

Chengyuan ZHANG

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CONTACT

- Homepage: <https://chengyuan-zhang.github.io>; Google Scholar: [[Link](#)]
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RESEARCH INTERESTS

My research develops computational models of human inference and interaction using Bayesian methods, multi-agent dynamical systems, and structured spatiotemporal representations. I aim to bridge theoretical principles with real-world behavioral data by building probabilistic generative models that make their assumptions explicit, support interpretable reasoning, and provide calibrated uncertainty. My works are motivated by improving AI decision-making in high-stakes, information-rich settings, especially where systems must learn from evolving observations and simulate human-centric behavior in a reliable, testable way.

I am currently interested in the following directions at the intersection of modern AI and human social behavior:

- **Agentic Inference & Multi-Agent Interaction:** Developing models in which agents infer others' goals, beliefs, and constraints, enabling structured accounts of social behavior and coordination.
- **Probabilistic Cognition & Uncertainty:** Using Bayesian inference and scalable approximations to obtain reliable predictions, quantify uncertainty, and diagnose model misspecification in decision systems.
- **Spatiotemporal Structure Learning:** Learning reusable representations and latent structure from dynamic, large-scale data for prediction, simulation, and causal understanding of behavior.

EDUCATION

McGill University

Ph.D. in Civil Engineering, supervised by Prof. Lijun Sun

Montréal, Québec, Canada

Sept. 2020 – May 2026

- **Dissertation:** "From Micro Interactions to Traffic Flow: Stochastic Driver Models for Realistic Traffic Simulation"
- **Cumulative GPA: 4.00/4.00;**
- Fast tracked to the Ph.D. program in 2022 winter with 4.00/4.00 Master's GPA;

Chongqing University

B.Eng. in Vehicle Engineering

Chongqing, China

Sept. 2015 – June 2019

- **Thesis:** "Recognition of Multi-Vehicle Interaction Patterns Based on Probabilistic Velocity Fields"
- **Selected scholarships and awards:** National Scholarship, 2017; Outstanding Undergraduate Thesis Award, 2019; Outstanding Graduate of Chongqing University, 2019; Outstanding Student Award (top 3%), 2018 and 2017;
- Selected to **Excellent Student Program** (top 5%, on basis of outstanding academic performance);
- Completed extensive coursework in **Electronics Science and Technology** (2015-2016.)

WORK/VISITING RESEARCH EXPERIENCE

Visiting Student Researcher

Robotics Institute, Carnegie Mellon University

Pittsburgh, Pennsylvania, USA

Jan. 2023 – Aug. 2023

Visiting Student Researcher

Department of Mechanical Engineering, UC Berkeley

Berkeley, California, USA

Sept. 2019 – Jan. 2020

Visiting Student Researcher

Department of Mechanical Engineering, Carnegie Mellon University

Pittsburgh, Pennsylvania, USA

July 2018 – Oct. 2018

Visiting Student

University of Pennsylvania

Philadelphia, Pennsylvania, USA

Jan. 2018 – Feb. 2018

PREPRINTS

- Menglin Kong, Chengyuan Zhang*, and Lijun Sun, “Active simulation-based inference for scalable car-following model calibration,” *arXiv preprint arXiv:2602.05246*, 2026. [[arXiv](#)]
- Chengyuan Zhang, Cathy Wu, and Lijun Sun*, “Markov regime-switching intelligent driver model for interpretable car-following behavior,” *arXiv preprint arXiv:2506.14762*, 2025. [[arXiv](#)]

JOURNAL PUBLICATIONS

- Chengyuan Zhang, Zhengbing He, Cathy Wu, and Lijun Sun*, “When context is not enough: Modeling unexplained variability in car-following behavior,” *arXiv preprint arXiv:2507.07012*. (Accepted at *ISTTT26 & TR Part B*), 2025. [[arXiv](#)]
- Xinyu Chen, Chengyuan Zhang, Xi-Le Zhao, Nicolas Saunier*, and Lijun Sun, “Forecasting sparse movement speed of urban road networks with nonstationary temporal matrix factorization,” *Transportation Science*, vol. 59, no. 3, pp. 670–687, 2025. [[TranSci](#)] [[arXiv](#)] [[slides](#)] [[Github](#)] [[blog](#)]
- Chengyuan Zhang, Wenshuo Wang, and Lijun Sun*, “Calibrating car-following models via bayesian dynamic regression,” *Transportation Research Part C: Emerging Technologies*, vol. 168, p. 104719, 2024. [[TR PartC](#)] [[arXiv](#)] [[Github](#)]
- Chengyuan Zhang and Lijun Sun*, “Bayesian calibration of the intelligent driver model,” *IEEE Transactions on Intelligent Transportation Systems*, vol. 25, no. 8, pp. 9308–9320, 2024. [[IEEE TITS](#)][[arXiv](#)] [[Github](#)] [[presentation](#)] [[poster](#)]
- Xiaoxu Chen, Chengyuan Zhang, Zhanhong Cheng, Yuang Hou, and Lijun Sun*, “A bayesian gaussian mixture model for probabilistic modeling of car-following behaviors,” *IEEE Transactions on Intelligent Transportation Systems*, vol. 25, no. 6, pp. 5880–5891, 2023. [[IEEE TITS](#)]
- Xinyu Chen=, Chengyuan Zhang= (equal contributions), Xiaoxu Chen, Nicolas Saunier, and Lijun Sun*, “Discovering dynamic patterns from spatiotemporal data with time-varying low-rank autoregression,” *IEEE Transactions on Knowledge and Data Engineering*, vol. 36, no. 2, pp. 504–517, 2023. [[IEEE TKDE](#)] [[arXiv](#)] [[data & code](#)] [[blog](#)]
- Chengyuan Zhang, Jiacheng Zhu, Wenshuo Wang*, and Junqiang Xi, “Spatiotemporal learning of multivehicle interaction patterns in lane-change scenarios,” *IEEE Transactions on Intelligent Transportation Systems*, vol. 23, no. 7, pp. 6446–6459, 2021. [[demo](#)] [[IEEE TITS](#)] [[project website](#)] [[Github](#)]
- Chengyuan Zhang, Xiaomin Zhang, Hongyun Ye, Ming Wei, and Xianxiong Ning*, “An efficient parking solution: A cam-linkage double-parallelgram mechanism based 1-degrees of freedom stack parking system,” *Journal of Mechanisms and Robotics*, vol. 11, no. 4, p. 045001, 2019. [[demo](#)] [[ASME JMR](#)]
- Chengyuan Zhang and Jian Xiao*, “Chaotic behavior and feedback control of magnetorheological suspension system with fractional-order derivative,” *Journal of Computational and Nonlinear Dynamics*, vol. 13, no. 2, p. 021007, 2018. [[ASME JCND](#)]

CONFERENCE PUBLICATIONS

- Menglin Kong, Chengyuan Zhang, and Lijun Sun*, “Online calibration of context-driven car-following models,” in (Accepted at *IEEE IV26'*), IEEE, 2026.
- Cameron Hickert, Athena Wang, Maryam Samaei, Chengyuan Zhang, Lijun Sun, Yanbing Wang, Mostafa Ameli, and Cathy Wu*, “Autotune: A unified benchmark for highway traffic microsimulation calibration,” in (Accepted at *IEEE IV26'*), IEEE, 2026.
- Chengyuan Zhang=, Kehua Chen=(equal contributions), Meixin Zhu, Hai Yang, and Lijun Sun*, “Learning car-following behaviors using bayesian matrix normal mixture regression,” in *2024 IEEE Intelligent Vehicles Symposium (IV)*, IEEE, 2024, pp. 608–613. [[arXiv](#)][[IEEE IV](#)]
- Chengyuan Zhang, Rui Chen, Jiacheng Zhu, Wenshuo Wang, Changliu Liu, and Lijun Sun*, “Interactive car-following: Matters but not always,” in *2023 IEEE 26th International Conference on Intelligent Transportation Systems (ITSC)*, IEEE, 2023, pp. 5120–5125. [[arXiv](#)][[IEEE ITSC](#)]

- Wenshuo Wang, Chengyuan Zhang, Pin Wang, and Ching-Yao Chan*, “Learning representations for multi-vehicle spatiotemporal interactions with semi-stochastic potential fields,” in *2020 IEEE Intelligent Vehicles Symposium (IV)*, IEEE, 2020, pp. 1935–1940. [[IEEE IV](#)]
- Chengyuan Zhang, Jiacheng Zhu, Wenshuo Wang, and Ding Zhao*, “A general framework of learning multi-vehicle interaction patterns from video,” in *2019 IEEE Intelligent Transportation Systems Conference (ITSC)*, IEEE, 2019, pp. 4323–4328. [[IEEE ITSC](#)]

BOOKS

- Wenshuo Wang, Letian Wang, Chengyuan Zhang, Changliu Liu, and Lijun Sun, “Social interactions for autonomous driving: A review and perspectives,” *Foundations and Trends® in Robotics*, vol. 10, no. 3-4, pp. 198–376, 2022. [[ebook](#)] [[arXiv](#)]
- Xinyu Chen, Jieling Jin, Qionghua Liao, Chengyuan Zhang, and Xiaoxu Chen, *Academic Writing with LaTeX (in Chinese)*. 2023. [[ebook](#)] [[link](#)]

PATENT

- [CN108222589B](#), Cam-connecting rod type mechanical three-dimensional parking device. Chengyuan Zhang, Xiaomin Zhang, Hongyun Ye, Jinming Shi, Manzhi Wang, and Xianxiong Ning. *Chongqing University*.

FUNDING PROGRAM

- “Quantitative Evaluation and Modeling of Action-Reaction Cycles in Interactive Human Driving Behaviors”, NSERC Alliance International Catalyst Grant, \$25,000, trainee, 2022-2023.
- “Quantitative Evaluation and Modeling of Action-Reaction Cycles in Interactive Human Driving Behaviors”, FRQNT Fellowship, \$100,000, 2023-2026.
- “Discovering Spatiotemporal Interactive Driving Behaviours in Traffic Scenes”, FRQNT Fellowship, \$17,500, 2022-2023.
- “Statistical Modeling Framework to Understand Dynamic Traffic Patterns from Video Data”, IVADO Fellowship, \$40,000, 2020-2022.

TEACHING

Traffic Engineering and Simulation (by Prof. Lijun Sun) *2022 Fall, 2023 Fall, 2025 Fall*
Teaching Assistant, Department of Civil Engineering, McGill University

- TA Tutorials: traffic flow fundamentals and simulation; fundamental diagrams and shockwaves.

Basics of Machine Learning and Data Analysis (by Prof. Pradeep Ravikumar) *2022 Fall*
Teaching Assistant (Online), Department of Computer Science, Carnegie Mellon University

- TA Tutorials: ordinary/generalized least squares (OLS/GLS), logistic regression, Bayesian inference, Gaussian processes.

Statistical Machine Learning (by Prof. Dino Sejdinovic) *2020 Spring, 2020 Summer, and 2022 Summer*
Teaching Assistant (Online), Department of Statistics, Oxford University

- TA Tutorials: LSE, MLE, Linear Regression, PCA, SVM, kernel methods, Bayesian Optimization, Deep Neural Network.

LEADERSHIP AND SERVICE

· (Co-)Chair/(Co-)Organizer:

- 2nd SIAM workshop on IEEE IV24’, Jeju Shinhwa World, Jeju Island, Korea, 2024. [[Website](#)]
- 1st SIAM workshop on IEEE IV23’, Anchorage, Alaska, USA, 2023. [[Website](#)]

· Journal Reviewer:

- Transportation Science;
- Transportation Research Part B: Methodological;
- Transportation Research Part C: Emerging Technologies;
- Artificial Intelligence for Transportation;
- Transportation Research Interdisciplinary Perspectives;
- IEEE Transactions on Intelligent Transportation

- Systems;
- IEEE Transactions on Intelligent Vehicles;
- IEEE Transactions on Consumer Electronics;
- IEEE Transactions on Cybernetics;
- IEEE Sensors Journal;
- European Journal of Operational Research;
- Travel Behaviour and Society;
- Conference Reviewer:
 - IEEE International Conference on Intelligent Transportation Systems (ITSC), 22-24;
 - IEEE Intelligent Vehicles Symposium (IV), 23-24;
 - Symposium on Machine Learning for Autonomous Driving; [NeurIPS'23] [AAAI'25]
 - Transportation Research Board Annual Meeting;
 - The 5th Symposium on Management of Future Motorway and Urban Traffic Systems (MFTS), 2024;
 - RSS 2024 Workshop on Autonomous Vehicles Across Scales (AVAS), 2024; [RSS'24]
 - Bayesian Decision-making and Uncertainty Workshop; [NeurIPS'24]
 - International Symposium on Transportation Data & Modelling (ISTDM), 2025;
- IEEE Graduate Student member;
- IEEE Intelligent Transportation Systems Society (ITSS) Student member;
- Student member of Chinese Overseas Transportation Association (COTA);
- Student member of Interuniversity Research Centre on Enterprise Networks, Logistics and Transportation (CIRRELT);
- Member of the Society of Automotive Engineers (SAE) of China;

HONORS, FELLOWSHIPS, AND RECOGNITION

- The Honorable Mention Award for the 2024 Clifford Spiegelman Student Paper Competition, 2024 [Link]
- Graduate Mobility Award, McGill University, 2022-2023
- Graduate Research Enhancement and Travel Awards, McGill University, 2023
- Ron Rice Memorial Award, McGill University, 2023
- Mitacs Globalink Research Award - Abroad, 2022-2023
- McGill Engineering Doctoral Award (MEDA), CAD \$111,000, McGill University, 2022-2025
- FRQNT Master's Scholarship (B1X), CAD \$17,500, 2022-2023 [Link]
- FRQNT Doctoral Scholarship (B2X), CAD \$100,000, 2023-2027 [Link]
- CIRRELT Doctoral Scholarship of Excellence - Final Stages, CAD \$7,500, 2025 [Link]
- CIRRELT Doctoral Scholarship of Excellence - Early Stages, CAD \$4,000, 2023 [Link]
- CIRRELT Master's Scholarship of Excellence, CAD \$3,500, 2022
- Graduate Excellence Fellowship Awards, McGill University, 2020
- IVADO Excellence Scholarships - Msc, CAD \$40,000, 2020-2022
- Outstanding Team Award & Best Application Award at DeeCamp, China, 2019
- Outstanding Graduate of Chongqing University, 2019
- First Prize in the 2018 National College Mechanical Innovation Competition (TOP #10 in China), 2018
- National Scholarship, China, 2017
- First Prize in the Chongqing University Physics Contest (#1/500 in Chongqing University), 2015

OPEN SCIENCE / SOFTWARE / ADDITIONAL OUTPUTS

- https://github.com/Chengyuan-Zhang/IDM_Bayesian_Calibration;
- https://github.com/Chengyuan-Zhang/Gaussian_Velocity_Field;
- Simulator: <https://chengyuan-zhang.github.io/traffic-sim/>;
- Research Notes: <https://chengyuan-zhang.github.io/notes/>;

SELECTED TALKS & PRESENTATIONS

- Invited Talk. Discovering Urban Mobility Patterns from Human Behavior to City-Scale Dynamics with Interpretable AI: Interpretable pattern discovery across mobility scales. MIT Senseable City Lab, Massachusetts Institute of Technology. Apr. 2026.
- Invited Talk. Modeling Human Driving as a Dynamic Interaction Process: Uncertainty-Aware Learning from Naturalistic Driving Data. MIT AgeLab, Massachusetts Institute of Technology. Apr. 2026.
- Invited Talk. From Micro Interactions to Traffic Flow: Stochastic Driver Models for Realistic Traffic Simulation. TOPS Lab, Department of Transportation Engineering, Tongji University. Feb. 2026.
- Invited Talk. From Micro Interactions to Traffic Flow: Stochastic Driver Models for Realistic Traffic Simulation. MIT Wu Lab, Massachusetts Institute of Technology. Oct. 2025.
- Invited Talk. Stochastic Modeling and Simulations of Car-Following Behaviors. JTL Research Seminar, Massachusetts Institute of Technology. Feb. 2025.
- Invited Talk. Bayesian Calibration of Car-Following Models. Department of Mechanical Engineering, Beijing Institute of Technology, Beijing. Nov. 2024.
- Invited Talk. Bayesian Calibration of Car-Following Models. Artificial Intelligence Institute, Shanghai Jiao Tong University, Shanghai. Oct. 2024.
- Podium Presentation. Calibrating Car-Following Models via Bayesian Dynamic Regression. The 25th International Symposium on Transportation and Traffic Theory (ISTTT25). University of Michigan, Ann Arbor. July 2024.
- Invited Talk. Bayesian Calibration of the IDM. Traffic Flow Theory and Characteristics (ACP50) general webinar series. Feb. 2023.
- Poster Presentation. Bayesian Calibration of the IDM. Transportation Research Board Annual Meeting. Washington, DC. Jan. 2023.
- Invited Talk. Learning to Drive: Imitating How Human Drivers Make Decisions in Complicated Urban Scenarios. Department of Mechanical Engineering, UC Berkeley, Berkeley. Dec. 2019.
- Invited Talk. Design of A Novel Cam-Linkage Mechanism. The 1st Workshop for SAILER at CMU. Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh. Aug. 2018.