Xinyu Chen (Ph.D.)

Last update on October 22, 2024

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 (homepage)
https://sites.mit.edu/xinychen (MIT sites)
xinychen
Google Scholar 1,320 citations (h-index: 13 & i10-index: 13)

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) 2020.08 – 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)
- Co-advisor: Lijun Sun (associate professor at McGill University)

Master's degree in Traffic Information Engineering & Control 2016.08 – 2019.06
Sun Yat-Sen University Guangzhou, China

Outstanding Thesis Award (top 2% in total)

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

Bachelor's degree in Traffic Engineering 2012.09 – 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: 16 publications (10 first-author) with 1,300+ citations in total (1,200+ 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*** (2 papers); Management Science journal ***IJOC*** (1 paper); Transportation Science journals such as ***TR-C*** and ***IEEE TITS***.

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

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**

6. 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*. Early Access.

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

5. Ben-Zheng Li, Xi-Le Zhao, Xinyu Chen, Meng Ding, Ryan Wen Liu (2024). **Convolutional low-rank tensor representation for structural missing traffic data imputation**. *IEEE Transactions on Intelligent Transportation Systems*. Early Access.

   https://doi.org/10.1109/TITS.2024.3430039

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

3. 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 (1st round)

2. Xinyu Chen, HanQin Cai, Fuqiang Liu, Jinhua Zhao (2024). **Correlating time series with interpretable convolutional kernels**. arXiv:2409.01362.

IEEE Transactions on Knowledge and Data Engineering — under review (1st round)

1. Xinyu Chen, Chengyuan Zhang, Xi-Le Zhao, Nicolas Saunier, Lijun Sun (2024). **Forecasting sparse movement speed of urban road networks with nonstationary temporal matrix factorization.**

Transportation Science — under review (2nd 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/Meeting Services

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

- **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
- **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)

Reviewing Activities

I am serving as a reviewer for some 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 (**4.6k+** stars & **500+** 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` ☆ 1.2k stars

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

`xinychen/awesome-latex-drawing` ☆ 1.3k stars

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

`xinychen/latex-cookbook` ☆ 1.3k 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: 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 (1.7k+ visitors)

Presentation & Talk

❒ 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

❒ 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 (MIT)
- **Master student**: Donghang Li (MIT)
- **Undergraduate student**: Jinming Yang (SYSU)

Skills

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

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