Xinyu Chen (Ph.D.)

Last update on March 18, 2025

Current Research Interests

- ❒ Machine Learning
- ❒ AI for Science
- ❒ Matrix/Tensor Computations
- ❒ Data Science
- ❒ Signal Processing
- ❒ Spatiotemporal Data Modeling
- ❒ Transport & Smart Cities
- ❒ Urban Human Mobility
- ❒ Optimization & Decision Making

Contact Information

chenxy346@gmail.com (primary) or xinychen@mit.edu (official)
https://xinychen.github.io (primary)
https://sites.mit.edu/xinychen (official)
https://github.com/xinychen
Google Scholar 1,510 citations (h-index: 14 & i10-index: 15)

Experience

Postdoctoral Associate 2024.04 – now
***Massachusetts Institute of Technology* (MIT)** Cambridge, USA

- Tensor decomposition for machine learning problems in urban systems (e.g., mobility networks). Project website: https://sites.mit.edu/tensor4ml
- Interpretable machine learning in computational social science data.
- Machine learning and causal inference from spatiotemporal system data. (Part of the Mens, Manus, and Machina (M3S) project and the US Department of Energy (DOE) project)
- Advisor: Jinhua Zhao (full professor at MIT's Department of Urban Studies and Planning)

Education

PhD in Civil Engineering (Transportation) 2023.12
Polytechnique Montreal (School of Engineering), ***University of Montreal*** Montreal, Canada

IVADO PhD Excellence Scholarship & CIRRELT PhD Excellence Scholarship

- Thesis: *Matrix and Tensor Models for Spatiotemporal Traffic Data Imputation and Forecasting*
- Advisor: Nicolas Saunier (full professor at Polytechnique Montreal)

Master's degree in Traffic Information Engineering & Control 2019.06
Sun Yat-Sen University Guangzhou, China

- Thesis: *Imputing Spatiotemporal Missing Traffic Data by Bayesian Tensor Factorization Models*

Bachelor's degree in Traffic Engineering 2016.06
Guangzhou University Guangzhou, China

- Thesis: *Modeling Vehicles' Time Headway with Log-Normal and Power-Law Distribution*

Honours and Awards

CIRRELT PhD Excellence Scholarship ($5,000) 2021.12
IVADO PhD Excellence Scholarship ($100,000, by Institute for Data Valorisation) 2020.04
National Scholarship (by Ministry of Education of China) 2018.11

Refereed Journal Papers

Google Scholar: https://scholar.google.com/citations?user=mCrW04wAAAAJ&hl

Publication metrics: 17 publications (12 first-author) with 1,500+ citations in total (1,300+ citations on first-author papers). These first-author papers have been published in top-tier Computer Science journals such as **IEEE TPAMI** (1 paper) and **IEEE TKDE** (3 papers); Management Science journal **IJOC** (1 paper) and **TS** (1 paper); Transportation Science/Engineering journals such as **TR-C** (5 papers) and **IEEE TITS** (1 paper).

◆ **First-author papers** (6 papers cited above 100 times)

12. Xinyu Chen, HanQin Cai, Fuqiang Liu, Jinhua Zhao (2025). **Correlating time series with interpretable convolutional kernels**. *IEEE Transactions on Knowledge and Data Engineering*.

https://doi.org/10.1109/TKDE.2025.3550877

11. Xinyu Chen, Chengyuan Zhang, Xi-Le Zhao, Nicolas Saunier, Lijun Sun (2025). **Forecasting sparse movement speed of urban road networks with nonstationary temporal matrix factorization**. *Transportation Science*.

https://doi.org/10.1287/trsc.2024.0629

10. Xinyu Chen, Xi-Le Zhao, Chun Cheng (2024). **Forecasting urban traffic states with sparse data using Hankel temporal matrix factorization**. *INFORMS Journal on Computing*.

https://doi.org/10.1287/ijoc.2022.0197

9. Xinyu Chen, Zhanhong Cheng, HanQin Cai, Nicolas Saunier, Lijun Sun (2024). **Laplacian convolutional representation for traffic time series imputation**. *IEEE Transactions on Knowledge and Data Engineering*. 36 (11): 6490–6502.

https://doi.org/10.1109/TKDE.2024.3419698

8. Xinyu Chen, Chengyuan Zhang, Xiaoxu Chen, Nicolas Saunier, Lijun Sun (2024). **Discovering dynamic patterns from spatiotemporal data with time-varying low-rank autoregression**. *IEEE Transactions on Knowledge and Data Engineering*. 36 (2): 504–517.

https://doi.org/10.1109/TKDE.2023.3294440

7. Xinyu Chen, Lijun Sun (2022). **Bayesian temporal factorization for multidimensional time series prediction**. *IEEE Transactions on Pattern Analysis and Machine Intelligence*. 44 (9): 4659–4673.

https://doi.org/10.1109/TPAMI.2021.3066551 200+ citations

6. Xinyu Chen, Mengying Lei, Nicolas Saunier, Lijun Sun (2022). **Low-rank autoregressive tensor completion for spatiotemporal traffic data imputation**. *IEEE Transactions on Intelligent Transportation Systems*. 23 (8): 12301–12310.

https://doi.org/10.1109/TITS.2021.3113608 100+ citations

5. Xinyu Chen, Yixian Chen, Nicolas Saunier, Lijun Sun (2021). **Scalable low-rank tensor learning for spatiotemporal traffic data imputation**. *Transportation Research Part C: Emerging Technologies*. 129: 103226.

https://doi.org/10.1016/j.trc.2021.103226

4. Xinyu Chen, Jinming Yang, Lijun Sun (2020). **A nonconvex low-rank tensor completion model for spatiotemporal traffic data imputation**. *Transportation Research Part C: Emerging Technologies*. 117: 102673.

https://doi.org/10.1016/j.trc.2020.102673 100+ citations

3. Xinyu Chen, Zhaocheng He, Yixian Chen, Yuhuan Lu, Jiawei Wang (2019). **Missing traffic data imputation and pattern discovery with a Bayesian augmented tensor factorization model**. *Transportation Research Part C: Emerging Technologies*. 104: 66–77.

https://doi.org/10.1016/j.trc.2019.03.003 100+ citations

2. Xinyu Chen, Zhaocheng He, Lijun Sun (2019). **A Bayesian tensor decomposition approach for spatiotemporal traffic data imputation**. *Transportation Research Part C: Emerging Technologies*. 98: 73–84.

https://doi.org/10.1016/j.trc.2018.11.003 300+ citations

1. Xinyu Chen, Zhaocheng He, Jiawei Wang (2018). **Spatial-temporal traffic speed patterns discovery and incomplete data recovery via SVD-combined tensor decomposition**. *Transportation Research Part C: Emerging Technologies*. 86: 59–77.

https://doi.org/10.1016/j.trc.2017.10.023 100+ citations

◆ **Co-authored papers**

5. Sheng Liu, Xi-Le Zhao, Jinsong Leng, Ben-Zheng Li, Jing-Hua Yang, Xinyu Chen (2024). **Revisiting high-order tensor singular value decomposition from basic element perspective**. *IEEE Transactions on Signal Processing*. 72: 4589–4603.

https://doi.org/10.1109/TSP.2024.3454115

4. Ben-Zheng Li, Xi-Le Zhao, Xiongjun Zhang, Teng-Yu Ji, Xinyu Chen, Michael K. Ng (2023). **A learnable group-tube transform induced tensor nuclear norm and its application for tensor completion**. *SIAM Journal on Imaging Sciences*. 16 (3): 1370–1397.

http://dx.doi.org/10.1137/22M1531907

3. Lijun Sun, Xinyu Chen, Zhaocheng He, Luis F. Miranda-Moreno (2021). **Routine pattern discovery and anomaly detection in individual travel behavior**. *Networks and Spatial Economics*. 35.

http://dx.doi.org/10.1007/s11067-021-09542-9

2. Pu Ren, Xinyu Chen, Lijun Sun, Hao Sun (2021). **Incremental Bayesian matrix/tensor learning for structural monitoring data imputation and response forecasting**. *Mechanical System and Signal Processing*. 158: 107734.

https://doi.org/10.1016/j.ymssp.2021.107734

1. Zhaocheng He, Kaiying Chen, Xinyu Chen (2018). **A collaborative method for route discovery using taxi drivers' experience and preferences**. *IEEE Transactions on Intelligent Transportation Systems*. 19 (8): 2505–2514.

http://doi.org/10.1109/TITS.2017.2753468

Conference Papers

TRB 2024: Xinyu Chen, Zhanhong Cheng, Chengyuan Zhang, Lijun Sun, Nicolas Saunier (2023). **Memory-efficient Hankel tensor factorization for extreme missing traffic data imputation** (presentation only). *The 103rd Annual Meeting of Transportation Research Board*.

WCTR 2023: Xinyu Chen, Zhanhong Cheng, Nicolas Saunier, Lijun Sun (2023). **Laplacian convolutional representation for traffic time series imputation** (presentation only). *Proceedings of the World Conference of Transport Research*.

TRB 2023: Xinyu Chen, Chengyuan Zhang, Lijun Sun, Nicolas Saunier (2023). **Nonstationary temporal matrix factorization for sparse traffic time series forecasting** (presentation only). *The 102nd Annual Meeting of Transportation Research Board*.

KDD Time Series Workshop: Xinyu Chen, Mengying Lei, Nicolas Saunier, Lijun Sun (2021). **Low-rank autoregressive tensor completion for spatiotemporal traffic data imputation** (presentation only). *The 7th SIGKDD Workshop on Mining and Learning from Time Series (MiLeTS)*.

Submitted Papers

2. Xinyu Chen, Dingyi Zhuang, HanQin Cai, Shenhao Wang, Jinhua Zhao (2024). **Dynamic autoregressive tensor factorization for pattern discovery of spatiotemporal systems**.

IEEE Transactions on Pattern Analysis and Machine Intelligence — under review (2nd round)

1. Xinyu Chen, Vassilis Digalakis Jr, Lijun Ding, Jinhua Zhao (2025). **Interpretable time series autoregression**.

INFORMS Journal on Computing — under review (1st round)

Academic Funding

1. **City-scale traffic data imputation and forecasting with tensor learning**
   - **Authors**: Xinyu Chen, Nicolas Saunier (advisor)
   - **Link**: https://ivado.ca/en/scholarships-and-grants/phd-excellence-scholarships/

IVADO PhD Excellence Scholarship — $100,000 — September 1, 2020

Seminar Services Experiences for organizing research seminar/meeting/workshop/conference.

- Role: **Host**. Invited Session at 2024 INFORMS Annual Meeting, Seattle, USA
  - Title: Simulation and learning from smart transportation systems, October 21, 2024
  - Session chairs: Prof. Li Jin, Prof. Shenhao Wang
- Role: **Host**. Senior Researcher Seminar of MIT Urban Mobility Lab, Cambridge, USA
  - Every Wednesday morning from September 18 to December 11, 2024
  - Guest speakers: Prof. Vassilis Digalakis Jr. (HEC Paris), Prof. Qiusheng Wu (University of Tennessee, Knoxville), Prof. Filipe Rodrigues (Technical University of Denmark), Dr. Konstantin Rusch (Postdoc at MIT CSAIL Lab), and Dr. Mehrdad Ghadiri (Postdoc at MIT Sloan School of Management)
- Role: **Host**. JTL Research Seminar of MIT Urban Mobility Lab, Cambridge, USA
  - Every Thursday morning from February 6 to July 10, 2025
  - Seminar website: `https://sites.mit.edu/jtl-seminar/`

Reviewing Activities I am serving as a reviewer for several scientific journals.

- Accident Analysis and Prevention
- Applied Mathematical Modeling
- Cities
- Expert Systems with Applications
- IEEE Intelligent Transportation Systems Magazines
- IEEE Open Journal of Signal Processing
- IEEE Transactions on Intelligent Transportation Systems
- IEEE Transactions on Knowledge and Data Engineering
- INFORMS Journal on Computing
- Mechanical System and Signal Processing
- Scientific Reports
- Signal Processing
- Transportation Research Part B: Methodological
- Transportation Research Part C: Emerging Technologies
- Transportation Research Part E: Logistics and Transportation Review
- Transportation Science

Professional Memberships

❒ Interuniversity Research Centre on Enterprise Networks, Logistics and Transportation (**CIRRELT**) — **Student Member** — 2021 – 2023

❒ Institute of Electrical and Electronics Engineers (**IEEE**) — **Student Member** — 2022 – 2023

Open-Source Projects I am a strong advocate of open science and leading some innovative projects on GitHub (**5,000+** stars & **600+** followers).

◆ **Selected repositories**

transdim: Python codes for spatiotemporal data imputation and prediction using a variety of state-of-the-art machine learning (mainly including low-rank matrix and tensor methods) and deep learning. 2018.09 - present

`xinychen/transdim` ☆ 1,300+ stars

awesome-LaTeX-drawing: Drawing Bayesian networks, graphical models, tensor structures, and technical frameworks in LaTeX. 2019.06 - present

`xinychen/awesome-latex-drawing` ☆ 1,500+ stars

LaTeX-cookbook: Academic writing with LaTeX: A tutorial (in Chinese). Published in *Tsinghua University Press*. 2021.05 - present

xinychen/latex-cookbook ☆ 1,400+ stars

Tensor4ML: Tensor decomposition for machine learning with Python implementation. 2019.06 - present

xinychen/Tensor4ML ☆ 200+ stars

tracebase: Multivariate time series forecasting on high-dimensional and sparse Uber movement speed data. 2020.11 - present

xinychen/tracebase ☆ 40+ stars

Spatiotemporal data modeling: This project aims at supporting research for all aspects of spatiotemporal data modeling with machine learning and addressing many scientific, mathematical, industrial, and engineering problems in urban systems, optimization & decision-making, signal processing, and network science. 2023.11 - present

https://spatiotemporal-data.github.io (3,000+ visitors)

Presentation & Talk

❒ Machine learning and optimization for data-driven transportation analytics and beyond. 2025.02

- Department of Industrial & Systems Engineering (ISE), University of Tennessee, Knoxville (UTK), Knoxville, USA

❒ Machine learning and optimization for data-driven transportation analytics. 2024.12

- Technical University of Munich (TUM), Heilbronn, Germany
- Technical University of Denmark (DTU), Kgs. Lyngby, Denmark

❒ Modeling urban traffic data with matrix and tensor approaches. 2024.10

- 2024 INFORMS Annual Meeting (INFORMS 2024), Seattle, USA
- Slides: https://xinychen.github.io/slides/informs24.pdf

❒ Laplacian convolutional representation for traffic data imputation. 2024.07

- Dalian University of Technology (DUT), Dalian, China
- Slides: https://xinychen.github.io/slides/LCR24.pdf

❒ Modeling temporal correlations and dynamics in spatiotemporal data systems. 2024.05

- Northeastern University (NEU), Boston, USA
- Slides: https://xinychen.github.io/slides/temporal_modeling.pdf

❒ Matrix and tensor models for spatiotemporal traffic data imputation and forecasting. 2023.12

- PhD Research Defense, Montreal, Canada
- Slides: https://xinychen.github.io/slides/defense.pdf

❒ Laplacian convolutional representation for traffic data imputation. 2023.07

- World Conference of Transport Research (WCTR 2023), Montreal, Canada
- Slides: https://xinychen.github.io/slides/LCR.pdf

❒ Low-rank matrix and tensor methods for spatiotemporal traffic data modeling. 2023.05

- Southern University of Science and Technology (SUSTech), Shenzhen, China
- Slides: https://xinychen.github.io/slides/traffic_data_modeling_v1.pdf

❒ Low-rank matrix and tensor methods for spatiotemporal data modeling. 2023.04

- Sichuan University (SCU), Chengdu, China
- University of Electronic Science and Technology of China (UESTC), Chengdu, China
- Slides: https://xinychen.github.io/slides/stdata_modeling.pdf

❒ Low-rank matrix and tensor factorization for speed field reconstruction. 2023.03

- Research Group of Transport, Polytechnique Montreal, Montreal, Canada
- Slides: https://xinychen.github.io/slides/MF_TF_SFR.pdf

❒ Spatiotemporal traffic data imputation and forecasting with tensor learning. 2022.05

- IVADO Project Workshop, Montreal, Canada
- Slides: https://xinychen.github.io/slides/phd_project_22summer.pdf

❒ Nonstationary temporal matrix factorization for multivariate time series forecasting. 2022.05

- Hong Kong Machine Learning Meetup (virtual)
- Slides: https://xinychen.github.io/slides/notmf.pdf

❒ Bayesian temporal factorization for multidimensional time series prediction. 2021.03

- IFT 6760A Course (*Matrix and tensor factorization techniques for machine learning*)
- University of Montreal, Montreal, Canada
- Slides: https://doi.org/10.5281/zenodo.4693404

Supervision

- **PhD student**: Yuhan Tang (2024 –, Civil Engineering at MIT); Nina Cao (2025 –, Mechanical Engineering at MIT)
- **Master student**: Donghang Li (2024 –, MIT)
- **Undergraduate student**: Jinming Yang (2018 – 2019, SYSU)

Skills

❒ **Language**: Chinese (native) & English (fluent)

❒ **Expertise**: Python/Matlab/Julia/R/Java; NumPy/PyTorch/CuPy; Jupyter Notebook; LaTeX; CSS/HTML.