VU ANH LE

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RESEARCH INTERESTS

Physics-Informed Machine Learning, Hybrid Machine Learning, Autonomous Scientific Discovery, Numerical Methods for Solving Differential Equations, Evidence-Based Decision-Making

EDUCATION

Beloit College Beloit, WI
Bachelor of Science, Mathematics
Relevant Coursework: Discrete Mathematics, Linear Algebra, Mathematical Statistics, Differential Equations, Complex Analysis, Object-oriented Programming, Data Structures and Algorithms, Mathematics Colloquium

AWARDS AND HONORS

Presidential Scholarship, Beloit College, Awards 48,000 USD annually *Aug 2021 - May 2025*
Board of Trustees Grant, Beloit College, Awards 10,000 USD annually *Aug 2021 - May 2025*
Dean's list, Beloit College *Every semester*
MIT Summer Research Program, Massachusetts Institute of Technology *June 2024*
Weissberg Human Rights Grant, Weissberg Foundation, Awards 1,000 USD *March 2024*
Semi Finalist, InSPiR2eS Global Pitching Research Competition 2023 (IGPRC 2023) *Jan 2024*
Station1 Frontiers Fellowship, Massachusetts Institute of Technology, Awards 13,500 USD *June 2023*
National Research Grant, Vietnam's Ministry of Finance, Awards 10,000 USD *Jan 2023*
Friends of UTokyo Scholarship, The University of Tokyo, Awards 4,000 USD *Jun 2022*

ARTICLES AND PREPRINTS

1. Vu, Thi Phuong Thao, Dang, Truong Giang, and **Le, Vu Anh**. "Reliability Assessment of Land Subsidence Monitoring Results Using PSI Technique in Ho Chi Minh City, Vietnam." *International Journal of Environmental Studies 81,* no. 2 (March 3, 2024): 881–95. **[Journal Article]**

2. Vu, Thi Phuong Thao, **Le, Vu Anh**, and Kalibbala, Martin. "Estimating the impact of climate change on flood-flow patterns into the Ban Chat Reservoir, Northern Vietnam." *Accepted for publication.* **[Preprint]**

RESEARCH EXPERIENCE

Google Research Remote
Research Intern *Aug 2024 - Present*

- **Research Advisors: [Jake Garrison (Google Research)]** and **[Prof. Mehmet Dik (Beloit College)]**.
- **Project:** Developed a novel neural operator to solve partial differential equations, with the goal of reducing both time complexity and computational expense. Proposed this project as part of my senior thesis for the math major at Beloit College.
- **Methods and Results:** Selected the hierarchical neural operator framework after benchmarking over 10 popular models in the same class, such as Fourier Neural Operator and DeepONet. Integrated physical law modules, including efficient equations like the conservation of mass, to reduce prediction loss while approximating solutions to coefficients. Compared to other benchmarked models, this approach required 15% fewer epochs to reach convergence and achieved 93% accuracy on a high-contrast, challenging dataset like **[ConDiff]** **[Update Link Here]**.

Massachusetts Institute of Technology Cambridge, MA
Research Assistant, Department of Nuclear Science and Engineering *Aug 2023 – Present*
Intern, MIT Summer Research Program - General *June 2024 - Aug 2024*
Intern, MIT Summer Research Program - Extension, School of Engineering *Sep 2024 - Nov 2024*

- **Research Advisor: [Prof. Haruko Murakami Wainwright].**
- **Project:** Assessed the time frame of contaminant attenuation to support long-term monitoring strategies in the local watersheds near the Savannah River Site, a Department of Energy-owned nuclear materials Superfund facility. Analyzed the impact of factors such as aquifer and well depth on contaminant mobility.
- **Methods and Results:** Extended the PyLEnM package for contamination analysis with a framework consisting of: (1) linear regression to predict the time-to-MCL (maximum concentration limit), (2) random forest regression to identify key factors affecting time-to-MCL, and (3) a Bidirectional LSTM model to predict near-future concentrations over the next several years, thereby enhancing prediction accuracy and reducing on-site field sampling intervals. Primarily results indicate that the Random Forest model achieved an average prediction accuracy of 97.7% for time-to-MCL across all wells, while the Bidirectional LSTM demonstrated a maximum prediction time-interval accuracy of 4 years **[Update Link Here]**.

Vietnam's Ministry of Natural Resources and Environment Hanoi, Vietnam
Research Assistant and Compliance Reporter, Remote Sensing Department *April 2020 - Present*

- **Research Advisor: [Dr. Le Quoc Hung].**
- **Project:** Monitored human-induced land deformation processes and accessing the impact of human activities such as operations of hydroelectric power plants in Vietnam territories.
- **Methods and Results:** Established image networks using Synthetic Aperture Radar (SAR) data to monitor ground movements. Performed interferometric processing to analyze phase shifts and reveal land deformation patterns. Developed models for primary and secondary displacement and employed kriging, a geostatistical technique, to validate displacement maps. Utilized finite element methods to simulate deformation processes resulting from groundwater extraction, hydraulic fracturing, and mining activities. Despite data limitations, the approach achieved a 1-meter accuracy range in the generated images **[Full Article]**.

Massachusetts Institute of Technology Remote
Summer Fellow, Station1 Frontiers Fellowship *June 2023 - Aug 2023*

- **Research Advisor: [Prof. Christine Ortiz].**
- **Project:** Applied the Life Cycle Assessment (LCA) methodology to quantify the environmental benefits of biodegradable materials compared to traditional polymers, with a specific focus on polylactic acid as an alternative to PVC.
- **Methods and Results:** Employed the ReciPe model for LCA, which uses impact assessment methods and normalization factors to translate various environmental impacts into a set of sub-scores. The primary results indicated that approximately 4.57 kilograms of carbon emissions can be mitigated for each unit of packaging produced **[Full Report]**.

University of Tokyo Kashiwa, Chiba, Japan
Summer Intern, Graduate School of Frontier Sciences *April 2022 - Aug 2022*

- **Research Advisor: [Prof. Frith Martin].**
- **Project:** Developing a sorting algorithm to identify orthologous regions in genomic datasets, aiming to uncover different disease mechanisms e.g. asthma. Orthologous regions are genes with similar sequences and functions across different species.
- **Methods:** Designed the algorithm utilizing dynamic programming and hidden Markov models (HMM) to enhance accuracy and efficiency of ortholog identification. Implemented maximum likelihood estimation (MLE) for parameter tuning in HMM, optimizing its performance.

ADDITIONAL EXPERIENCE

Legal Initiatives of Vietnam Remote
Paralegal Assistant *Dec 2023 - Present*

- Conduct legal research on the current political strategies and policies implemented by Vietnamese authorities.
- Publish opinions on critical political issues via the affiliated newspaper "Luat Khoa Tap Chi".

Beloit Math and CS Club Beloit, WI
Co-founder and President *Aug 2021 - May 2023*

- Updated students on field-related opportunities such as research projects, internships, and employment.
- Set preparatory sessions for undergraduate competitions like the Mathematical Contest in Modeling and Putnam

Beloit College Beloit, WI
Division III Athlete, Cross Country Team *Aug 2021 - May 2023*

RECENT PRESENTATIONS

1. Le, Vu Anh. "Extension of PyLEnM: Machine Learning Approaches for Assessing the Site Closure Time Frame for Soil and Groundwater Contaminated Sites.

- AGU Annual Meeting 2024 at Washington D.C., *American Geophysical Union*, Dec 2024
- Midstates Physical Sciences, Mathematics and Computer Science Undergraduate Research Symposium, *University of Chicago*, Nov 2024
- Beloit and Beyond Conference, *Beloit College*, Nov 2024
- MIT summer Research Program Conference, *Massachusetts Institute of Technology*, Aug 2024

2. Le, Vu Anh. "Reliability Assessment of Land Subsidence Monitoring Results Using PSI Technique in Ho Chi Minh City, Vietnam.

- Midstates Physical Sciences, Mathematics and Computer Science Undergraduate Research Symposium, *University of Chicago*, Nov 2023
- Beloit College STEM Poster Session, *Beloit College*, Sep 2023

3. Le, Vu Anh. "Life Cycle Assessment of Biodegradable Plastic Packaging Subject to Comprehensive Organic Sorting.

- Midstates Biological Sciences and Psychology Undergraduate Research Symposium, Washington University at St. Louis,
  American Physician Scientist Association - Midwest Regional Meeting, Saint Louis University School of Medicine, Oct 2023
- Beloit College STEM Poster Session, *Beloit College*, Seo 2023
- Station1 Frontier Fellowship Capstone Poster Event, *Station1*, Aug 2023

SKILLS

Programming and Software: Python, Java, MATLAB, R, LaTeX, QGIS, PostgreSQL, PostGIS, ArcGIS
Libraries and Frameworks:

- ***Python:*** NumPy, SciPy, TensorFlow/PyTorch, Keras, scikit-learn, SymPy, Theano, JAX, Dask, Cvxpy, PySPH, Pyomo, pymc3, xarray, Numba, mpi4py, Matplotlib, SciencePlots, Pandas, SimPy, geopandas, shapely, Fiona, SEABORN, rasterio, Brigthway2, PyLEnM, folium
- ***MATLAB:*** Simulink, Optimization Toolbox, Global Optimization Toolbox, Parallel Computing Toolbox, Partial Differential Equation Toolbox, Symbolic Math Toolbox, Statistics and Machine Learning Toolbox, Deep Learning Toolbox, Image Processing Toolbox, Curve Fitting Toolbox
- ***R:*** Matrix, pracma, deSolve, nloptr, minipack.lm, rootSolve, caret, foreach, xgboost, ggplot2, dplyr, tidyr

REFERENCES

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