Zhihao Wang

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Education

University of Maryland *Ph.D., Geographical Information Science; GPA: 3.84* **2020 – 2025 (Expected)**

The Ohio State University *M.A., Geography; GPA: 4.00* **2018 – 2020**

University of Waterloo *B.E.S., Honors Geomatics; Minor, Computer Science; GPA: 3.91* **2016 – 2018**

Wuhan University *B.E., Remote Sensing Science and Technology; GPA: 3.82* **2014 – 2018**

Research Projects

Advanced Physics-Guided Deep Learning | *Python, TensorFlow* **Sep. 2021 – Present**

- *Proj. 1*: Developing a deep-learning framework for predicting global carbon stocks and fluxes in the NASA's Earth Information System. Technology contributions cover: (1) a robust **spherical Fourier Neural Operators** framework for accelerating **PDEs** in numerical models and accurately representing Earth's surface conditions; (2) a **knowledge-informed neural network** for generating more reliable predictions across various spatial and temporal scales, particularly in few-shot conditions; (3) a **statistics-guided learning network partitioning** strategy to reduce heterogeneous data from globally collected data.
- *Proj. 2*: Developed Deep-ED, a framework approximating and accelerating long-term projections of a process-based ecological model. Key achievements include: (1) **a de-sequencing and multi-scale structure** for achieving approximately a 62% reduction of error accumulation in long-term forecasting; (2) **a self-guided learning strategy** to mitigate heterogeneous variable effects; and (3) **a geo-physical active learning algorithm** to enhance sampling efficiency.
- *Proj. 3*: Created SimFair, a **physics-guided** and **fairness-aware** deep learning model for temperature estimations. Novelties include: (1) proposing an **inverse-modeling design** to guide traditional data-driven predictions to align with natural laws through (53% RMSE improvement); (2) integrating **the law of energy conservation** from radiative transfer models into the learning process; and (3) achieving greater prediction fairness by 73% in new test regions through a dual-fairness consistency loss.
- *Proj. 4*: Designed a U-Net based deep segmentation model for building detection from LiDAR point clouds. The model outperforms other competitors because of (1) **using knowledge-informed features** for more stable and generalizable building representations, and (2) applying **training- and test-time augmentation** with statistical filtering strategies for refined detection.

Cloud-Based Data Generation & Satellite Image Classification | *Google Earth Engine* **Jan. 2019 – Dec. 2022**

- Designed a **cloud-based automation pipeline** for extracting spatially and temporally intersected pairs of satellite imagery, enabling the generation of extensive deep learning training datasets on a global scale for long-term analysis.
- Parallelly computed **100k+** raw satellite images for computing spatial and temporal intersections in Apache Sedona.
- Designed a **Markov Random Field**-based algorithm to optimize time-series classification consistency using Javascript in GEE, enhancing the accuracy by integrating environmental change principles into the classification process.

Selected Publications

- **Wang, Z.**, Xie, Y., Li, Z., Jia, X., Jiang, Z., Jia, A., & Xu, S. SimFair: Physics-Guided Fairness-Aware Learning with Simulation Models. In Proceedings of the AAAI Conference on Artificial Intelligence. AAAI'24.
- **Wang, Z.**, Xie, Y., Jia, X., Ma, L., & Hurtt, G. High-Fidelity Deep Approximation of Ecosystem Simulation over Long-Term at Large Scale. ACM SIGSPATIAL'23. **(Oral)**.
- Chen, W.*, **Wang, Z.***, Li, Z.*, Xie, Y., Jia X., & Li, A. Deep Semantic Segmentation for Building Detection Using Knowledge-Informed Features from LiDAR Point Clouds. ACM SIGSPATIAL'22. **(Top-3 Solution**).

Skills

Languages: Python, MATLAB, R, JavaScript, C++/C, SQL
Tools/Libraries: TensorFlow, PyTorch, Google Earth Engine and Cloud Platform, Apache Sedona, Linux, Git, ArcGIS
Coursework: Machine Learning, Neural Networks, Computer Vision, Biogeography-Environmental Change, linear algebra

Honors and Awards

- Top-3 Competition Winner & Travel Grant, ACM SIGSPATIAL CUP 2022, 2023
- Dean's Fellowship, University of Maryland 2020
- Dean's Honor List & Entrance Scholarship, University of Waterloo 2016, 2017, 2018
- Wuhan University Scholarship, 5050 Scholarship, Wuhan University 2016