# Guanya Shi

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## Appointments

- **Carnegie Mellon University (CMU)** — Sep. 2023 –
  *Assistant Professor at the Robotics Institute, School of Computer Science*
- **University of Washington** — Sep. 2022 – Aug. 2023
  *Postdoc in the Paul G. Allen School of Computer Science and Engineering* — *Advisor: Byron Boots*

## Education

- **California Institute of Technology** — Sep. 2017 – Aug. 2022
  *Ph.D. in Control and Dynamical Systems* — *Advisors: Soon-Jo Chung, Yisong Yue*
- **Tsinghua University** — Aug. 2013 – Jul. 2017
  *B.E. in Vehicle Engineering (rank: 1/93) and Dual Degree in Economics* — *Advisor: Shengbo Eben Li*
- **Stanford University** — Jun. 2016 – Sep. 2016
  *Undergraduate Visiting Research Program (UGVR)* — *Advisor: Sindy K.Y. Tang*

## Research Interests

My research interests are in the intersection of machine learning and control theory, spanning the entire spectrum from theory and foundation, and algorithm design, to real-world applications in robotics and autonomy. I lead the LeCAR (Learning and Control for Agile Robotics) Lab at CMU.

## Honors and Awards

- Ben P.C. Chou Doctoral Prize (one person per year) from Caltech [link] — 2022
- Rising Star in Data Science from the University of Chicago [link] — 2021
- The World Artificial Intelligence Conference (WAIC) Yunfun Award — 2021
- Simoudis Discovery Prize (one person per year) from Caltech [link] — 2020
- Distinguished Graduate Award ($< 1\%$) from Tsinghua University — 2017
- UGVR Fellowship (18 international students per year) from Stanford University [link] — 2016
- Qualcomm Scholarship from Tsinghua University — 2016
- China National Scholarship ($< 1\%$) from Tsinghua University — 2014 & 2015

## Publications

(* *equal contributions,* ** *alphabetical order. For the up-to-date list, please visit my Google Scholar page.*)

### Under Review & Preprints

1. Andrew Wagenmaker, Guanya Shi, Kevin Jamieson, "Optimal Exploration for Model-Based RL in Nonlinear Systems", *arXiv preprint*, 2023. [pdf]
2. Yifang Chen, Yingbing Huang, Simon S. Du, Kevin Jamieson, Guanya Shi, "Active Representation Learning for General Task Space with Applications in Robotics", *arXiv preprint*, 2023. [pdf]

### Journal Papers

3. [**ScienceRobotics'22**] Michael O'Connell**, Guanya Shi**, Xichen Shi, Kamyar Azizzadenesheli, Anima Anandkumar, Yisong Yue, Soon-Jo Chung, "Neural-Fly Enables Rapid Learning for Agile Flight in Strong Winds", *Science Robotics*, 2022. [paper][Caltech news][video][Reuters news][PopSci report][blog]

4. [**SIGMETRICS'22**] Weici Pan, Guanya Shi, Yiheng Lin, Adam Wierman, "Online Optimization with Feedback Delay and Nonlinear Switching Cost", *Proceedings of the ACM on Measurement and Analysis of Computing Systems*, 2022. [pdf]

5. [**SIGMETRICS'22**] Tongxin Li*, Ruixiao Yang*, Guannan Qu, Guanya Shi, Chenkai Yu, Adam Wierman, Steven Low, "Robustness and Consistency in Linear Quadratic Control with Untrusted Predictions", *Proceedings of the ACM on Measurement and Analysis of Computing Systems*, 2022. [pdf][blog]

6. [**TRO'21**] Guanya Shi, Wolfgang Hönig, Xichen Shi, Yisong Yue, Soon-Jo Chung, "Neural-Swarm2: Planning and Control of Heterogeneous Multirotor Swarms Using Learned Interactions", *IEEE Transactions on Robotics (T-RO)*, 2021. [pdf][Caltech news][Yahoo! news][video][blog]

7. [**RAL'20**] Yashwanth Kumar Nakka, Anqi Liu, Guanya Shi, Animashree Anandkumar, Yisong Yue, Soon-Jo Chung, "Chance-Constrained Trajectory Optimization for Safe Exploration and Learning of Nonlinear Systems", *IEEE Robotics and Automation Letters (RA-L)*, 2020. [pdf][blog]

8. [**IJARS'18**] Hongbo Gao, Guanya Shi, Guotao Xie, Bo Cheng, "Car-Following Method Based on Inverse Reinforcement Learning for Autonomous Vehicle Decision-Making", *International Journal of Advanced Robotic Systems*, 2018. [pdf]

9. [**JIS'17**] Guanya Shi, Jianing Wu, Shaoze Yan, "Drag Reduction in a Natural High-Frequency Swinging Micro-Articulation: Mouthparts of the Honey Bee", *Journal of Insect Science*, 2017. [pdf]

10. [**JPD'17**] Jianing Wu, Guanya Shi, Yiwei Zhao, Shaoze Yan, "How to Dip Nectar: Optimal Time Apportionment in Natural Viscous Fluid Transport", *Journal of Physics D: Applied Physics*, 2017. [pdf]

11. [**Biomicrofluidics'17**], Liang Huang, Shengtai Bian, Yinuo Cheng, Guanya Shi, Peng Liu, Xiongying Ye, Wenhui Wang, "Microfluidics Cell Sample Preparation for Analysis: Advances in Efficient Cell Enrichment and Precise Single Cell Capture", *Biomicrofluidics*, 2017. [pdf]

### Conference Papers

12. [**CoRL'23**] Kevin Huang, Rwik Rana, Alexander Spitzer, Guanya Shi, Byron Boots, "DATT: Deep Adaptive Trajectory Tracking for Quadrotor Control", *Conference on Robot Learning (CoRL)*, 2023. [website]

13. [**CoRL'23**] Yuxiang Yang, Guanya Shi, Xiangyun Meng, Wenhao Yu, Tingnan Zhang, Jie Tan, Byron Boots, "CAJun: Continuous Adaptive Jumping using a Learned Centroidal Controller", *Conference on Robot Learning (CoRL)*, 2023. [website]

14. [**CDC'23**] Wenqi Cui, Guanya Shi, Yuanyuan Shi, Baosen Zhang, "Leveraging Predictions in Power System Frequency Control: an Adaptive Approach", *IEEE Conference on Decision and Control (CDC)*, 2023. [pdf]

15. [**ACC'22**] Chenkai Yu, Guanya Shi, Soon-Jo Chung, Yisong Yue, Adam Wierman, "Competitive Control with Delayed Imperfect Information", *American Control Conference (ACC)*, 2022. [pdf][blog]

16. [**NeurIPS'21**] Guanya Shi, Kamyar Azizzadenesheli, Michael O'Connell, Soon-Jo Chung, Yisong Yue, "Meta-Adaptive Nonlinear Control: Theory and Algorithms", *Neural Information Processing Systems (NeurIPS)*, 2021. [pdf][code]

17. [**NeurIPS'21**] Yiheng Lin*, Yang Hu*, Guanya Shi*, Haoyuan Sun*, Guannan Qu*, Adam Wierman, "Perturbation-Based Regret Analysis of Predictive Control in LTV Systems", *Neural Information Processing Systems (NeurIPS)*, 2021. **Spotlight Presentation** ($< 3\%$). [pdf][blog]

18. [**ICRA'21**] Guanya Shi, Yifeng Zhu, Jonathan Tremblay, Stan Birchfield, Fabio Ramos, Animashree Anandkumar, Yuke Zhu, "Fast Uncertainty Quantification for Deep Object Pose Estimation", *IEEE International Conference on Robotics and Automation (ICRA)*, 2021. [pdf][website][code][NVIDIA developer blog]

19. [**CISS'21**] Guanya Shi, "Competitive Control via Online Optimization with Memory, Delayed Feedback, and Inexact Predictions", *Annual Conference on Information Sciences and Systems (CISS)*, 2021. **Lecture Presentation**. [abstract]

20. [**ICRA'20**] Guanya Shi, Wolfgang Hönig, Yisong Yue, Soon-Jo Chung, "Neural-Swarm: Decentralized Close-Proximity Multirotor Control Using Learned Interactions", *IEEE International Conference on Robotics and Automation (ICRA)*, 2020. [pdf][video]

21. [**NeurIPS'20**] Guanya Shi*, Yiheng Lin*, Soon-Jo Chung, Yisong Yue, Adam Wierman, "Online Optimization with Memory and Competitive Control", *Neural Information Processing Systems (NeurIPS)*, 2020. [pdf][video]

22. [**NeurIPS'20**] Chenkai Yu, Guanya Shi, Soon-Jo Chung, Yisong Yue, Adam Wierman, "The Power of Predictions in Online Control", *Neural Information Processing Systems (NeurIPS)*, 2020. [pdf][blog]

23. [**L4DC'20**] Anqi Liu, Guanya Shi, Soon-Jo Chung, Animashree Anandkumar, Yisong Yue, "Robust Regression for Safe Exploration in Control", *Learning for Dynamics and Control (L4DC)*, 2020. [pdf]

24. [**ICRA'19**] Guanya Shi*, Xichen Shi*, Michael O'Connell*, Rose Yu, Kamyar Azizzadenesheli, Animashree Anandkumar, Yisong Yue, Soon-Jo Chung, "Neural Lander: Stable Drone Landing Control Using Learned Dynamics", *IEEE International Conference on Robotics and Automation (ICRA)*, 2019. [pdf][video][Caltech front page][Import AI highlight][PyTorch interview][blog]

25. [**MEMS'17**] Liang Huang, Peng Zhao, Shengtai Bian, Guanya Shi, Peng Liu, Song Zong, Wenhui Wang, "A Novel BioMEMS Device for Efficient On-chip Single Cell Loading and 3D Rotation", *IEEE International Conference on Micro Electro Mechanical Systems (MEMS)*, 2017. [pdf]

### Patents

26. Guanya Shi, Xichen Shi, Michael O'Connell, Animashree Anandkumar, Yisong Yue, Soon-Jo Chung, "Systems and Methods for Robust Learning-Based Control During Forward and Landing Flight Under Uncertain Conditions", *US Patent 2020/0183339 A1.*

27. Jonathan Tremblay, Fabio Ramos, Yuke Zhu, Animashree Anandkumar, Guanya Shi, "Data Selection based on Uncertainty Quantification", *US Patent.*

## Invited Talks and Interviews

- "Planning and Control with Machine Learning for Autonomous and Robotic Systems", *Tutorial for the IEEE Conference On Systems, Man, and Cybernetics (with Soon-Jo Chung and Hiroyasu Tsukamoto)*, 2023.
- "Neural-Control Family: Safe Agile Deep-learning-based Control in Dynamic Environments", *Learning for Agile Robotics Workshop at CoRL, Vanderbilt University*, 2022.
- "Reliable Learning and Control in Dynamic Environments: Towards Unified Theory and Learned Robotic Agility" (Job Talk), *UMich, Harvard, Cornell, UIUC, CMU, UT Austin, Duke*, 2022.
- "Safety-Critical Learning and Control in Dynamic Environments: Towards Unified Theory and Learned Robotic Agility", *Rising Star in Data Science Workshop at the University of Chicago, CS Seminar at UIUC, Harvard EE, Stanford Aero/Astro*, 2021. [link]
- "Reliable Learning and Nonlinear Control in Dynamic Environments: Unified Theory and Agile Robot Applications", *the Reliable Autonomous Systems Lab at MIT Aero/Astro*, 2021.
- "Neural-Lander Family: Learning-Based Nonlinear Control in Dynamic Environments", *IROS Workshop on Safe Real-World Robot Autonomy*, 2021. [link]
- "Towards the Convergence of Learning and Nonlinear Control: Unified Theories and Real-World Applications", *Microsoft Research Lab New York City*, 2021.
- "Neural-Lander Family: Learning-Based Nonlinear Stable Control in Challenging Environments", the *University of Toronto AI in Robotics Reading Group*, 2021.
- "Competitive Control via Online Optimization with Memory, Delayed Feedback, and Inexact Predictions", *Lecture Presentation at the 55th Annual Conference on Information Sciences and Systems (CISS)*, 2021.
- "Neural-Lander Family: Learning-based Nonlinear Provably Stable Control in Multi-Agent and Changing Environments", *Caltech RSRG*, 2020.

- "Physics-Infused Learning for Control with Theoretical Guarantees", *NVIDIA Research*, 2020.
- "Using Deep Learning and PyTorch to Power Next Generation Aircraft at Caltech", *interviewed by Facebook and PyTorch*, 2019. [video]

## Academic Services

- **Journal Reviewer**: IEEE Transactions on Automatic Control (TAC), IEEE Transactions on Robotics (T-RO), IEEE Robotics and Automation Letters (RA-L), Journal of Machine Learning Research (JMLR), Autonomous Robots, Artificial Intelligence, IEEE Transactions on Cybernetics.
- **Conference Reviewer**: ICRA, IROS, CoRL, RSS, NeurIPS, ICML, ICLR.
- **Area Chair**: ICLR 2024.
- Co-organizing the IEEE CDC 2023 invited session "Control with Learning for Autonomous Robots."
- Co-organizing Control Meets Learning, a virtual seminar series on the intersection of control and learning.

## Teaching Experiences

- 2023 Fall: Co-teach 16-665 Robot Mobility on Air, Land, & Sea.
- 2023 Fall: Co-teach 16-831 Introduction to Robot Learning.
- Teaching assistant for CS 165 at Caltech: Foundations of Machine Learning and Statistical Inference.
- Guest lecturer for CS 159 at Caltech: Advanced Topics in Machine Learning.

## Diversity, Equity, and Inclusion

- Co-organizing Caltech Productive Collaborations Workshop.
- Mentor of the Caltech CMS first-year mentorship program.
- Student representative: meeting with Caltech EAS faculty committee on DEI.
- Led group assimilation exercise for Yue Group to improve group dynamics and provide feedback to Professor.
- Panelist: advice panel for going through candidacy & thesis proposal in Caltech CMS.
- Committee member of Caltech Chinese Association (CaltechC).
- Volunteer teacher (Jul. 2014 – Sep. 2014) in the China-USA Education Support Program for underdeveloped areas in rural China.
- Member (2013 – 2017) of the Student Association of Educational Poverty Alleviation (SAEPA) at Tsinghua.

## Selected Press Coverage

- "Rapid Adaptation of Deep Learning Teaches Drones to Survive Any Weather", by Robert Perkins, *Caltech front page highlight*, 2022. [link]
- "AI-powered Drone Fights off Tornadoes", *Reuters*, 2022. [link]
- "This New AI Algorithm Could Help Flying Cars Survive Windy Days", by Rob Verger, *PopSci*, 2022. [link]
- "NVIDIA Research: Fast Uncertainty Quantification for Deep Object Pose Estimation", by Yuke Zhu, *NVIDIA developer blog*, 2021. [link]
- "Machine Learning Helps Robot Swarms Coordinate", *Caltech news*, 2020. [link]
- "AI Helps Drone Swarms Navigate Through Crowded, Unfamiliar Spaces", by Jon Fingas, *Yahoo!* and *Engadget*, 2020. [link]
- "'Neural Lander' Uses AI to Land Drones Smoothly", by Robert Perkins, *Caltech front page highlight*, 2019. [link]
- "Neural Net Beats Tuned PD Controller at Tricky Drone Landing Task", *Import AI*, 2019. [link]
- "Using Deep Learning and PyTorch to Power Next Generation Aircraft at Caltech", *Facebook PyTorch*, 2019. [link]

## Industrial Experiences

- **NVIDIA Research** Jul. 2020 – Sep. 2020
  *AI Algorithm research intern* *Mentors: Yuke Zhu, Anima Anandkumar*

## Advising and Mentorship

- Yuxiang Yang, Ph.D. student at UW.
- John Lathrop, Caltech CMS first-year mentorship program.
- Yiheng Lin (from Tsinghua IIIS), visiting undergraduate at Caltech. Next: Ph.D. at Caltech.
- Chenkai Yu (from Tsinghua IIIS), visiting undergraduate at Caltech. Next: Ph.D. at Columbia.
- Weici Pan (from Tsinghua IIIS), visiting undergraduate at Caltech. Next: Ph.D. at Stony Brook.
- Anya Vinogradsky, Caltech SURF undergraduate.
- Alice Jin, Caltech SURF undergraduate. Next: Ph.D. at MIT.
- Luis Pabon Madrid, Caltech SURF undergraduate. Next: Ph.D. at Stanford.
- Nelson Badillo (from the University of Notre Dame), WAVE undergraduate. Next: Ph.D. at Harvard.