Ting-Yu Dai

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Education

Ph.D. Candidate in Sustainable System, *University of Texas at Austin* — Austin, TX *2021 - Present*
Advisors: Prof. Dev Niyogi & Prof. Zoltan Nagy

MSc in Computer-Aided Engineering, *National Taiwan University* — Taipei, Taiwan *2019 - 2021*

BS in Civil Engineering, *National Chiao Tung University* — Hsinchu, Taiwan *2015 - 2019*

Research interests

- **Machine Learning**
  Generative Model, Diffusion Model, Self-supervised Learning, Transformer
- **Climate Change**
  Building Energy Modeling, Climate Modeling, Digital Twin

Research Projects

PrecipDiff: Leveraging diffusion models to enhance satellite-based precipitation – *Diffusion, Downscaling*

[AAAI 2025] The study introduces the first diffusion model for correcting discrepancies among precipitation data, enabling downscaling of satellite estimates from 10 km to 1 km resolution. Experiments in Seattle indicate notable improvements in accuracy and spatial detail, highlighting the efficacy of a computer vision-based approach to enhance precipitation data from satellites. *Feb. 2025*

CityTFT: Temporal Fusion Transformer for Urban Building Energy Modeling – *Transformer, Energy*
[NeurIPS 2023], Extended to [Applied Energy] Established a temporal fusion transformer to model urban energy demands as a surrogate model for traditional physic-based UBEM methods. CityTFT reached **40 times** faster to simulate compared to the physics-based model and **6 times** more accurately compared to classic RNN and transformers while predicting in an unseen climate dynamic. (F1 score of **99.98 %** while RMSE of loads of **13.57 kWh**.) *Oct. 2023*

UTwin: A digital twin of the UT Campus – *Digital Twin, Software Engineering* **[BuildSys 2023]**
Presented a preliminary digital twin of the UT Austin campus focused on building energy use, integrating various geospatial datasets. Developed a platform to integrate and visualize data from multiple sources like live feeds, historical data, and forecasts. *Nov. 2023*

Analyzing the impact of COVID-19 on the electricity demand in Austin, TX using an ensemble-model based counterfactual and 400,000 smart meters – *Ensemble Model, Social Science, Building Energy*
[Urban Computational Science] Applied a large-scale private smart meter electricity demand data from **the City of Austin**, combined with publicly available environmental data, and develops an ensemble regression model for long-term daily electricity demand prediction. *Dec. 2022*

Generating High-Resolution PM2.5 using a Two-stage Machine Learning Approach with Low-Cost Air Quality Sensors and Satellite Observations – *Data Fusion, Air Quality, Remote Sensing* **[REF]**
[AGU2022 Oral] Developed a two-stage machine learning method to create **a ground-level PM2.5 grid dataset** by calibrating LCS and using the calibrated PM2.5 to fuse with HRRR(Meteorological data) and AOD values. *Dec. 2022*

Modelling high-resolution rainfall extremes in a changing climate – *Self-Attention, Rainfall Extremes* **[REF]**
[MSc Thesis][EGU2021] Implemented an ML-based approach to bridge climate reanalysis data and local rainfall statistics and predicted future rainfall patterns based on future climate. *Apr. 2021*

Research and Industry Experience

Fujitsu Research of America San Jose, California
Research Intern – Diffusion, Downscaling *May. 2024 - Aug. 2024*

- Working in Converging Technology Lab for a digital climate project
- Developed **PrecipDiff**, a novel deep learning framework that leverages diffusion models to **correct biases** and significantly **enhance the resolution** of satellite-based precipitation data.
- This computer vision-based approach is the **first** to use a diffusion model to resolve inconsistencies between satellite and radar data by learning the residual difference between them.
- The model successfully downscales precipitation estimates **from 10 km to a 1 km**, **reducing the Root Mean Squared Error (RMSE) by over 67%** compared to the original satellite data and improving its quality for weather forecasting.

NASA, Universities Space Research Association (USRA) Huntsville, Alabama
Research Intern – machine learning, air quality, geospatial data *May. 2022 - Aug. 2022*

- Working with the **NASA Marshall Space Flight Center** research team for a Citizen Science Project.
- Utilized PurpleAir sensor in San Francisco and Los Angeles and developed a machine learning model to calibrate the LCS measurements with the federal equivalent methods which **decrease the MSE from 6.38 to 0.11**.
- Designed a data fusion method to merge meteorology and AOD data into the ground-level PM2.5 concentration and generated an urban gridded PM2.5 dataset in both SF and LA area that contains **over 134 million data points.**

Teaching Experience

National Taiwan University Taipei, Taiwan
Teaching Assistant – Computational Statistics for Data Analytics (CIE5140) *Sep. 2020 - Jan. 2021*

- Assisted Prof. Li-Pen Wang in teaching a upper-level course on data science applications in engineering.
- Conducted weekly office hours and provided support for students on assignments and projects.
- Developed supplementary materials for open data and public geospatial data to enhance students' understanding of data science concepts.

JOURNAL PUBLICATIONS

[1] **Dai, T.-Y.**, Niyogi, D., Nagy, Z. "CityTFT: A temporal fusion transformer-based surrogate model for urban building energy modeling". In: *Applied Energy* 389 (2025), p. 125712.
[2] **Dai, T.-Y.**, Radhakrishnan, P., Nweye, K., Estrada, R., Niyogi, D., Nagy, Z. "Analyzing the impact of COVID-19 on the electricity demand in Austin, TX using an ensemble-model based counterfactual and 400,000 smart meters". In: *Computational Urban Science* 3.1 (2023), p. 20.

CONFERENCE PUBLICATIONS

[1] **Dai, T.-Y.**, Ushijima-Mwesigwa, H. "PrecipDiff: Leveraging image diffusion models to enhance satellite-based precipitation observations". In: *Proceedings of the AAAI Conference on Artificial Intelligence*. Vol. 39. 27. 2025, pp. 27932–27939.
[2] **Dai, T.-Y.**, Dilsiz, A. D., Niyogi, D., Nagy, Z. "A comparison of different deep learning model architectures and training strategy for urban energy modeling". In: *Proceedings of the 10th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*. 2023, pp. 316–317.
[3] Lin, C., **Dai, T.-Y.**, Dilsiz, A. D., Crawley, D., Niyogi, D., Nagy, Z. "UTwin: A digital twin of the UT Austin campus". In: *Proceedings of the 10th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*. 2023, pp. 282–283.
[4] **Dai, T.-Y.**, Wang, L.-P. "Modelling high-resolution rainfall extremes in a changing climate". In: *EGU General Assembly Conference Abstracts*. 2021, EGU21–2436.
[5] Wang, L.-P., **Dai, T.-Y.**, He, Y.-T., Chou, C.-C., Onof, C. "pyBL: An open source Python package for stochastic high-resolution rainfall modelling based upon a Bartlett Lewis Rectangular Pulse model". In: *EGU General Assembly Conference Abstracts*. 2021, EGU21–8557.

Professional Service

Conference Workshop Reviewer Workshops on Tackling Climate Change with Machine Learning
ICLR 2024, NeurIPS 2024, ICLR 2025, NeurIPS 2025 *2023 - Present*

- Reviewed workshop papers for conferences in NeurIPS and CVPR.

Peer-reviewed Journal Reviewer

- Environmental Data Science
- Journal of Parallel and Distributed Computing

Awards & Honors

- **Kolodzey Travel Grant** Spring 2025
The 39th Annual AAAI Conference on Artificial Intelligence *Philadelphia, PA*

- **George J. Heuer, Jr. Ph.D. Endowed Graduate Fellowship Fund** Fall 2024
Graduate Fellowship *Austin, TX*