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Research Interests

- 1 Spatiotemporal data modeling,
- 2 Reinforcement learning for transportation control,
- 3 Connected & automated vehicle highway systems,
- 4 Smart urban.

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

800+ Google scholar citations, h-index 13; i10-index 14

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 Zhang, H., **Wu, Yuankai***, Tan, H., Dong, H., Ding, F., & Ran, B. (2020). Understanding and modeling urban mobility dynamics via disentangled representation learning. *IEEE Transactions on Intelligent Transportation Systems*.
- 7 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.
- 8 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.
- 9 **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.
- 10 **Wu, Yuankai**, Tan, H., Peng, J., & Ran, B. (2019). A deep reinforcement learning based car following model for electric vehicle., 2(5).
- 11 **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.
- 12 **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.
- 13 **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.
- 14 **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.
- 15 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.
- 16 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.
- 17 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.
- 18 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.
- 19 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 **Wu, Yuankai**, Zhuang, D., Labbe, A., & Sun, L. (2021). Inductive graph neural networks for spatiotemporal kriging, In *Proceedings of the aaai conference on artificial intelligence*.
- 2 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*.
- 3 **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*.

- 4 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*.
- 5 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.
- 6 Tan, H., Wang, P., **Wu, Yuankai**, Zhang, J., & Ran, B. (2016). High-dimension traffic data imputation based on a square norm, In *Cictp 2016*.
- 7 Tan, H., Xuan, X., **Wu, Yuankai**, Zhong, Z., & Ran, B. (2016). A comparison of traffic flow prediction methods based on dbn, In *Cictp 2016*.
- 8 Tan, H., Li, Q., **Wu, Yuankai**, Ran, B., & Liu, B. (2015). Tensor recovery based non-recurrent traffic congestion recognition, In *Cictp 2015*.
- 9 **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*.
- 10 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**, Tan, H., Jiang, Z., & Ran, B. (2019). *Es-ctc: A deep neuroevolution model for cooperative intelligent freeway traffic control*.
- 3 Xi, C., Shi, T., **Wu, Yuankai**, & Sun, L. (2019). *Efficient motion planning for automated lane change based on imitation learning and mixed-integer optimization*.
- 4 **Wu, Yuankai**, Tan, H., & Ran, B. (2018). *Differential variable speed limits control for freeway recurrent bottlenecks via deep reinforcement learning*.
- 5 **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 cauchy 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

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| 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

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| 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

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| Oct. 2020 | Tensor decomposition for spatiotemporal modeling, Shenzhen University, Remote lecture. |
| May. 2020 | 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 |
| 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, Shenzhen, 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, • IEEE Intelligent Systems, • Applied soft computing, • Computers and Operations Research, • 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