Taylan Kargin

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Education

California Institute of Technology — Pasadena, CA, USA
Ph.D. Candidate in Electrical Engineering, expected 2025 — *September 2019 – Present*
Advisor: Prof. Babak Hassibi

California Institute of Technology — Pasadena, CA, USA
M.S. in Electrical Engineering; GPA: 3.9 — *September 2019 – June 2023*

Bilkent University — Ankara, Turkey
B.S. in Electrical and Electronics Engineering; GPA: 3.96 — *August 2014 – August 2019*
B.S. in Physics (Double Major); GPA: 3.97 — *September 2016 – August 2019*

National University of Singapore — Singapore
Exchange Studies in Electrical and Computer Engineering — *August 2017 – December 2017*

Research Interests

My research lies at the intersection of control theory, optimization, and machine learning, focusing on reliable decision-making for large-scale autonomous systems in complex and uncertain environments.

Professional Experience

California Institute of Technology — Pasadena, CA, USA
Graduate Research Assistant (Advisor: Prof. Babak Hassibi) — *September 2019 – Present*

- **Distribution Shifts:** Developed novel and practical methods for mitigating distribution shifts for reliable and resilient control, estimation/prediction, and communication.
- **Learning and Control:** Developed and analyzed novel and provably efficient algorithms for online learning and adaptive control of unknown dynamical systems.

Amazon.com Inc. — Seattle, WA, USA
Applied Scientist Intern (Supervisor: Dr. Kevin Small) — *June 2023 – September 2023*

- **Positional Encoding for Transformers:** Developed a new positional encoding scheme for autoregressive transformers using equiangular tight frames (ETFs).
- **In-context Learning:** Investigated in-context learning mechanism in autoregressive transformers for linear Markov processes.

National Magnetic Resonance Research Center (UMRAM) — Ankara, Turkey
Undergraduate Researcher & Intern (Supervisor: Prof. Tolga Cukur) — *January 2018 – January 2019*

- **Tensor Dictionary Learning for MRI:** Developed a novel compressed sensing algorithm for joint reconstruction 3D MRI scans of different weightings using tensor dictionary learning.

Bilkent University — Ankara, Turkey
Senior Project (Advisors: Prof. Orhan Arikan & Caglar Akman) — *September 2018 – June 2019*

- **Acoustic UAV Detection and Tracking:** Created an acoustic drone tracking system by developing a data-driven beamforming algorithm with deep neural networks and particle filtering. Our project was covered on national TV and radio channels.

Undergraduate Researcher (Supervisor: Prof. Fatih Omer Ilday) *June 2016 – August 2016*

- **Liquid Crystals:** Conducted experiments with cholesteric liquid crystals under high energy laser beams to study self-organizing behavior.

Teaching Experience

I am actively pursuing the **Certificate of Practice in University Teaching** through the Caltech Center for Teaching, Learning and Outreach (CTLO). This recognizes graduating students for their consistently excellent teaching practice across diverse educational contexts.

California Institute of Technology Pasadena, CA

Guest Lecturer in ACM 170: Mathematics of Signal Processing *April 2023*

Head Teaching Assistant *2021 – 2023*

- *ACM 170: Mathematics of Signal Processing (Spring 2023)*
- *EE 164: Stochastic and Adaptive Signal Processing (Winter 2021 and Winter 2023)*
- *CMS 117: Probability Theory and Stochastic Processes (Fall 2022)*
- *EE 150: Random Matrices (Spring 2022)*
- *EE 160: Fundamentals of Information Transmission and Storage (Winter 2022)*
- *CMS 122: Mathematical Optimization (Fall 2021)*

Teaching Assistant *2020 – 2021*

- *EE 1: The Science of Data, Signals, and Information (Spring 2021)*
- *EE 111: Signal Processing Systems and Transforms (Fall 2020)*

Bilkent University Ankara, Turkey

Teaching Assistant *2017 – 2019*

- *EEE 321: Signals and Systems (Spring 2019)*
- *PHYS 101/102: General Physics I/II (Spring 2017)*

Honors and Awards

Caltech Y Hummel/Gray Award *2024*

Awarded $1000 to support travel that fosters professional and leadership development opportunities

DeepMind Student Travel Grant *2022*

Awarded $250 to support travel to COLT 2022

Qualcomm Innovation Fellowship North America *2021*

Finalist as a group of two Ph.D. students

Caltech Graduate Fellowship *2019 – 2020*

Awarded full tuition waiver and a stipend during the first year at Caltech.

Bilkent University Graduation Awards *2019*

Awarded for Academic Excellence, Research Excellence, and Social Awareness and Activities.

TEV Outstanding Success Scholarship *2014 – 2019*

Received the prestigious Turkish Educational Foundation (TEV) Scholarship, awarded to only 50 students annually, for exceptional leadership, including a monthly stipend throughout my bachelor's.

National Scholarship of Prime Ministry of Turkey *2014 – 2019*

Awarded a prestigious monthly stipend throughout my bachelor's studies for ranking among the top 100 students in the nationwide university entrance exam.

Bilkent University Comprehensive Scholarship *2014 – 2019*
Awarded a monthly stipend and full tuition waiver throughout my bachelor's studies.

IsBank Golden Youth Award *2014*
Awarded for outstanding performance in the nationwide university entrance exam.

Nationwide University Entrance Exam *2014*
Ranked 22nd among 2 million students.

Publications

Working Journal Papers

[1] **T. Kargin**, J. Hajar, V. Malik, and B. Hassibi, *Non-rational Control: A Unified Approach to Infinite-Horizon Optimal Control for General Objectives,* In preparation for IEEE Transactions on Automatic Control (TAC), 2024

[2] **T. Kargin** and B. Hassibi, *Robust MMSE in the Presence of Channel Uncertainty Using Transportation-induced Kernel Distances,* In preparation for IEEE Transactions on Signal Processing (TSP), 2024

[3] **T. Kargin***, J. Hajar*, V. Malik, and B. Hassibi, *Distributionally Robust Kalman Filtering over Finite and Infinite Horizon,* In preparation for IEEE Transactions on Signal Processing (TSP) (arXiv:2407.18837), July 2024.

Refereed Conference Papers

[4] J. Hajar, **T. Kargin**, V. Malik, and B. Hassibi, *The Distributionally Robust Infinite-Horizon LQR,* To appear at CDC 2024 (arXiv:2408.06230), Aug. 2024.

[5] V. Malik*, **T. Kargin***, J. Hajar, and B. Hassibi, *Optimal Infinite-Horizon Mixed H_2/H_∞ Control,* 60th Annual Allerton Conference on Communication, Control, and Computing (Allerton), Urbana, IL, USA, Sept. 2024

[6] **T. Kargin***, J. Hajar*, V. Malik*, and B. Hassibi, *Infinite-Horizon Distributionally Robust Regret-Optimal Control,* 41st International Conference on Machine Learning (ICML), Vienna, Austria, July 2024

[7] Y. Li*, J. Yu*, L. Conger, **T. Kargin**, and A. Wierman, *Learning the Uncertainty Sets of Linear Control Systems via Set Membership: A Non-asymptotic Analysis,* 41st International Conference on Machine Learning (ICML), Vienna, Austria, July 2024

[8] V. Malik, **T. Kargin**, V. Kostina, and B. Hassibi, *A Distributionally Robust Approach to Shannon Limits using the Wasserstein Distance,* 2024 IEEE International Symposium on Information Theory (ISIT), Athens, Greece, July 2024

[9] **T. Kargin***, J. Hajar*, V. Malik*, and B. Hassibi, *Wasserstein Distributionally Robust Regret-Optimal Control over Infinite-Horizon,* 6th Annual Learning for Dynamics & Control Conference (L4DC), Oxford, UK, July 2024

[10] J. Hajar, **T. Kargin**, and B. Hassibi, *Wasserstein Distributionally Robust Regret-Optimal Control under Partial Observability*, 59th Annual Allerton Conference on Communication, Control, and Computing (Allerton), Urbana, IL, USA, Sept. 2023

[11] **T. Kargin**, F. Salehi, and B. Hassibi, *Asymptotic Distribution of Stochastic Mirror Descent Iterates in Average Ensemble Models*, 2023 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Rhodes, Greece, June 2023

[12] **T. Kargin**, S. Lale, K. Azizzadenesheli, A. Anandkumar, and B. Hassibi, *Thompson Sampling for Partially Observable Linear-Quadratic Control,* 2023 American Control Conference (ACC), San Diego CA, USA, May 2023

[13] **T. Kargin***, S. Lale*, K. Azizzadenesheli, A. Anandkumar, and B. Hassibi, *Thompson Sampling Achieves $O(\sqrt{T})$ Regret in Linear-Quadratic Control,* 35th Conference on Learning Theory (COLT), London, UK, July 2022

Talks and Poster Presentations

Non-rational Infinite-Horizon Control: A Unified Framework for Robust Control

- *Invited talk at the EPFL & ETH Zürich Automatic Control Labs* — *November, 2024*
- *Invited talk at the 44th Southern California Control Workshop hosted at USC* — *November, 2024*
- *Invited talk at Tamer Başar's Research Lab, UIUC* — *October, 2024*
- *Invited talk at the Safe Autonomous Systems (SAS) Lab, UC San Diego* — *September, 2024*
- *Invited talk at the Rigorous Systems Research Group (RSRG), Caltech* — *September, 2024*

Infinite-Horizon Wasserstein Distributionally Robust Control

- *Invited poster at Cornell ORIE Young Researchers Workshop* — *October, 2024*
- *Invited talk at Bilkent University EE Seminar Series* — *August, 2024*
- *Poster at the 41st International Conference on Machine Learning (ICML)* — *July, 2024*
- *Poster at the 6th Learning for Dynamics & Control Conference (L4DC)* — *July, 2024*
- *Invited talk at EE LSC Seminar Series, Caltech* — *June, 2024*

Optimal Infinite-Horizon Mixed H_2/H_∞ Control

- *Contributed talk at the 60th Allerton Conference, UIUC* — *September, 2024*

Mean-field Limit of Stochastic Mirror Descent for Ensemble Models

- *Poster at the 48th ICASSP* — *June, 2023*

Thompson Sampling for Partially Observable Linear-Quadratic Control

- *Contributed talk at the American Control Conference* — *June, 2023*

Thompson Sampling Achieves $O(\sqrt{T})$ Regret in Linear-Quadratic Control

- *Poster at the CMS + IST Meeting of the Minds at Caltech* — *May, 2023*
- *Poster at the Information Theory and Applications (ITA) Workshop at UCSD* — *February, 2023*
- *Poster at the Caltech AI4Science Workshop* — *February, 2023*
- *Contributed talk at the 35th Conference on Learning Theory (COLT)* — *July, 2022*

Mentoring and Outreach

Research Mentor | San Marino High School, CA — *October 2024 – Present*

Currently working with two senior high school students on a year-long project in robust model predictive control.

Research Mentor | Caltech Connection — *2021 – Present*

Worked with three minority-serving local community college students on three different six-month long projects centered in reinforcement learning, robust control, and model predictive control. Two students transferred to UC Irvine CS and Cal Poly Pomona ME.

Facilitator | Caltech Connection — *2024 – Present*

Leading monthly meetings with the entire cohort of Caltech Connection mentees to supplement their research experience through soft skills development, including scientific communication, literature review, goal setting, and time management.

Research Mentor | First-Year Success Research Institute (FSRI) at Caltech — *2023 – 2024*

Worked with six incoming Caltech undergraduates from underserved communities during the summers of 2023 and 2024 on two research projects centered around reinforcement learning and robust control to facilitate their successful transition from high school to Caltech.

Judge & Session Chair | Caltech Summer Undergraduate Research Fellowships (SURF) *2024*
Served as a judge and session chair for SURF students' oral presentations, selecting finalists for the Doris S. Perpall SURF Speaking Awards.

Judge | Orange County Science and Engineering Fair (OCSEF) *2024*
Interviewed senior division students on their science projects, selecting 9 exceptional finalists for the International Science and Engineering Fair (ISEF)

Volunteer | Caltech Alpine Club *2024*
Assisted in organizing the 2023/2024 Banff Mountain Film Festival World Tour at Caltech, contributing to a successful fundraiser for the Caltech Alpine Club.

Tutor | Caltech Y RISE Program *2022*
Tutored two local college students in coding.

Science Communicator | Caltech Alpine Club *2022*
Served as a science communicator for community outreach at the STEM Stall Booth at the Twentynine Palms, CA, farmers market.

Orientation Leader | Caltech Graduate Orientation Program *2021 – 2022*
Lead the group discussions and social activities for incoming graduate students

Peer Mentor | Caltech Electrical Engineering Department *2021*
Advised four incoming grad students in EE throughout the year.

Panelist | Caltech Electrical Engineering Department *2021*
Served a panelist for the EE Graduate Orientation panel on navigating graduate school life.

Tutor | Bilkent University IEEE Student Club *2019*
Tutored freshmen in basics of MATLAB *coding.*

Volunteer | Bilkent University IEEE Student Club *2015 – 2016*
Assisted in organizing the Road to University program, hosting select local high school students for a multi-day experience introducing them to various engineering disciplines.

Student Coordinator | Bilkent University EEE Department *2015*
Assisted in coordinating the Graduate Research Conference.

Professional Service and Activities

Organizer | Caltech EE Systems Seminar *2020, 2024*
Invited and served as student hosts of Prof. Francis Bach in 2020 and Prof. Hitay Özbay in 2024.

Student Host | Frontiers in Information, Systems, and Computing *2024*
Hosted faculty candidates at Caltech.

Peer Reviewer *2022 – Present*
AISTATS (2025), ICASSP (2025), NeurIPS (2022, 2023, 2024), ICLR (2024), CDC (2024), INFORMS Journal of Computing, IEEE Transactions on Automatic Control, IEEE Control Systems Letter, Systems & Control Letters.