Wenyao Liu

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AREAS OF INTEREST

I am a dedicated researcher experienced in improving decision-making by analyzing data with **applied statistics** and **artificial intelligence** techniques. I have hands on experience in developing **pavement materials, dynamic simulation, laser scanning devices**, **segmentation algorithms**, **automated anomaly detection**, and **maintenance decision** based on **life cycle cost analysis (LCCA)**.

- **Multisource Data Application in Transportation**
  - **Management Datasets**: Integrating maintenance records, roadway performance, accidents records, and economic influences for quantifying time, site, and management behavior on the traffic system.
  - **Single Vehicle Data**: Utilizing machine learning techniques to predict roadway features by collecting, processing, and analyzing vehicular data; to detect cracks in the field-collected pavement images.
  - **Connected Vehicle Data**: Visualizing and analyzing connected vehicle data to detect traffic patterns and locations that need optimization; to identify potential factors in improving efficiency.
- **Infrastructure Monitoring and Maintenance**
  - **Life Cycle Cost Analysis (LCCA)**: Building up statistical models comparing the agency cost, user cost, and safety influence between different maintenance methods across the whole service life.
  - **Software Development**: Incorporating the developed models to the existing management and decision-making systems, platforms, or software, depending on the project phases and users.
  - **Hardware Development (to-do)**: Combining techniques from multi-discipline to develop intellectual-owned and automative devices on constructing, monitoring, inspecting, and repairing infrastructure.
- **Pavement Materials and Mechanics**
  - **Modified Binders**: Exploring new materials or additives in producing low-cost, eco-friendly, and long-lasting binders that achieve enhanced engineering performance in emerging transportation scenarios.
  - **Mechanical Simulation:** Applying novel mechanical theories such as peridynamics to simulate cracking or other material defects under traffic loading for revealing better design and construction.

EMPLOYMENT HISTORY

College of Civil Engineering, Hunan University, Changsha, China

Date (from - to):	08/2023 – 08/2024
Position:	Post-doctoral Fellow (Hong Kong Research Talent Hub)
Responsibility:	Conducting research on pavement management decision making based on causal discovery and deep learning algorithm; Participate a project in chiller water pipe leakage detection.

Centre for Advances in Reliability and Safety, Hong Kong SAR, China

Date (from - to):	08/2023 – 08/2024
Position:	Post-doctoral Fellow (Hong Kong Research Talent Hub)

Responsibility: Conducting research on pavement management decision making based on causal discovery and deep learning algorithm; Participate a project in chiller water pipe leakage detection.

Hong Kong Center for Construction Robotics, Hong Kong SAR, China

Date (from - to): 12/2022 – 07/2023
Position: Post-doctoral Fellow
Responsibility: Conducting research, leading a team for entrepreneurship, team management, market research, hardware, and software development, deep learning algorithms development

Oklahoma State University, Stillwater, OK, USA

Date (from - to): 01/2019 – 12/2022
Position: Research (& Teaching) Assistant in College of Civil Engineering
Responsibility: Conducting research, writing project proposals and reports and providing teaching assistance.

EDUCATION

Ph.D. Civil Engineering (01/2019 – 12/2022**)**

University: Oklahoma State University, Stillwater, OK, USA
Specialization: Non-Destructive Evaluation, Statistics, and Machine Learning
Thesis: Data-Driven Pavement Friction and Roadway Safety Management using Statistics and Machine Learning

M.SC. Architecture and Civil Engineering (09/2015 – 06/2018**)**

University: Hunan University, Changsha, China
Specialization: Cracking Mechanism, Sustainable and Reliable Materials
Thesis: Peridynamics-based Simulation of Semi-circular Bending Experiment of Asphalt Mixture at Low Temperatures

B.SC. Civil Engineering (09/2011 – 06/2015**)**

University: Hunan University, Changsha, China
Subjects: Reliability theory of engineering structures

PROFESSIONAL CERTIFICATES

Deep Learning Specialization, Coursera, 2022.06

Statistics for data science and business analysis, Udemy, 2021.12

Python for Data Science and Machine Learning Bootcamp, Udemy, 2021.10

SELECTED PROJECTS

Long Term Performance Monitoring of High Friction Surfacing Treatments (HFST) Sites (2016-2020)

Awarding Authority: Federal Highway Administration, USA
Involvement: Ph.D. Student, Research Assistant
Contributions: Development of **Deep Learning Algorithms** for identifying cracks that involves

1. Assistance in developing l**aser scanning devices.**
2. Field data collection on 36 HFST sites over 12 states in U.S.

3. Leading undergraduates in labeling collected images.
4. Development of **image segmentation** models using **U-net**.
5. Assistance in developing **classification** models using **YOLO**.

Utilizing Pavement Friction and Texture Data for The Reduction of Traffic Crashes and Delays (2018-2022)

Awarding Authority: Oklahoma Department of Transportation, USA
Involvement: Ph.D. Student, Research Assistant
Contributions: Development of **Machine Learning Algorithms** for anomaly detection that involves

1. Data acquisition through OBD port and smartphone sensors.
2. **Signal denoising** and **geographic matching** in data wrangling.
3. Development of **regression models** based on **Random Forest**, **CatBoost**, **LightGBM**, **Weighted Ensemble Model**, etc.
4. Performance evaluation from accuracy and latency aspects.

Development of Pavement **Maintenance Decision Making** Tools **based on LCCA considering Safety Cost** that involves

1. Data wrangling through **Python** and **SQL** on four datasets**.**
2. Development of **deterioration models** with **R** and **statistics**.
3. **LCCA** framework implementation considering **safety cost** variation on different **maintenance strategies**.
4. **Software development** with case study and training tutorials.

PUBLICATIONS

1. **Liu**, **W.**, J. Huang, and X. Zhang*. "Enhance Pavement Management by Integrating Causal Effects in Decision Model: A Case Study on Pavement Friction and Roadway Safety". *Reliability Engineering and System Safety*. (Under Review, **SCI Q1**)
2. **Liu, W.**, J. Q. Li*, G. Yang, and K. C. P. Wang. 2024. "Pavement Safety Characteristics Evaluation Utilizing Crowdsourced Vehicular and Cellular Sensor Data". *Journal of Transportation Engineering Part B: Pavements*. (Accepted, **SCI Q2**, CiteSore 2.8)
3. Zhang X., K Yan, and **W. Liu***. 2023. "Partially Replacing Cement with Rice Husk Ash (RHA) in Cement Stabilized Macadam (CSM) containing Reclaimed Asphalt Pavement (RAP) for Qualified Subbase." *Road Materials and Pavement Design*. https://doi.org/10.1080/14680629.2022.2150275. (**SCI Q1**, h-index 37, CiteSore 6.3, Cited by 1)
4. Wang. G, Yang. G, K. Wang*, J.Q. Li, and **W. Liu**. 2023. Field Condition Evaluation of Pavement with Dry Process Ground Tire Rubber (GTR) in Oklahoma. International Conference on Transportation and Development 2023, Austin, Texas: American Society of Civil Engineers; 2023, p. 445–57. https://doi.org/10.1061/9780784484876.039.
5. **Liu, W.**, J. Q. Li*, G. Yang, K. C. P. Wang, B. Wilson, and X. Yang. 2023. "Long-Term Performance and Safety Implications of High Friction Surfacing Treatments." *Journal of Transportation Engineering Part B: Pavements*, 149(1): 04022073. https://doi/10.1061/JPEODX.PVENG-1073. (**SCI Q2**, CiteSore 2.8)
6. Yang, G, A. Zhang, K. Wang*, J.Q. Li, **W. Liu**, and Y. Liu. 2022. "Deep-learning based non-contact method for assessing pavement skid resistance using 3D laser imaging technology."

International Journal of Pavement Engineering. 1-10. https://doi.org/10.1080/10298436.2022.2147520. (**SCI Q1**, h-index 36, CiteSore 6.5)

7. **Liu, W.**, K. Yan*, and H. Ji. 2022. "Bonding Performance Evaluation on WTR-APAO Composite Modified Asphalt as Waterproof Adhesive Layer for Concrete Bridge." *Construction and Building Materials*, 349: 128667. https://doi.org/10.1016/j.conbuildmat.2022.128667. (**SCI Q1**, h-index 129, CiteSore 10.60, Cited by 1)
8. **Liu, W.**, J. Q. Li*, X. Yang, K. Wang, and W. Yu. 2022. "Integrating Skid Resistance and Safety Benefits into Life Cycle Cost Analysis for Pavement Surface Treatment Selection." *Journal of Transportation Engineering, Part B: Pavements*, 148 (2): 04022015. American Society of Civil Engineers. https://doi.org/10/gpqm2m. (**SCI Q2**, CiteSore 2.8, Cited by 2)
9. Li, J. Q.*, **W. Liu**, X. Yang, P. Lu, and K. C. P. Wang. 2022. "Statistical Safety Performance Models considering Pavement and Roadway Characteristics." *Journal of Advanced Transportation*, 2022: e5871601. Hindawi. https://doi.org/10.1155/2022/5871601. (**SCI Q2**, h-index 34, CiteSore 3.7, Cited by 2)
10. Yang, S., K. Yan*, and **W. Liu**. 2022. "The Effect of Ultraviolet Aging Duration on the Rheological Properties of Sasobit/SBS/Nano-TiO2-Modified Asphalt Binder." *Applied Sciences* 12 (20), 10600. https://doi.org/10.3390/app122010600. (**SCI Q2**, CiteSore 3.6, Cited by 1)
11. Zhu, W., J. Pan, W. Ma*, S. Deng, W. Zhou, **W. Liu**, S. Long, C. Yang, and L. You. 2022. "Dynamic Response of the Heterogeneous Deep-sea Sediment with Nonlinear Gradient Modulus to Mining Machine Loading." *Marine Georesources & Geotechnology*, 40 (3): 255–266. Taylor & Francis. https://doi.org/10/gj8fnc. (**SCI Q2**, h-index 23, CiteSore 4.6, Cited by 4)
12. Yang, G., K. Wang, J. Q. Li*, M. Romero, and **W. Liu**. 2022. "Laboratory and Field Performance Evaluation of Warm Mix Asphalt Incorporating RAP and RAS." *KSCE Journal of Civil Engineering*, 26 (1): 107. https://doi.org/10/gn34vm. (**SCI Q2**, h-index 26, CiteSore 3.7, Cited by 3)
13. Yang, G., K. Wang, J. Q. Li*, G. Wang, **W. Liu**, X. Yang. 2022. "Crash Reduction Benefits of High Friction Surfacing Treatments (HFST)." International Conference on Transportation and Development 2022 (pp. 150-161). https://doi.org/10.1061/9780784484333.014. (Conference Paper)
14. Huang, C, J. Q. Li*, **W. Liu**, X. Yang. 2022. "Evaluating the Impact of Autonomous Vehicles on Traffic Flow at a Stillwater Intersection." International Conference on Transportation and Development 2022 (pp. 51-62). https://doi.org/10.1061/9780784484326.006. (Conference Paper)
15. **Liu, W.**, K. Yan, J. Q. Li*, and S. Yang. 2021. "Peridynamics-based Simulation of Semi-circular Bending (SCB) Testing." *Construction and Building Materials*, 268: 121190. https://doi.org/10/gj74d8. (**SCI Q1**, h-index 129, CiteSore 10.60, Cited by 4)
16. **Liu, W.**, J. Q. Li*, W. Yu, and G. Yang. 2021. "Change-Point Detection Approaches for Pavement Dynamic Segmentation." *Journal of Transportation Engineering, Part B: Pavements*, 147 (2): 06021001. American Society of Civil Engineers. https://doi.org/10.1061/JPEODX.0000270. (**SCI Q2**, CiteSore 2.8, Cited by 2)
17. Yan, K.*, H. Lan, Z. Duan, **W. Liu**, L. You, S. Wu, and M. Miljković. 2021. "Mechanical Performance of Asphalt Rejuvenated with Various Vegetable Oils." *Construction and Building*

Materials, 293: 123485. https://doi.org/10.1016/j.conbuildmat.2021.123485. (**SCI Q1**, h-index 129, CiteSore 10.60, Cited by 20)

18. Yan, K., **W. Liu***, L. You, J. Ou, and M. Zhang. 2021. "Evaluation of Waste Cooling Oil and European Rock Asphalt Modified Asphalt with Laboratory Tests and Economic Cost Comparison." *Journal of Cleaner Production*, 310: 127364. https://doi.org/10.1016/j.jclepro.2021.127364. (**SCI Q1**, h-index 150, CiteScore 15.8, Cited by 17)

19. Li, J. Q.*, K. Wang, S. A. Cross, **W. Liu**, and K. Suitor. 2021. "ODOT Involvement with the NCAT Test Track and Task Groups." International Conference on Transportation and Development 2021 (pp. 215-224). https://doi.org/10.1061/9780784483541.020. (Conference Paper)

20. Yan, K.*, W. He, M. Chen, and **W. Liu**. 2016. "Laboratory Investigation of Waste Tire Rubber and Amorphous Poly Alpha Olefin Modified Asphalt." *Construction and Building Materials*, 129: 256–265. https://doi.org/10.1016/j.conbuildmat.2016.10.090. (**SCI Q1**, h-index 129, CiteSore 10.60, Cited by 44)

21. **Liu, W.**, K. Yan*, D. Ge, and M. Chen. 2018. "Effect of APAO on the Aging Properties of Waste Tire Rubber Modified Asphalt Binder." *Construction and Building Materials*, 175: 333–341. https://doi.org/10/gj74fb. (**SCI Q1**, h-index 129, CiteSore 10.60, Cited by 41)

22. Liu, J., K. Yan*, **W. Liu**, and X. Zhao. 2020. "Partially Replacing Styrene-Butadiene-Styrene (SBS) with Other Asphalt Binder Modifier: Feasibility Study." *Construction and Building Materials*, 249: 118752. https://doi.org/10.1016/j.conbuildmat.2020.118752. (**SCI Q1**, h-index 129, CiteSore 10.60, Cited by 15)

PATENTS

1. **Wenyao Liu** (2018). Bike Saddle Capable of Being Turned Over for Replacement. China Invention Patent.
2. **Wenyao Liu** (2016). A Moving-object Article Management System. China Unity Model Patent.

TECHNICAL REPORTS

1. Joshua Q. Li, Kelvin C. P. Wang, **Wenyao Liu**, and Wenying Yu. 2021. "Utilizing Pavement Friction and Texture Data for the Reduction of Traffic Crashes and Delays." Final Report FHWA-OK-21-01 (SP&R 2309). Oklahoma Department of Transportation (ODOT), Oklahoma City, OK.
2. Joshua Q. Li, Kelvin C. P. Wang, Wenying Yu, **Wenyao Liu**. 2020. "Continuous Friction Measurement Equipment (CFME) for Highway Safety Management in Oklahoma." Final Report FHWA-OK-20-02 (SP&R 2306). Oklahoma Department of Transportation (ODOT), Oklahoma City, OK.

SOFTWARE SKILLS

1. Excellent programming skills developed by working with **Python**, **R** and **SQL**.
2. Command on python-based machine learning and deep learning libraries developed through working with Scikitlearn, **TensorFlow** and **Pytorch**.
3. Capability of GUI software development using **VBA**, **C++** and **QT** developed through projects.
4. Excellent command on MS Office toolset (Word, Excel and Power Point) developed through academic writing and project presentations.

5. Quick command on other supporting software such as Photoshop, Premiere, Blender, etc.

SOCIAL AND OGANIZATIONAL SKILLS

1. Excellent problem solving, communication, interpersonal, leadership and presentation skills (developed through project presentations and working in international teams).
2. Very good command on English report writing and communications (developed through projects progress report writing, publishing scientific articles, and presenting at research conferences).
3. Self-motivated person capable of working under pressure.

REPRESENTATIVE HONORS

1. Best Poster Award — Oklahoma City, OK. Oct. 2020

   Wenyao Liu, Joshua Li, Guangwei Yang, Xue Yang, and Kelvin C. P. Wang. "Utilizing Pavement Friction Data for the Reduction of Traffic Crashes and Delays." 2020 Oklahoma Transportation Research Day.

2. Outstanding Graduate of Hunan University and Human Province — Changsha, China. Jun. 2018
3. National Scholarship for Graduate Student — China. Sep. 2016

PROFESSIONAL SERVICES

1. Reviewer for
   - Automation in Construction (SCI Q1, CiteScore 15.0)
   - International Journal of Pavement Engineering (SCI Q1, CiteScore 6.5)
   - Journal of Materials in Civil Engineering (SCI Q1, CiteScore 5.5)
   - Journal of Infrastructure Systems (SCI Q2, CiteScore 4.3)
   - Advances in Data Science and Adaptive Analysis
   - TRB Annual Meeting
2. Teaching assistant on
   - CIVE-3633-20472 Transportation Engineering Spring 2022
   - CIVE-3633-60636 Transportation Engineering Fall 2019

REFERENCES

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* Additional references available upon request