

Nathan Lichtlé

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Education

University of California, Berkeley Ph.D., EECS, Berkeley AI Research (BAIR). <i>Advisor: Prof. Alexandre Bayen</i> M.S., Electrical Engineering and Computer Sciences (EECS).	2022 – 2025
École Nationale des Ponts et Chaussées (Institut Polytechnique de Paris) Ph.D., Mathematics and Control. <i>Advisor: Prof. Amaury Hayat</i>	2021 – 2024 <i>Graduated Dec. 2024</i>
École Normale Supérieure Paris-Saclay (Paris-Saclay University) M.S., Computer Science. AI specialization (MVA Master). Élève Normalien (4-year ENS fellowship).	2017 – 2021

Research Experience

CIRCLES: World’s Largest RL-Driven Traffic Smoothing Field Test (100 Cars) <i>Collaboration with Toyota, Nissan, General Motors</i>	2020 – 2024 [code]
<ul style="list-style-type: none">Led the end-to-end design, training, validation, and deployment of RL controllers that drove 100 autonomous vehicles in the largest-ever traffic smoothing experiment, conducted on a live highway during rush hoursBuilt the core data-based simulation framework and evaluation benchmarks used across the project, coordinating with 50+ researchers and industry partners to ensure safety, robustness, and scalability of deployed controllersAnalyzed field data showing 10–20% energy savings near our AVs, which represented only 1–2% of total traffic	
Largest-Ever Comparison of Deep RL Methods in Imperfect-Information Games	2024 – 2025 [code]
<ul style="list-style-type: none">Developed self-play RL benchmarks and ran 5,600+ hyperparameter sweeps across 4 large gamesFound that properly tuned policy gradient algorithms outperform specialized game-theoretic methods	
Autoregressive CNNs for Sequential Traffic Prediction	2024 – 2025
<ul style="list-style-type: none">Trained CNNs to forecast traffic over long horizons by integrating hyperbolic PDEs with highway dataAchieved 2–3x better accuracy than traditional numerical methods on large-scale benchmarks	
Exponential Stability of the Viscous Saint-Venant Equations	2021 – 2024
<ul style="list-style-type: none">Proved the exponential stability of the viscous Saint-Venant equations in the linear case using quadratic Lyapunov functions and appropriate boundary feedback controlShowed that the optimal Lyapunov function for the inviscid system is no longer valid for the viscous system	
Stabilizing a Model of Pest Control using Reinforcement Learning	2023 – 2024
<ul style="list-style-type: none">Trained stabilizing feedback controls using deep reinforcement learning for an ODE model of pest control, under physical constraints, in which case no mathematical control previously existedExtracted an explicit feedback control using mathematical analysis on the trained neural networkShowed the numerical stability and robustness of the resulting mathematical control	
Nocturne: Goal-Based 2D Driving Benchmark with Partial Observability <i>Collaboration with Meta AI</i>	2021 – 2022 [code]
<ul style="list-style-type: none">Built a fast C++ driving simulator with human-like partial observability and Python bindings for RLCreated a large open-source benchmark with challenging coordination tasks from Waymo traffic dataAchieved a 75% goal-reaching rate using decentralized multi-agent PPO with shared policies	
FLOW: Deep RL for Mixed Autonomy in Microsimulations	2019 – 2021 [code]
<ul style="list-style-type: none">Heavily contributed to FLOW and its RL training stack in various traffic optimization scenarios	

- Improved throughput in a road bottleneck by 20% with 5% autonomous vehicles using multi-agent RL
- Reduced overall fuel consumption by 25% with 10% RL-controlled AVs in large highway simulations

Research Publications

[†]Equal first author.

Conference Publications

1. **International Conference on Neuro-symbolic Systems (NeuS), 2025.**
[A Tutorial on Neural Network-Based Solvers for Hyperbolic Conservation Laws: Supervised vs. Unsupervised Learning, and Applications to Traffic Modeling.](#)
 Alexi Canesse, Zhe Fu, **Nathan Lichtlé[†]**, Hossein Nick Zinat Matin, Zihe Liu, Maria Laura Delle Monache, and Alexandre M. Bayen.
2. **IEEE Intelligent Transportation Systems Conference (ITSC), 2023.**
[Traffic Smoothing Controllers for Autonomous Vehicles Using Deep RL and Real-World Trajectory Data.](#)
Nathan Lichtlé, Kathy Jang, Adit Shah, Eugene Vinitsky, Jonathan W. Lee, and Alexandre M. Bayen.
3. **Conference on Neural Information Processing Systems (NeurIPS), 2022.**
[Nocturne: a scalable driving benchmark for bringing multi-agent learning closer to the real world.](#)
 Eugene Vinitsky, **Nathan Lichtlé[†]**, Xiaomeng Yang, Brandon Amos, and Jakob Foerster.
4. **IEEE International Conference on Robotics and Automation (ICRA), 2022.**
[Deploying Traffic Smoothing Cruise Controllers Learned from Trajectory Data.](#)
Nathan Lichtlé, Eugene Vinitsky, Matthew Nice, Benjamin Seibold, Dan Work, and Alexandre M. Bayen.
5. **IEEE Intelligent Transportation Systems Conference (ITSC), 2021.**
[Fuel Consumption Reduction of Multi-Lane Road Networks using Decentralized Mixed-Autonomy Control.](#)
Nathan Lichtlé, Eugene Vinitsky, George Gunter, Akash Velu, and Alexandre M. Bayen.

Under Review

6. **International Conference on Learning Representations (ICLR), 2025.**
[\(U\)NFV: Supervised and Unsupervised Neural Finite Volume Methods for Solving Hyperbolic PDEs.](#)
Nathan Lichtlé, Alexi Canesse, Zhe Fu, Hossein Nick Zinat Matin, Maria Laura Delle Monache, and Alexandre M. Bayen.
7. **International Conference on Learning Representations (ICLR), 2025.**
[Reevaluating Policy Gradient Methods for Imperfect-Information Games.](#)
 Max Rudolph, **Nathan Lichtlé[†]**, Sobhan Mohammadpour, Alexandre M. Bayen, J. Zico Kolter, Amy Zhang, Gabriele Farina, Eugene Vinitsky, and Samuel Sokota.

Journal Articles

8. **IEEE Control Systems Magazine (CSM), 2025.**
[Reinforcement Learning-Based Oscillation Dampening: Scaling Up Single-Agent Reinforcement Learning Algorithms to a 100-Autonomous Vehicle Highway Field Operational Test.](#)
 Kathy Jang, **Nathan Lichtlé[†]**, Eugene Vinitsky, Adit Shah, Matthew Bunting, Matthew Nice, Benedetto Piccoli, Benjamin Seibold, Daniel B. Work, Maria Laura Delle Monache, Jonathan Sprinkle, Jonathan W. Lee, and Alexandre M. Bayen.
9. **IEEE Control Systems Magazine (CSM), 2025.**
[Traffic Control via Connected and Automated Vehicles: Open-Road Field Experiment with 100 CAVs.](#)
 Jonathan W. Lee, Han Wang, Kathy Jang, **Nathan Lichtlé[†]**, Amaury Hayat, Matthew Bunting, *et al.*

10. **IEEE Transactions on Robotics (T-RO), 2024.**
[From Sim to Real: A Pipeline for Training and Deploying Traffic Smoothing Cruise Controllers.](#)
 Nathan Lichtlé, Eugene Vinitsky, Matthew Nice, Rahul Bhadani, Matthew Bunting, Fangyu Wu, Benedetto Piccoli, Benjamin Seibold, Daniel B. Work, Jonathan W. Lee, Jonathan Sprinkle, and Alexandre M. Bayen.
11. **Systems & Control Letters (SCL), 2024.**
[A Novel Approach to Feedback Control with Deep Reinforcement Learning](#)
 Kala Agbo Bidi, Jean-Michel Coron, Amaury Hayat, and Nathan Lichtlé[†].
12. **ACM Transactions on Cyber-Physical Systems (TCPS), 2023.**
[Optimizing Mixed Autonomy Traffic Flow with Decentralized AVs and Multi-Agent RL.](#)
 Eugene Vinitsky, Nathan Lichtlé[†], Kanaad Parvate, and Alexandre M. Bayen.

Under Review

13. **SIAM Journal on Numerical Analysis (SINUM), 2025.**
 Supervised and Unsupervised Neural Network Solver for First Order Hyperbolic Nonlinear PDEs.
 Zakaria Baba, Alexandre M. Bayen, Alexi Canesse, Maria Laura Delle Monache, Martin Drieux, Zhe Fu, Nathan Lichtlé[†], Zihe Liu, and Hossein Nick Zinat Matin.
14. **IEEE Transactions on Automatic Control (TAC), 2024.**
[Exponential stability of viscous Saint-Venant equations using a quadratic Lyapunov function.](#)
 Amaury Hayat and Nathan Lichtlé[†].

Workshop Papers

15. **Conference on Neural Information Processing Systems (NeurIPS) 2023.**
Workshop on Mathematical Reasoning and AI (Math-AI).
[RL in Control Theory: A New Approach to Mathematical Problem Solving.](#)
 Kala Agbo Bidi, Jean-Michel Coron, Amaury Hayat, and Nathan Lichtlé[†].
16. **Data-Driven and Intelligent Cyber-Physical Systems (DI-CPS), 2021.**
[Integrated Framework of Vehicle Dynamics, Instabilities, Energy Models, and Sparse Flow Smoothing Controllers.](#)
 Jonathan W. Lee, George Gunter, Rabie Ramadan, Sulaiman Almatrudi, Paige Arnold, *et al.*
17. **Conference on Neural Information Processing Systems (NeurIPS) 2020.**
Workshop on Deep Reinforcement Learning (Deep RL).
[Optimizing Traffic Bottleneck Throughput using Cooperative, Decentralized Autonomous Vehicles.](#)
 Eugene Vinitsky, Nathan Lichtlé, Kanaad Parvate, and Alexandre M. Bayen.
18. **Conference on Neural Information Processing Systems (NeurIPS) 2020.**
Workshop on Emergent Communication (EmeCom).
[Beliefs and Level-k Reasoning in Traffic.](#)
 Eugene Vinitsky, Angelos Filos, Nathan Lichtlé, Kevin Lin, Nicholas Liu, Alexandre M. Bayen, Anca Dragan, Rowan McAllister, and Jakob Foerster.

Others

19. **Dataset, Zenodo, 2023.**
[The I-24 Trajectory Dataset.](#)
 Matthew Nice, Nathan Lichtlé, Gracie Gumm, Michael Roman, Eugene Vinitsky, Safwan Elmadani, *et al.*
20. **Preprint, 2019.**
[Inter-Level Cooperation in Hierarchical Reinforcement Learning.](#)
 Abdul Rahman Kreidieh, Samyak Parajuli, Nathan Lichtlé, Yiling You, Rayyan Nasr, and Alexandre M. Bayen.

Teaching and Mentoring Experience

Graduate Student Instructor, UC Berkeley
CS70, Discrete Mathematics and Probability Theory

Fall 2023, Spring 2024 (2 semesters)

- Enrollment: over 800 students
- Led three two-hour discussion sections for groups of 30-40 students twice per week and delivered short lectures
- Held office hours three days per week to support students individually and in small groups
- Created and graded exam questions in coordination with the teaching team
- Managed Zoom Q&A during lectures
- Attended a semester-long workshop on effective teaching strategies and pedagogy

Project Instructor, École Nationale des Ponts et Chaussées

- Guided eight graduate students through semester-long projects on simulation-based autonomous driving
- Taught reinforcement learning fundamentals through a series of targeted mini-lectures

Mentor, University of California, Berkeley

Mobile Sensing Lab research project mentor, undergraduate and graduate students (all co-authors) 2021 - 2025

Alexi Canesse, École Normale Supérieure de Lyon, 2025. Currently Ph.D. student at École polytechnique.

Zakaria Baba, École polytechnique, 2025. Currently Ph.D. student at Caltech.

Martin Drieux, École polytechnique, 2025. Currently MS student at Carnegie Mellon University.

Adrien Bindel, École polytechnique, 2025. Currently MSc student at Imperial College London.

Ashwin Dara, EECS, 2023 - 2025. Currently software engineer at Doordash.

Ashish Pandian, EECS, 2024 - 2025.

Zihe Liu, CEE, 2024 - present. Currently Ph.D. student at UC Berkeley.

Adit Shah, EECS, 2021 - 2024. Currently ML research engineer at Until.

BAIR undergraduate mentoring program

Spring 2023

Hiya Shah, EECS, Spring 2023

Nicole Han, CS & DS, Spring 2023

EECS MEng capstone project mentor

Sep 2023 - May 2024

Alvin Bao, EECS, 2023 - 2024. Currently software engineer at Netflix.

Tony Luo, EECS, 2023 - 2024. Currently software engineer at Doordash.

Abirami Sabbani, EECS, 2023 - 2024. Currently software engineer at Walmart Global Tech.

Cathy Wang, EECS, 2023 - 2024. Currently software engineer at AWS.

Referee Service

Journal Article Reviewer

- IEEE Control Systems Letters (L-CSS)
- IEEE Transactions on Automatic Control (TAC)

Conference Paper Reviewer

- Conference on Neural Information Processing Systems (NeurIPS)
- International Conference on Learning Representations (ICLR)
- International Conference on Machine Learning (ICML)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- Computer-Aided Civil and Infrastructure Engineering (CACAIIE)
- American Control Conference (ACC)
- IEEE Intelligent Transportation Systems Conference (ITSC)

Talks, Media and Outreach

- **Guest blog post**, BAIR blog (Berkeley Artificial Intelligence Research) March 2025
“Scaling Up Reinforcement Learning for Traffic Smoothing: A 100-AV Highway Deployment”
- **Featured article**, CNRS newsletter, CIRCLES project ([link](#), in French) May 2024
- **Invited speaker**, Traffic and Autonomy Conference (Maiori, Italy) June 2023
- **Podcast guest**, INGENIUS ENPC, “Autonomous Driving for Traffic Flow Optimization” (in French) Feb 2023
- **Poster presentations**: NeurIPS 2023, NeurIPS 2022 (Math-AI), ICRA 2022, ITSC 2021
- **Press**: CIRCLES work featured in Fortune, AP news, Popular Science, PR Newswire, TechXplore, UC Berkeley News, Vanderbilt University News, Fox Channel 2 KTVU, Fox Channel 17 WZTV Nashville, ABC 7 News, WKRN News Channel 2, WKRN News Channel 2, WABI News Channel 5, WTVF News Channel 5, WSMV Channel 4, Main Street Media of Tennessee, Motor, CNRS, RTFlash, Sciences et Avenir, ENPC newsletter, JdG, France Info, La Tribune Auto, Automobile Magazine, Usine Digitale. Links on [website](#).

Awards and Honors

- **IEEE ITS Institutional Lead Award** for the CIRCLES project in which I was a major contributor ([link](#)). 2024
- **Berkeley Fellow** (1-year funding) University of California, Berkeley | 2022 – 2023
- **ENPC Scholarship** (1.5-year funding) École des Ponts ParisTech | 2021 – 2022
- **ENS Fellow (Élève Normalien)** (4-year funding) École Normale Supérieure Paris-Saclay | 2017 – 2021
Admitted by ranking 68th nationwide in the highly selective entrance exams for France’s most prestigious institutions.
- **Top 5% in Google Hash Code** 2020
- **Top 1% in Le Shaker Hackathon** 2018
- **Finalist (ranked 7th/2000⁺) in MDF Hackathon (Meilleur Dev de France)** 2018
- **High School Diploma with Highest Honors** 2015

Technical Skills

Languages: Python, C, C++, Javascript, Bash, SQL

Frameworks: PyTorch, RLlib, SB3, CleanRL, Gym, OpenAI API, LangChain, ONNX, SUMO, raylib, WandB

Infrastructure: AWS (EC2/S3), Azure, SLURM, W&B, Docker, Git, Linux