PEILUN (TOMMY) LI

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Biography

I am a senior undergraduate student pursuing double majors in Computer Science (Honors track) and Mathematics (Honors track) at Vanderbilt University. I am passionate about understanding and developing novel data-driven approaches to analyze Cyber-Physical Systems with reliability, generalizability, and interpretability.

Research Interests: Physics-Informed Learning, Uncertainty Quantification, Machine Learning, Robotics.

Education

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. 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. (**Accepted, to appear**)

2. **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.

3. 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.

4. **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. (**under review**)

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 [4], and outlier dynamics detection algorithms based on conformal prediction [1]. Projects resulted in 2 paper under review at L4DC and acepted 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 [2] 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 [3] 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   Jan 2023 – May 2023

Research Assistant   *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   Aug 2022 – Feb 2023

Research Assistant   *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   Aug 2022 – Present

Teaching Assistant and Grader   *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   Aug 2024 – Present

Teaching Assistant and Grader   *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)   Jul 2024

Oral Presentation   *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   Aug 2023

Poster Presentation   *Nashville, TN*

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

Shanks Workshop on Advances in Theoretical Biology and Mathematical Biology   Mar 2023

Poster Presentation   *Nashville, TN*

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

Awards and Honors

CRA Outstanding Undergraduate Researcher Award Honorable Mentions   Dec 2024

Computing Research Association (CRA)

- 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)   Mar 2024

Vanderbilt University

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.