Lauren Conger

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https://leconger.github.io

Research interests

My work leverages concepts from control and game theory to develop new infinite-dimensional analysis tools, particularly in coupled multispecies gradient flow analysis. These tools offer unique insights into strategic learning and algorithm improvement, and I am interested in both fundamental analysis results and building bridges across engineering and math disciplines.

Keywords: gradient flows, strategic learning, control theory

Education

California Institute of Technology. Pasadena, CA — current
Ph.D. in Control and Dynamical Systems.
Advisors: *Franca Hoffmann (math), Eric Mazumdar (CS, econ), and John Doyle (control)*
NDSEG Graduate Research Fellow
PIMCO Graduate Fellow in Data Science

Cornell University. Ithaca, NY — 2018
B.S. *summa cum laude* in Electrical and Computer Engineering.

Working Papers

† *indicates undergraduate I advised*

1. **Monotone Multispecies Flows**
Under review
Lauren Conger, Franca Hoffmann, Eric Mazumdar, Lillian J. Ratliff
2. **Coupled Wasserstein Gradient Flows for Min-Max and Cooperative Games**
Under review
Lauren Conger, Franca Hoffmann, Eric Mazumdar, Lillian J. Ratliff
3. **Computing Optimal Transport Plans via Min-Max Gradient Flows**
Accepted to Conference for Decision and Control 2025
Lauren Conger, Franca Hoffmann, Ricardo Baptista, Eric Mazumdar

Conference Publications

1. **Convex Constrained Controller Synthesis for Evolution Equations**
American Control Conference ***(ACC 2025)***
Lauren Conger, Antoine Leeman, Franca Hoffmann
Best Student Paper Award
2. **Characterizing Controllability and Observability for Systems with Locality, Communication, and Actuation Constraints**
Conference for Decision and Control ***(CDC 2024)***
Lauren Conger, Yiheng Lin, Eric Mazumdar, Adam Wierman
3. **Learning the Uncertainty Sets for Control Dynamics via Set Membership: A Non-Asymptotic Analysis**
International Conference on Machine Learning ***(ICML 2024)***
Yingying Li, Jing Yu, **Lauren Conger**, Taylan Kargin, Adam Wierman
4. **Strategic Distribution Shift of Interacting Agents via Coupled Gradient Flows**
Neural Information Processing Systems ***(NeurIPS 2023)***

Lauren Conger, Franca Hoffmann, Eric Mazumdar, Lillian Ratliff

5. **Designing System Level Synthesis Controllers for Nonlinear Systems with Stability Guarantees**
   Learning for Decision and Control ***(L4DC 2023)***
   Lauren Conger, Sydney Vernon†, Eric Mazumdar
6. **Nonlinear System Level Synthesis for Polynomial Dynamics**
   Conference for Decision and Control ***(CDC 2022)***
   Lauren Conger, Jing Shuang (Lisa) Li, Eric Mazumdar, Steven L. Brunton
7. **Output-Feedback System Level Synthesis via Dynamic Programming**
   American Control Conference ***(ACC 2022)***
   Lauren Conger, Shih-Hao Tseng

Journal Publications

1. **Resolution and dose dependence of radiation damage in biomolecular systems**
   International Union of Crystallography Journal; vol. 6, part 6, pp. 1040-1053, 2019
   Hakan Atakisi, **Lauren Conger**, David W. Moreau, and Robert E. Thorne

Workshop Papers

1. **Coupled Gradient Flows for Strategic Non-Local Distribution Shift**
   Workshop on New Frontiers in Learning, Control, and Dynamical Systems ***(ICLR 2023)***
   Lauren Conger, Franca Hoffmann, Eric Mazumdar, Lillian J. Ratliff
   Full version: conference paper 4.
2. **Signal Enhancement for Magnetic Navigation Challenge Problem**
   JuliaCon 2020
   Albert Gnadt, Joseph Belarge, Aaron Canciani, **Lauren Conger**, Joseph Curro, Alan Edelman, Peter Morales, Michael O'Keeffe, Jonathan Taylor, Christopher Rackauckas

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Awards and Funding

Best Student Paper, American Control Conference	2025
PIMCO Graduate Fellowship in Data Science	2023
NDSEG Graduate Research Fellowship Awardee, $144,000	2022
NSF Graduate Research Fellowship Awardee, $138,000	2022
Linde Institute of Economic Sciences Research Grant, $5,000	2021

Travel Support

FoCM Workshop on *Computational Optimal Transport*	2026
Oberwolfach Workshop: *Flows on Measure Spaces and Applications in Machine Learning*, Oberwolfach-Walke, Germany	2026
Workshop on *Mathematics of Adversarial Machine Learning*, Oaxaca, Mexico	2025
IEEE American Control Conference, Denver, USA	2025
Workshop on *Wasserstein Gradient Flows in Math and Machine Learning*, Banff, Canada	2025
Oberwolfach Mini-Workshop: *High-Dimensional Control Problems and Mean-Field Equations with Applications in Machine Learning*, Oberwolfach-Walke, Germany	2024
European Congress of Mathematics, Mini-Symposium on *Theory of Interacting Particle Systems*, Seville, Spain	2024
Summer Research School on *Frontiers in Interacting Particle Systems, Aggregation-Diffusion Equations & Collective Behavior* , CIRM Marseille, France	2024

Workshop on *Interacting Particle Systems: Analysis, Control, Learning and Computation*, ICERM Providence, USA 2024

Conference on *Aggregation-Diffusion Equations & Collective Behavior: Analysis, Numerics and Applications Conference*, CIRM Marseille, France 2024

Selected Talks

Monotonicity of Coupled Multispecies Wasserstein-2 Gradient Flows

Wasserstein Gradient Flows in Math and Machine Learning - BIRS. July 2025
Data-Driven Seminar, University of Washington. July 2025
Mathematical Analysis of Adversarial Machine Learning BIRS Oaxaca. Aug 2025

A New Control Parameterization for Constrained Systems

Oberwolfach Mini-Workshop High-Dimensional Control Problems and Mean-Field Equations with Applications in Machine Learning. December 2024

Convex Constrained Controller Synthesis for Evolution Equations

University of California San Diego – CoPI Seminar. July 2024

Strategic Distribution Shift of Interacting Agents via Coupled Gradient Flows

University of Southern California – CSC@USC Seminar Series. September 2024
European Congress of Mathematics, Theory of Interacting Particle Systems Mini-Symposium. July 2024
ETH Zurich – Intelligent Control Systems Lab Seminar. July 2024
Universität Münster – Kolloquium der angewandten Mathematik. July 2024
UCLA – SoCal Control Workshop. April 2024
Berkeley – Semiautonomous Seminar. December 2023
Harvard College – Group Seminar. May 2023
MIT Lincoln Lab Homeland Protection Systems – Research Seminar. May 2023

Conferences, Schools, and Visits

* *indicates host funding*
† *indicates fellowship funding*

*Mathematics of Adversarial Machine Learning
Banff International Research Station, Oaxaca, Mexico. August 2025

*IEEE American Control Conference
Denver, USA. July 2025

Workshop on Dynamics of Density Operators
IPAM Los Angeles, USA. April 2025

*Wasserstein Gradient Flows in Math and Machine Learning
Banff International Research Station, Banff, Canada. July 2025

†,*IEEE Conference on Decision and Control
Milan, Italy. December 2024

†,*Oberwolfach Mini-Workshop: High-Dimensional Control Problems and Mean-Field Equations with Applications in Machine Learning
Oberwolfach-Walke, Germany. December 2024

*Theory of Interacting Particle Systems Mini-Symposium, European Congress of Mathematics
Seville, Spain. July 2024

Modern Perspectives in Applied Mathematics, Theory and Numerics of PDEs

Zürich, Switzerland. July 2024

*Dr. André Schlichting, research visit
Münster, Germany. July 2024

*Frontiers in Interacting Particle Systems, Aggregation-Diffusion Equations & Collective Behavior Summer Research School
CIRM Marseille, France. July 2024

*Interacting Particle Systems: Analysis, Control, Learning and Computation
ICERM Providence, USA. May 2024

International Conference on Multiscale Modeling and Simulation based on Physics and Data
IPAM Los Angeles, USA. April 2024

*Aggregation-Diffusion Equations & Collective Behavior: Analysis, Numerics and Applications Conference
CIRM Marseille, France. April 2024

Neural Information Processing Systems (NeurIPS)
New Orleans, USA. December 2023

International Conference on Machine Learning (ICML)
Honolulu, USA. July 2023

†Learning for Decision and Control Conference (L4DC)
Philadelphia, USA. June 2023

†IEEE Conference on Decision and Control
Cancun, Mexico. December 2022

IEEE American Control Conference
Atlanta, USA. June 2022

Mentorship

Minh Nguyen (Caltech PhD incoming) 2025
Topic: particle method for Knothe-Rosenblatt optimal transport maps

Katherine Graham (University of Alabama Birmingham B.S. '28) 2023-2024
Topic: data analysis of health care outcomes and insurance coverage

Sarvagna Velidandla (Caltech B.S. '27) 2023
Topic: data analysis for effects of COVID-19 on high school athletes

Ting Li (Johns Hopkins B.S. '24) 2023
graduate application assistance through CAPP Program

Sultan Daniels (Brown Sc.B '23) 2022
graduate application assistance through CAPP Program
Next step: Berkeley EECS PhD student

Sydney Vernon (Caltech B.S. '25) 2022
Topic: machine learning application of nonlinear control
Next step: UW Research Assistant

Teaching Experience

California Institute of Technology

- *Teaching Assistant + Lecturer*

CDS 131: Linear Systems Winter 2025

- *Teaching Assistant*

CS 143: Networks: Algorithms & Architecture Fall 2025
CS 42: Computer Science Education in K-14 Settings Winter 2024
CDS 131: Linear Systems Fall 2023
CS 144: Networks and Economics Winter 2021

Cornell University

- *Teaching Assistant*

PHYS 1112: Mechanics and Heat — Fall 2016
PHYS 2214: Oscillations, Waves, and Quantum Physics — Spring 217, Fall 2018
ECE 3250: Mathematics of Signals and Systems — Spring 2018

- *Grader*

ECE 2200: Signals and Information — Fall 2018

Professional Service

Seminar Organization

Gradient Flow Reading Group, organizer — 2025

Organize bi-weekly discussions on gradient flow literature for PhD students and postdocs; 14 discussion leaders from US and Europe.

Hoffmann Group Seminars, organizer — 2024 – 2025

Organize bi-weekly guest speakers and internal technical talks on PDE analysis, mean field limits, and related fields.

Journal Reviewing

IEEE Transactions on Automatic Control — 2023

Conference and Workshop Reviewing

- *Conferences*

IEEE American Control Conference (ACC). — 2022 – 2025
IEEE Conference on Decision and Control (CDC). — 2022 – 2025
Learning for Dynamics & Control Conference (L4DC). — 2023

- *Workshops*

ICML New Frontiers in Learning, Control, and Dynamical Systems. — 2023

Departmental Service

Student Member of Caltech CMS AI/ML Admissions Committee — 2024 – 2025

Review 30+ graduate student applications and make admission recommendations to faculty committee.

Women in CMS organizer — 2023
Computing & Mathematical Sciences Advisory Board — 2021 – 2024

Work Experience

MIT Lincoln Laboratory. Lexington, MA — February 2019 – August 2020
Assistante Technical Staff
Radar simulation, C++ implementation of camera tracker with learning algorithm, optimization of high-dimensional parameter spaces, frequency analysis algorithms for synthetic UAV motion, denoising magnetic fields.

Raytheon Missile Systems. Tucson, AZ — Summer 2017, 2018
Signal Processing Intern

Raytheon Missile Systems. Tucson, AZ — Summer 2016
Modeling, Simulation & Analysis Intern