

Catherine Weaver

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🎓 Education

Ph.D. Mechanical Eng. 2024

U.C. Berkeley
PI: Masayoshi Tomizuka
Major Field: Controls
Minors: Optimization & Artificial Intelligence

M.S. Mechanical Eng. 2021

U.C. Berkeley

B.S. Mechanical Eng. 2019

Purdue University
GPA 3.98
Highest Distinction
Spanish Language Minor

</> Programming

Languages and Libraries

- Python ●●●●●
- PyTorch ●●●●●
- Tensorflow ●●●●○
- C/C++ ●●●●○
- MATLAB ●●●●●
- Simulink ●●●●○
- Excel VBA ●●●●○
- LaTeX ●●●●●
- HTML ●●●○

Skills

- Environment control (conda, Docker)
- Version control (Github)
- Coding style guidelines and typing (MyPy)
- GPU training (CUDA)

📄 Summary

- Future Ph.D. from UC Berkeley developing state-of-the-art deep learning and control algorithms for practical, continuous time systems
- Experience pushing the limits of artificial intelligence with high-quality, highly-collaborative code at Sony AI
- Over two years of cumulative experience in industry in control systems, computer science, product development, and manufacturing

📁 Professional Experience

Mechanical Systems Control Lab | UC Berkeley

4.5 years

Graduate Student Researcher

August 2019 – Present

- Conducted 5-year research project in collaboration with Sony AI to advance learning-based control algorithms for autonomous racing in the challenging, high-fidelity simulator Gran Turismo Sport
- Implemented and improved many cutting edge, popular ML and RL algorithms by leveraging my deep understanding of their mathematical derivation and theoretical basis for algorithmic choices
- Tackled **learning from human demonstrations** by leveraging RL with generative adversarial networks and proposed a new imitation-based decision transformer with corrective online rollouts
- Derived a novel hierarchical RL algorithm with learned skills that shows significant improvement over existing methods in **long-horizon** robotic manipulation (Fetch), maze (D4RL), and racing (Gran Turismo) tasks
- Effectively communicated in regular research presentations and seminars for various audiences and exhibited high-quality technical writing and editing of applications and scientific papers
- Showed leadership and long-term vision when mentoring 4 graduate students visiting from other universities that resulted in multiple publications and continuous improvement of a unified control system

Sony AI America | Boston, MA (Remote)

7 months

Research Scientist Intern

May - December 2021

- Proposed a novel motion primitive formulation for online racing trajectory planning, resulting in ongoing collaboration with top robotics researchers and paper submission to competitive controls conference
- After inspecting company's existing **racing MPC** implementation, suggested and executed algorithmic improvements that increased tracking performance and decreased lap-time by 2 seconds
- Merged multiple branches with new features to a Github repository with 30+ contributors and wrote code that adhered to **unit testing, typing, and style** requirements to pass peer and manager code reviews

Zimmer Biomet | Warsaw IN

18 months

Development Engineering Co-op

August – December 2017

- Led **design verification** for small-scale pilot project, and presented department's verification reports to Quality and Regulatory departments

Engineering Co-op

August – December 2016

- Determined process time requirements and troubleshooted an electronic form to allow non-standard address lines and automatic drop downs

Manufacturing Engineering Co-op

May – August 2015, January – May 2016

- Statistically characterized process capability with historical measurements and composed re-work steps for non-conforming products

Jain Research Lab – Purdue University

19 months

Undergraduate Researcher

May 2017 – May 2019

- Created a thermodynamic model of a hydrogen fuel cell and water storage system resulting in a conference article as well as a first author presentation on a rule-based controller for the system

Select Algorithms

- Model Predictive Control (MPC, iLQR)
- Reinforcement Learning (SAC, PPO)
- Imitation Learning (GANs, GAIL)
- Sequence Modeling (Decision Transformer)
- Attention Mechanisms (VAE)
- Computer Vision
- Hierarchical RL

Awards

- Graduate Research Fellowship, *National Science Foundation* (2019-22)
- Berkeley Fellowship for Graduate Study, *UC Berkeley* (2019-21)
- H. William Bottomley Research Scholarship, *Dept. of Mech. Eng., Purdue University* (2019)
- Office of Undergraduate Research Scholarship, *Purdue University* (2018-19)
- Trustees Scholarship, *Purdue University* (2014-19)

Select Courses

Graduate (UC Berkeley)

- Advanced Robotics
- Reinforcement Learning
- Machine Learning
- Game Theory
- Advanced Controls (I & II)
- Nonlinear systems
- Vehicle Dynamics
- Probability & Optimization

Undergraduate (Purdue)

- Renewable Energy
- Thermodynamics (I & II)
- Heat Transfer
- Circuit Analysis
- Machine Design
- Fluid Dynamics

Publications

1. **Weaver, C.**, Tang, C., Hao, C., Kawamoto, K., Tomizuka, M., Zhan, W. "Transformer-Assisted Adversarial Imitation Learning for Autonomous Racing." *IEEE Robotics and Automation Letters*. *Awaiting Review*. sites.google.com/berkeley.edu/betail
2. Benciolini, T., Tang, C., Leibold, M., **Weaver, C.**, Tomizuka, M., Zhan, W. "Active Exploration in Iterative Gaussian Process Regression for Uncertainty Compensation in Autonomous Racing." *IEEE Transactions on Control Systems Technology*. *Awaiting Review*.
3. Hao, C., Tang, C., Bergkvist, E., **Weaver, C.**, Sun, L., Zhan, W., Tomizuka, M. "Outracing Human Racers: Model-based Trajectory Planning and Control for Time-trial Autonomous Racing" *IEEE Transactions on Intelligent Vehicles*. *Awaiting Review*. arxiv.org/abs/2211.09378
4. Hao, C.*, **Weaver C.*** (**Equal Contribution*), Tang, C., Kawamoto, K., Tomizuka, M., Zhan, W. "Skill-Critic: Refining Learned Skills for Reinforcement Learning", *IEEE Robotics and Automation Letters*. *Awaiting Review*. sites.google.com/view/skill-critic
5. **Weaver, C.**, Capobianco, R., Wurman, P., Stone, P. "Real-time Trajectory Generation via Imitation Learning of Dynamic Movement Primitives for Autonomous Racing" *American Control Conference*, 2024. sites.google.com/berkeley.edu/racingdmp/home
6. Su, S., Hao, C., **Weaver, C.**, Tang, C., Zhan, W., Tomizuka, M. "Double-Iterative Gaussian Process Regression for Modeling Error Compensation in Autonomous Racing" *IFAC World Congress*, 2023. arxiv.org/abs/2305.07740
7. Bird, T., **Weaver, C.**, and Jain, N. "Switched Linear Model of a Stratified Hot Water Tank for Control of Micro-CHP Systems" *Dynamic Systems and Control Conference, ASME*, 2019 October 9-12, Park City, UT. (*Energy Systems Technical Committee Best Paper Award*) dx.doi.org/10.1115/DSCC2019-9236

Disseration and Masters Report

- **Weaver, C.** "Data-Driven Methods for Real-Time Control in Autonomous Racing Games," Dissertation *to be submitted* in partial fulfillment of Ph.D. in Mechanical Engineering. University of California, Berkeley. 2024. PI: Masayoshi Tomizuka
- **Weaver, C.** "Racing strategy analysis using Bayesian Nonparametric Segmentation and Functional Clustering and Alignment," Masters Report submitted in partial fulfillment of M.S. in Mechanical Engineering. University of California, Berkeley. 2021. PI: Masayoshi Tomizuka

Professional Service and Teaching

Expanding Your Horizons Conference – UC Berkeley

Event Co-Chair

May 2021 – May 2023

- **2 years in charge of organizing annual STEM conference for 300+ students**
- Managed 40 planning committee volunteers and 150 day-of-volunteers
- Organized volunteers into 7 different committees and delegated tasks appropriately to manage Food, Finance, Programs, Transportation, etc.

Logistics Committee Chair (2020-21), Committee Member (2019-20)

Graduate Instructor – Statistics and Data Science August - December 2023

School of Mechanical Engineering, UC Berkeley

- Led 4 hour-long Python-based lab sections each week on statistics and machine learning topics to upper-level undergraduates

Instructor – Creative Engineering and Robotics / AI Robotics July 2021

Summer Institute for the Gifted, UC Berkeley

- Instructed two intensive, hands on courses for gifted students (each class was 3hrs/day for 3 weeks)