science of intelligent systems and decision making, such as optimal control theory, reinforcement learning and optimization. I am particularly interested in studying and improving the efficiency and complexity of RL and control algorithms, and in combining learning with control in unknown systems.

## HONORS AND AWARDS

### Undergraduate:

**National Scholarship for Undergraduates** 2019 & 2021

- The highest honor for undergraduates (1 student per grade per department).

**First-class Scholarship at Tsinghua (in memory of Nanxiang Jiang)** 2020

- The highest honor for junior-year students at Tsinghua (1 junior student per department).

**Silver Medal of “Yao Award” at IIIS, Tsinghua** 2021

- Awarded to outstanding senior students at “Yao Class” (1 gold, 2 silver, 4 bronze).

**Second-class Scholarship for Freshmen** 2018

**Scholarship for the Cultivation of Outstanding Talents** 2018 ~ 2021

### High school:

First Prize of National Mathematical Olympiad (First Round) 2016 & 2017

First Prize of National Olympiad in Informatics in Provinces (NOIP) 2015 & 2017

Silver Medal of Russian Mathematical Olympiad (10<sup>th</sup> Grade, Final Round) 2017

## RESEARCH EXPERIENCE

**Undergraduate Research Assistant** Sept. 2019 ~ Dec. 2020

*IIIS, Tsinghua University (Advisor: Prof. Chongjie Zhang)*

- Focus on the empirical side of Reinforcement Learning.
- In the project, I helped to implement and improve algorithms in multi-agent reinforcement learning (MARL), and design an efficient distributed architecture for MARL (see [3]).

**Undergraduate Research Assistant** July 2020 ~ Dec. 2020

*IIIS, Tsinghua University (Advisor: Prof. Yang Yu)*

- Focus on the social-economical applications of Reinforcement Learning.
- In the project (see [2]), we design a new DDPG-based algorithm that learns optimal pandemic-control policies to solve the problem of inter-regional collaborative pandemic control, and discuss sociological implications of collaborative behavior in multi-agent settings.

**Research Internship (remote)****Jan. 2021 ~ present****CMS, California Institute of Technology** (Advisor: Prof. Adam Wierman)

- Focus on optimal control theory, esp. Model Predictive Control (MPC).
- Prove novel theoretical performance guarantees for MPC in linear time-varying (LTV) systems.
- In the project (see [1]), we provide the first theoretical performance guarantees (i.e., input-to-state stability, dynamic regret and competitive ratio) for MPC controllers in LTV systems with general well-conditioned costs. We introduce a new perturbation-based analysis framework that is general for analysis of controllers, and reveal a new reduction from MPC to SOCO.

**Research Internship (remote)****Aug. 2021 ~ present****ECE, Carnegie Mellon University** (Advisor: Prof. Guannan Qu, co-advisor: Prof. Adam Wierman)

- Focus on optimal control theory, esp. the stabilization of linear systems.
- In the project (see [4]), we study the sample complexity of adaptively stabilizing linear time-invariant (LTI) systems. We introduce a novel spectral-decomposition-based approach to learn stabilizing controllers and provide theoretical stabilization guarantees for it.

**PUBLICATIONS**

[1] Y. Lin\*, Yang Hu\*, H. Sun\*, G. Shi\*, G. Qu\*, A. Wierman. Perturbation-based Regret Analysis of Predictive Control in Linear Time Varying Systems, 2021, arXiv preprint arXiv: 2106.10497.

Co-first authors are marked with asterisks (\*).

Accepted by NeurIPS'2021 as Spotlight (top 3% of all submissions).

[2] Yang Hu, Z. Zhu, S. Song, X. Liu, Y. Yu. Calculus of Consent via MARL: Legitimizing the Collaborative Governance Supplying Public Goods, 2021, arXiv preprint arXiv: 2111.10627.

Accepted by NeurIPS'2021 PERLS Workshop as Poster.

[3] S. Wu\*, T. Wang\*, C. Li, Yang Hu, C. Zhang. Containerized Distributed Value-Based Multi-Agent Reinforcement Learning, 2021, arXiv preprint arXiv: 2110.08169.

[4] Yang Hu, G. Qu, A. Wierman. On the Sample Complexity of Stabilizing LTI Systems, 2021.

Manuscripts in preparation (accessible via personal website).

**COURSE PROJECTS****Performance Improvement of Episodic Memory Deep Q-Networks**

Project of the course "Artificial Intelligence: Principles and Techniques"

- Attempt multiple approaches to improve the performance of EMDQN by better utilizing the similarity of states and improving the efficiency of episodic memory.

**A Survey on the Representation Learning of Large-Scale Networks**

Project of the course "Numerical Analysis"

- Survey, implementation and comparison of multiple network embedding algorithms.

**A 2-Player No-limit Texas Holdem Bot Based on Monte-Carlo CFR and Hand-crafted Rules**

Project of the course "Game Theory"

- Design and train an agent for 2-player Texas Holdem, using a simplified counterfactual regret minimization (CFR) approach that is compatible with small-scale training.

**SELECTED COURSES**

**Mathematics:** Calculus A1 (A+), Calculus A2 (A), Linear Algebra (A), Abstract Algebra (A+),

*Mathematics for Computer Science (A).*

**Theory:** *Algebra and Computation (A), Algorithm Design (A), Network Science (A+), Quantum Computer Science (A+), Theory of Computation (A), Distributed Computing (A).*

**AI and Control:** *Artificial Intelligence: Principles and Techniques (A), Machine Learning (A), Intelligent Systems and Robotics (on-going).*

## SERVICES

**Volunteer at the Tsinghua Undergraduate Admissions Office in Shanghai** 2019 & 2020

- Receive “outstanding service award” in year 2019.

**Writing assistant at the Tsinghua Teaching Center for Writing** 2021 ~ present

## REFERENCES

**Adam Wierman**, Professor of Computing and Mathematical Sciences

*Department of Computing and Mathematical Sciences*

*California Institute of Technology, Pasadena, CA*

(626) 395-6569, [adamw@caltech.edu](mailto:adamw@caltech.edu)

**Guannan Qu**, Assistant Professor

*Department of Electrical and Computer Engineering*

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**Chongjie Zhang**, Assistant Professor

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