PEILUN (TOMMY) LI

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Biography

I am a Computer Science Ph.D student advised by Prof.Thomas Beckers at Vanderbilt University, where I was selected as Russel G. Hamilton Scholar. I am passionate about understanding and developing smarter robotic and embodied intelligence systems through machine learning with reliability, generalizability, and interpretability.

Research Interests: Machine Learning, Robotics, Uncertainty Quantification.

Education

Vanderbilt University   **Aug 2025 – May 2029**
Ph.D in Computer Science   ***GPA:*** *NA*/4.00

- **Research advisors**: Prof.Thomas Beckers

Vanderbilt University   **Aug 2021 – May 2025**
B.S. in Computer Science (Hons) and Mathematics (Hons) (Double Majors)   ***GPA:*** 3.924/4.00

- **Research advisors**: Prof.Thomas Beckers, Prof.Glenn Webb
- **2025 CRA Outstanding Undergraduate Researcher Award Honorable Mentions**
- **Selected coursework**: numerical linear algebra, numerical modeling with differential equations, real and complex analysis, (scientific) machine learning, statistical inference and probability, topology, discrete math.

Publications

1. **P.Li**, K.Tan, and T.Beckers. "NAPI-MPC: Neural Accelerated Physics-Informed MPC control for nonlinear PDE systems". 7th Conference on Learning for Dynamics and Control (**L4DC**). 2025.
2. K.Tan, **P.Li**, J.Wang, and T.Beckers. "PnP-PIML: Physics-informed Learning of Outlier Dynamics using Uncertainty Quantified Port-Hamiltonian Models". In: Proceedings of the 2025 IEEE International Conference on Robotics and Automation (**ICRA**), 2025.
3. **P.Li**, K.Tan, and T.Beckers. "PyGpPHs: A Python Package for Bayesian Modeling of Port-Hamiltonian Systems". In: Proceedings of the 8th IFAC Workshop on Lagrangian and Hamiltonian Methods for Nonlinear Control (**LHMNC**). 2024.
4. K.Tan, **P.Li**, and T.Beckers. "Physics-Constrained Learning for PDE Systems with Uncertainty Quantified Port-Hamiltonian Models". In: Proceedings of the 6th Conference on Learning for Dynamics and Control (**L4DC**). 2024.

Research Experiences

Department of Computer Science, Vanderbilt University   **May 2023 – Present**
Research Assistant, VUSE Summer Fellowship '23 '24   *Nashville, TN*

- Project topics: Physics-Informed Bayesian Modeling, Uncertainty Quantification on Cyber-Physical Systems
- Collaborator: Kaiyuan Tan (Ph.D. Student); Mentor/PI: Prof.Thomas Beckers

- Currently leading projects that involve physics-informed autoencoder and model-based Reinforcement Learning (RL).
- Proposed and developed physics-informed, Scenario-based Model-Predictive Control [1], and outlier dynamics detection algorithms based on conformal prediction [2]. Projects resulted in 2 paper under review at L4DC and accepted by ICRA.
- Designed, developed, and maintained PyGpPHs, a Python package based on GP-PHS (Gaussian Process port-Hamiltonian System), that shows high accuracy, efficiency, and generalizability in modeling non-linear dynamics. This project resulted in a publication [3] in the IFAC workshop on LHMNC and a public, well-maintained toolbox.
- Studied and expanded Bayesian modeling approaches to distributed Port-Hamiltonian System (dPHS). Collaborated in implementing GP-dPHS models. This project culminated in a publication [4] in the L4DC conference.

Department of Mathematics, Vanderbilt University   **Jan 2023 – May 2023, Aug 2024 – Present**
Research Assistant   *Nashville, TN*

- Project: Math Modeling of Disease Biology with Systems of Ordinary and Partial Differential Equation (ODE and PDE)
- Mentor/PI: Prof.Glenn Webb

- Currently exploring the models of vaccine hesitation and analyzing mathematical properties of such models.
- Studied mathematical theories of disease modeling with ODEs and PDEs. Developed theory and constructed population age-structured, compartmentalized systems of ODEs that considers social contacts. Presented my findings and system of ODEs at Shanks Workshop on mathematical biology.

Data Science Institute, Vanderbilt University
Research Assistant

Jan 2023 – May 2023
Nashville, TN

- Project: Dialogic Questioning AI Product Using GPT Models for Improving Reading Comprehension among Children
- PI: Prof.Jesse Spencer-Smith, Dr.Umang Chaudhry

- Improved performance of a interactive dialogic questioning product based on ChatGPT through prompt and fine tuning.

Vanderbilt University Medical Center
Research Assistant

Aug 2022 – Feb 2023
Nashville, TN

- Project: Identification of Geometry-Defining Protein sub-chains using Neural Networks
- PI: Dr.Richard Stein, Prof.Hassane Mchaourab

- Studied basics of protein biology and neural networks, utilized tools like Alpha-fold, protein library, and dimension reduction to engineer a learning framework for identifying and analyzing geometry-defining protein sub-chain.

Teaching Experiences

Department of Computer Science, Vanderbilt University
Teaching Assistant and Grader

Aug 2022 – Present
Nashville, TN

- CS4262/5262: Foundation of Machine Learning, Fall 2024
- CS3251/5251: Intermediate Software Design, Fall 2023, Spring 2024
- CS/DS1100: Applied Programming and Problem Solving with Python, Fall 2022

Department of Mathematics, Vanderbilt University
Teaching Assistant and Grader

Aug 2024 – Present
Nashville, TN

- Math3630/5630: Mathematical Modeling in Biology and Medicine, Spring 2025
- Math3620/5620: Intro to Numerical Math, Fall 2024

Presentations

16th World Congress on Computational Mechanics (WCCM)
Oral Presententation

Jul 2024
Vancouver, British Columbia

- Presented our paper on PyGpPHs toolbox for Bayesian Modeling of Port-Hamiltonian Systems
- Presented our paper on Physics-Constrained Learning for PDE Systems with Uncertainty Quantified PHS

Institute for Software Integrated System (ISIS) 25th Anniversary Celebration
Poster Presentation

Aug 2023
Nashville, TN

- Presented our recent work on "Bayesian Physics-Informed Models for Soft Robotics."

Shanks Workshop on Advances in Theoretical Biology and Mathematical Biology
Poster Presentation

Mar 2023
Nashville, TN

- Presented my work on Age-Structured Systems of Ordinary Differential Equation Modeling on COVID-19.

Awards and Honors

University Graduate Fellowship & Russel G.Hamilton Scholarship ($5000)
Vanderbilt University

Aug 2025

- Awarded by both the Graduate School and Graduate Education and Research Endowment to highly qualified students intending to pursue the Ph.D. degree.

CRA Outstanding Undergraduate Researcher Award Honorable Mentions
Computing Research Association (CRA)

Dec 2024

- Placed me among highly selected group of **fewer than 200 in North America** for excellence in research. I was nominated for the award as **1 of the top 4** undergraduates by the Department of CS at Vanderbilt University.

VUSE-ISIS Summer Research Fellowship ($8000)
Vanderbilt University

Mar 2024

School of Engineering Research Travel Grant ($500)   **Feb 2024**
Vanderbilt University

Tennessee Beta Chapter of Tau Beta Pi (TBP) at Vanderbilt University   **Dec 2023**
Tau Beta Pi (TBP)
- Award extended to undergraduate engineering majors who are in the top 12.5% of Class of 2025.

School of Engineering Award Undergraduate ($5000)   **May 2023**
Vanderbilt University
- Scholarship award to 40 excelling undergraduate students in the School of Engineering.

American Mathematics Competition Honor Roll   **Feb 2021**
AMC10, AMC12
- Achieved top 5% score in the AMC 12 competition and AMC 12 Honor Roll; qualified for AIME.