Yuankai Wu, Ph.D.

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Research Interests

1 Spatiotemporal data modeling,

2 Reinforcement learning for transportation control,

3 Connected & automated vehicle highway systems.

Employment History

2019.10 – · · · · **Postdoc Researcher, McGill University,** Department of Civil Engineering.
Advisors: *Prof. Lijun Sun & Aurelie labbe (HEC Montreal)*

2019.06 – 2019.10 **Research associate.** The Joint Research Institute on Internet of Mobility, Southeast Univ. and Univ. of Wisconsin-Madison.

Education

2015 – 2019 **Ph.D., Beijing Institute of Technology**, Vehicle Operation Engineering.
Thesis title: *A high dimensional traffic state processing method based on tensorial model.*
Advisor: *Prof. Hongwen He.*

2016 – 2017 **Visiting Ph.D., University of Wisconsin-Madison**, Department of Civil & Environmental Engineering.
Advisor: *Prof. Bin Ran..*

2012 – 2015 **Master., Beijing Institute of Technology**, Transportation Engineering.
Thesis title: *Short-term traffic prediction based on dynamic tensor completion.*
Advisor: *Prof. Huachun Tan..*

2008 – 2012 **Bachelor., Shanghai Ocean University**, Mechanical Engineering.

Research Publications

700 Google scholar citations, h-index 12; i10-index 12

Journal Articles

1. Li, Q., Tan, H., **Wu, Yuankai***, Ye, L., & Ding, F. (2020). Traffic flow prediction with missing data imputed by tensor completion methods. *IEEE Access*, *8*, 63188–63201.
2. Lian, R., Peng, J., **Wu, Yuankai***, Tan, H., & Zhang, H. (2020). Rule-interposing deep reinforcement learning based energy management strategy for power-split hybrid electric vehicle. *Energy*, 117297.
3. Lian, R., Tan, H., Jiankun, P., Li, Q., & **Wu, Yuankai***. (2020). Cross type transfer for deep reinforcement learning based hybrid electric vehicle energy management. *IEEE Transactions on Vehicular Technology*.
4. **Wu, Yuankai**, Tan, H., Qin, L., & Ran, B. (2020). Differential variable speed limits control for freeway recurrent bottlenecks via deep actor-critic algorithm. *Transportation Research Part C: Emerging Technologies*, *117*, 102649.
5. Wang, Y., Tan, H., **Wu, Yuankai***, & Peng, J. (2020). Hybrid electric vehicle energy management with computer vision and deep reinforcement learning. *IEEE Transactions on Industrial Informatics*.
6. Tan, H., Liang, X., Wu, Z., **Wu, Yuankai**, & Tan, H. (2019). Stochastic resonance in two kinds of asymmetric nonlinear systems with time-delayed feedback and subject to additive colored noise. *Chinese journal of physics*, *57*, 362–374.

7. Tan, H., Zhang, H., Peng, J., Jiang, Z., & **Wu, Yuankai**. (2019). Energy management of hybrid electric bus based on deep reinforcement learning in continuous state and action space. *Energy Conversion and Management*, *195*, 548–560.
8. **Wu, Yuankai**, Tan, H., Chen, X., & Ran, B. (2019). Memory, attention and prediction: A deep learning architecture for car-following. *Transportmetrica B: Transport Dynamics*, *7*(1), 1553–1571.
9. **Wu, Yuankai**, Tan, H., Peng, J., & Ran, B. (2019). A deep reinforcement learning based car following model for electric vehicle., *2*(5).
10. **Wu, Yuankai**, Tan, H., Peng, J., Zhang, H., & He, H. (2019). Deep reinforcement learning of energy management with continuous control strategy and traffic information for a series-parallel plug-in hybrid electric bus. *Applied Energy*, *247*, 454–466.
11. **Wu, Yuankai**, Tan, H., Li, Y., Zhang, J., & Chen, X. (2018). A fused cp factorization method for incomplete tensors. *IEEE transactions on neural networks and learning systems*, *30*(3), 751–764.
12. **Wu, Yuankai**, Tan, H., Qin, L., Ran, B., & Jiang, Z. (2018). A hybrid deep learning based traffic flow prediction method and its understanding. *Transportation Research Part C: Emerging Technologies*, *90*, 166–180.
13. **Wu, Yuankai**, Tan, H., Li, Y., Li, F., & He, H. (2017). Robust tensor decomposition based on cauchy distribution and its applications. *Neurocomputing*, *223*, 107–117.
14. Ran, B., Tan, H., **Wu, Yuankai**, & Jin, P. J. (2016). Tensor based missing traffic data completion with spatial–temporal correlation. *Physica A: Statistical Mechanics and its Applications*, *446*, 54–63.
15. Tan, H., **Wu, Yuankai**, Shen, B., Jin, P. J., & Ran, B. (2016). Short-term traffic prediction based on dynamic tensor completion. *IEEE Transactions on Intelligent Transportation Systems*, *17*(8), 2123–2133.
16. Tan, H., Li, Q., **Wu, Yuankai**, Wang, W., & Ran, B. (2015). Freeway short-term travel time prediction based on dynamic tensor completion. *Transportation Research Record*, *2489*(1), 97–104.
17. Tan, H., **Wu, Yuankai**, Cheng, B., Wang, W., & Ran, B. (2014). Robust missing traffic flow imputation considering nonnegativity and road capacity. *Mathematical Problems in Engineering*, *2014*.
18. Tan, H., **Wu, Yuankai**, Feng, G., Wang, W., & Ran, B. (2013). A new traffic prediction method based on dynamic tensor completion. *Procedia-Social and Behavioral Sciences*, *96*, 2431–2442.

Conference Proceedings

1. Lian, R., Peng, J., **Wu, Yuankai**, Tan, H., He, H., & Wu, J. (2019). Deep reinforcement learning based energy management of hybrid electric vehicles with expert knowledge, In *Icae 2019, the 11th international conference on applied energy*.
2. **Wu, Yuankai**, Tan, H., Peng, J., Li, Y., & He, H. (2019). A deep neuroevolution based energy management strategy for plug–in hybrid electric vehilce, In *Icae 2019, the 11th international conference on applied energy*.
3. Wang, Y., **Wu, Yuankai**, Peng, J., Tan, H., Zeng, D., & He, H. (2019). Vision-aided deep reinforcement learning for energy management of hybrid electric vehicles, In *Icae 2019, the 11th international conference on applied energy*.
4. Tan, H., Zhong, Z., **Wu, Yuankai**, Chen, X., & Zhang, J. (2018). A deep architecture combining cnns and grbms for traffic speed prediction, In *Cictp 2017: Transportation reform and change—equity, inclusiveness, sharing, and innovation*, American Society of Civil Engineers Reston, VA.
5. Tan, H., Wang, P., **Wu, Yuankai**, Zhang, J., & Ran, B. (2016). High-dimension traffic data imputation based on a square norm, In *Cictp 2016*.
6. Tan, H., Xuan, X., **Wu, Yuankai**, Zhong, Z., & Ran, B. (2016). A comparison of traffic flow prediction methods based on dbn, In *Cictp 2016*.

7. Tan, H., Li, Q., **Wu, Yuankai**, Ran, B., & Liu, B. (2015). Tensor recovery based non-recurrent traffic congestion recognition, In *Cictp 2015*.
8. **Wu, Yuankai**, Tan, H., Peter, J., Shen, B., & Ran, B. (2015). Short-term traffic flow prediction based on multilinear analysis and k-nearest neighbor regression, In *Cictp 2015*.
9. Tan, H., **Wu, Yuankai**, Feng, J., Wang, W., & Ran, B. (2014). Traffic missing data completion with spatial-temporal correlations, In *93rd annual meeting of the transportation research board, washington, dc*.

Preprint Articles

1. Li, Q., Tan, H., Jiang, X., **Wu, Yuankai**, & Ye, L. (2020). *Non-recurrent traffic congestion detection with a coupled scalable bayesian robust tensor factorization model*.
2. **Wu, Yuankai**, Zhuang, D., Labbe, A., & Sun, L. (2020). *Inductive graph neural networks for spatiotemporal kriging*.
3. **Wu, Yuankai**, Tan, H., Jiang, Z., & Ran, B. (2019). *Es-ctc: A deep neuroevolution model for cooperative intelligent freeway traffic control*.
4. Xi, C., Shi, T., **Wu, Yuankai**, & Sun, L. (2019). *Efficient motion planning for automated lane change based on imitation learning and mixed-integer optimization*.
5. **Wu, Yuankai**, Tan, H., & Ran, B. (2018). *Differential variable speed limits control for freeway recurrent bottlenecks via deep reinforcement learning*.
6. **Wu, Yuankai**, & Tan, H. (2016). *Short-term traffic flow forecasting with spatial-temporal correlation in a hybrid deep learning framework*.

Patents

Patents

1. Ran, B., Cheng, Y., Li, S., Zhang, Z., Ding, F., Tan, H., **Wu, Yuankai**, Dong, S., Ye, L., Li, X. Et al. (2020). Intelligent road infrastructure system (iris): Systems and methods [US Patent App. 16/776,846].
2. Tan, H., Ding, F., Wang, P., Jiang, Z., **Wu, Yuankai**, & Li, Q. (2020). Traffic big data filling method based on tensor train decomposition model [Chinese Patent App. 202010058620].
3. Tan, H., Ding, F., Wang, P., **Wu, Yuankai**, & Cheng, B. (2020). Tensor data recovery method based on multilinear augmented lagrange multiplier method [Chinese Patent App. 202010061279].
4. Ran, B., Cheng, Y., Li, S., Zhang, Z., Ding, F., Tan, H., **Wu, Yuankai**, Dong, S., Ye, L., Li, X. Et al. (2019). Intelligent road infrastructure system (iris): Systems and methods [US Patent App. 16/135,916].
5. Cheng, Y., Ran, B., Li, S., Zhong, G., Wang, C., **Wu, Yuankai**, Dong, S., & Ye, L. (2019). Connected automated vehicle highway systems and methods for shared mobility [US Patent App. 16/267,800].
6. Tan, H., Li, Q., Ye, L., **Wu, Yuankai**, & Ding, F. (2019). Method for detecting occasional traffic congestion based on tensor recovery [Chinese Patent App. 201910444421].
7. Tan, H., **Wu, Yuankai**, Chen, X., Ye, L., & Li, Q. (2019). Data reconstruction method based on cauthy distribution tensor decomposition [Chinese Patent App. 201910432452].
8. Tan, H., **Wu, Yuankai**, Li, Q., Feng, J., & Chen, X. (2019). Traffic data cleaning method based on tensor recovery [Chinese Patent App. 201910433784].
9. Chen, Y., Ran, B., Li, S., Tan, H., Chen, Z., **Wu, Yuankai**, Lin, P., He, S., Gang, Z. Et al. (2018). Intelligent network connection traffic management system facing mobile sharing [Chinese Patent App. 201810818222].

10 Ran, B., Tan, H., Chen, Y., Chen, Z., Lin, P., Li, S., Zhang, Z., Ding, F., **Wu, Yuankai** Et al. (2018). Intelligent road facility system and control method thereof [Chinese Patent App. 201810287873].

11 Tan, H., Zhou, Y., He, H., Zhong, Z., Li, Q., & **Wu, Yuankai**. (2017). Method and system for preventing tramcars from collision at intersection [Chinese Patent App. 201710247951].

12 Tan, H., Song, L., He, H., **Wu, Yuankai**, Li, Q., & Wang, P. (2016). Fusion tensor filling and tensor recovery data reconstruction method [Chinese Patent App. 201611155058].

Projects Experience

Feb.2020 — · · · · **Ivado Postdoc Funding, (Role: PI. Award CAD 140,000$)**, Deep Spatiotemporal Modeling for Urban Traffic Data.

Dec.2019 — · · · · **Mitacs Canada and Fundway Technology Inc, Role: Investigator**, Develop reinforcement learning platform for traffic signal control based on real-world traffic data and scenarios.

Jan.2018 — Aug.2019 **National Natural Science Foundation of China, key project, Role: Investigator**, Multi-tensor networks for coupled high-dimensional multi-modal big data and its empirical study.

Sep.2012 — Dec.2016 **National Natural Science Foundation of China, Role: Investigator**, Multi-dimensional traffic data completion.

Jun.2018 — Aug.2019 **National Natural Science Foundation of China, Role: Investigator**, Deep reinforcement learning based energy management strategy for plug-in hybrid electric vehicles.

Dec.2016 — Aug.2019 **Research in TOPS lab, University of Wisconsin, Madison, Role: Investigator**, Design and evaluation of Connected and Automated Vehicle & Highway systems.

Jan.2016 — Dec.2017 **SAIC MOTOR open funding, Role: Investigator**, Big data platform for key technologies of electric vehicles.

Jan.2014 — Dec.2015 **Open Fund of State Key Laboratory of Automotive Safety and Energy, Role: Investigator**, Research on anti collision system of vehicle based on video processing.

Jul.2014 — Oct.2014 **Tencent computer system Co. Ltd., Role: Research Internship**, Development of a traffic state prediction method using sparse floating car data.

Honors and Awards

2019 **Second Prize of Chinese Institute of Electronics (ranked 6/10)**.

Nov.2017 **China National Scholarships for PhD student**

Jul.2016 **China Scholarship Council (CSC) scholarships**

Dec.2014 **Best paper reward of the 12th academic conference of Beijing Institute of Technology**

Talks and Presentations

May. 2019 Deep learning for spatiotemporal modeling, Chengdu Normal University, Remote lecture.

Oct. 2019 Control methods for connected automated vehicle & highway systems, Hunan University, Changsha, China.

Jun. 2019 Tensor decomposition and its application on traffic data analysis, Tongji University, Shanghai, China.

A deep reinforcement learning based car following model for electric vehicle, Proceedings of the 2019 World Transport Convention, Beijing, China

Talks and Presentations (continued)

May. 2019	Traffic data analysis and data-driven control for connected and automated vehicle & highway systems, Central South University, Changsha, China.
Jun. 2018	A hybrid deep learning based traffic flow prediction method and its understanding, Central South University, Changsha, China
Apr. 2018	Deep learning method and its application on transportation systems, Beijing Jiaotong University, Beijing, China.
Aug. 2015	Short-term traffic flow prediction based on multilinear analysis and k-nearest neighbor regression, CICTP2015, Beijing, China.
Jan. 2015	Freeway short-term travel time prediction based on dynamic tensor completion, 94th TRB annual meeting, Washington DC, USA.
Nov. 2014	Robust Missing Traffic Flow Imputation Considering Nonnegativity and Road-capacity, Beijing Institute of Technology, Beijing, China.
Jan. 2014	Traffic Missing Data Completion with Spatial–Temporal Correlations, 93rd TRB annual meeting, Washington DC, USA.
Aug. 2013	A new traffic prediction method based on dynamic tensor completion, CICTP2013, Shenzeng, China.

Professional Services

Reviewer

• Transportation Research Part B: Methodological, • Transportation Research Part C: Emerging Technologies, • IEEE Transactions on Intelligent Transportation Systems, • IEEE Transactions on Industry Informatics, • IEEE Internet of Things Journal, • IEEE Transactions on Systems, Man, and Cybernetics: Systems, • Artificial Intelligence in Medicine, • Transactions in GIS, • Journal of Cleaner Production, • Applied soft computing, • International Journal of Electrical Power Energy Systems, • Journal of Advanced Transportation, • IEEE Sensors Journal, • Neurocomputing, • IEEE Access, • Physica A: Statistical Mechanics and its Applications, • Sensors, • Wireless Sensor Network, • Wireless Communications and Mobile Computing, • Mobile Information Systems, • IEEE/CAA Journal of Automatica Sinica, • SN Applied Sciences (SNAS), • Machine Learning and Knowledge Extraction, • World Electric Vehicle Journal, • Electronics, • Energy and AI, • TRB Annual Meeting - Transportation Research Board, • CICTP.

Member

• IVADO: The institute for data valorization, • Mitacs, • China Highway and Transportation Society. • World Transport Convention Standing Committee on Public Transportation Management