

Interdisciplinary Research

Computational Engineering in CEE



Xinyu Chen

Postdoc, MIT (now)

PhD, University of Montreal ('23)
Civil Engineering (Transportation)

Interests

- Advanced computing for engineering
- Urban system & mobility & demand
- Data-driven traffic flow modeling
- Climate system monitoring
- Machine learning & data science
- Optimization & math programming

PhD (ML for Transportation)

- **Traffic imputation** w/ tensor decomposition
[Chen et al.'19](#); [Chen et al.'21](#) in TR-C (cited 300+)
[Chen et al.'22](#) in IEEE TITS (cited 100+)
- **Time series imputation** w/ Laplacian convolution
[Chen et al.'24](#) in IEEE TKDE
- **Mobility prediction** w/ Bayesian optimization
[Chen & Sun'22](#) in IEEE TPAMI (cited 250+)
- **Traffic prediction** w/ Hankel factorization
[Chen et al.'24](#) in IJOC
- **Dynamic climate pattern discovery**
[Chen et al.'24](#) in IEEE TKDE

Postdoc (ML + Optimization for Spatiotemporal Data)

- **Tensor decomposition for ML**
[Chen et al.'24](#), major revision in IEEE TPAMI
- **Causal inference from climate systems**
[Chen et al.'24](#), 2nd-round review in IEEE TKDE
- **Mobility periodicity quantification w/ MIP**

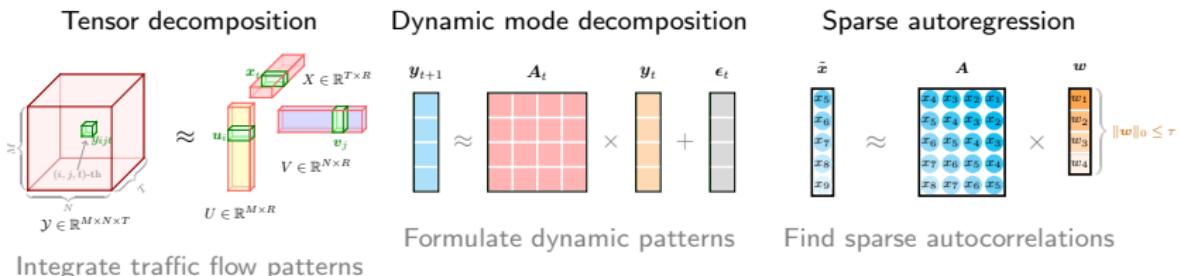


Research Contributions

- Formulating challenging engineering problems



- Advancing ML development with methodological contributions



Reproducible Research for Engineering

- The last mile of AI for computational engineering

Human mobility & smart cities
Data-driven transport analytics
Spatiotemporal data modeling
Interpretable ML for causal inference
Tensor decomposition for ML

...

Directions & Topics



Reproducible Research

- Advancing ML development with open-source research



transdim
(1,200+ GitHub stars)

ML for Transport Data Imputation

<https://github.com/xinychen/transdim>



Tensor Decomposition for ML
(ML initiative)

Math & ML Tutorials

<https://sites.mit.edu/tensor4ml/>



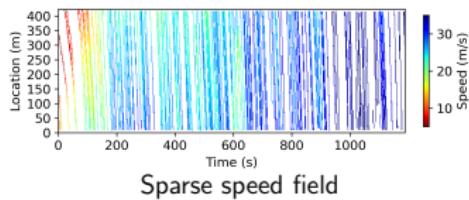
Spatiotemporal data modeling
(Data science initiative)

Model Development of ML & Data Science

<https://spatiotemporal-data.github.io>

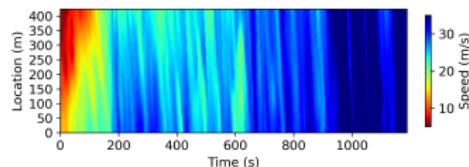
Building Research Impact at Vanderbilt

- CEE collaboration
- Initiatives at Vanderbilt
- College of Connected Computing

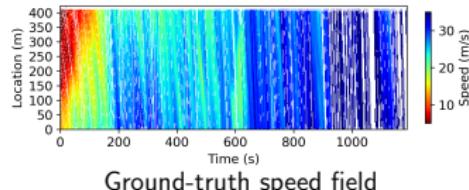


Sparse speed field

LCR-2D



Reconstructed speed field



Ground-truth speed field

- Collaboration & possible contributions

Improve I-24 Motion data quality with imputation

Teaching & Grant