Wei Liang, P.E., Ph.D.

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Education

Carnegie Mellon University — Pittsburgh, PA

Ph.D.Student in Building Performance and Diagnostics; GPA: 4.00 — *Aug. 2019 – May 2024*

- **Advisor: Prof. Erica Cochran Hameen**
- **Dissertation**: An Automatic Mobile Sensing Platform for Indoor Environmental Quality Assessments

University of California, Merced — Merced, CA

M.S. in Mechanical Engineering; GPA: 3.87 — *Aug. 2012 – Dec. 2014*

- **Advisor: Prof. Jian-Qiao Sun**
- **Thesis**: Modeling and Control of Air Handling Units (AHUs) in Building HVAC System.

Nanjing University — Nanjing, Jiangsu, China

B.S. in Acoustics; GPA: 81/100 — *Sept. 2008 – Jun. 2012*

Research Experience

Senior Research Fellow — Jul. 2024 - - May 2026 (Expected)

IDEAS Lab, National University of Singapore Singapore — ***Supervisor: Dr. Adrian Chong***

- Developed an inverse reinforcement learning (IRL) framework for mixed-mode ventilation (MMV) systems that learns from rule-based control strategies to uncover the underlying reward functions representing complex control objectives, outperforming direct RL agents.
- Proposed and developed a novel research project utilizing Large Language Models (LLMs) driven agentic framework to dynamically manage building automation systems (BAS)
- Developed a suboptimal rule-based control algorithm for mixed-mode ventilation (MMV) and deployed it using the NETx automation API in an actual BAS system
- Developed a control algorithm that reduces the peak demand during mode switch for mixed-mode ventilation (MMV) by 36% and increases the building energy flexibility
- Led interdisciplinary research projects, including overseas collaborations, coordination with industrial partners, and supervising Ph.D. students
- Wrote and contributed to grant proposals to secure funding from NUS, A*STAR, and GBIC.

Research Assistant — Aug. 2019 - - May 2024

Carnegie Mellon University, Pittsburgh, PA

- Computer Vision-Aided Spatial Mapping of Thermal Comfort — *Apr. 2023 - May 2024*
  - Built a framework that uses an RGB-D camera, a thermal infrared camera, and a tracking camera to actively measure and map the spatial distribution of mean radiant temperature in an indoor environment using visual simultaneous localization and mapping (vSLAM) and semantic segmentation
- Spatiotemporal Indoor Environment Quality Measurements and Modeling — *Apr. 2023 - May 2024*

  - Built a Multi-variable Gaussian Process Model as a Bayesian updating mechanism to incorporate the new data and refine the model of the IEQ spatiotemporal distribution.
  - Prediction results of temperature distribution maps throughout different timestamps achieve an RMSE of 0.20 $^{\circ}C$ compared to the ground truth data.

- Mobile Sensing Platform for Indoor Environment Quality *Aug. 2020 - May 2022*
  - Built a mobile sensing platform including occupancy, thermal comfort, IAQ, and illuminance detection based on Raspberry Pi, ESP8266, Open CR, and Turtlebot 3.
  - Built a database and server based on InfluxDB, Mosquitto (MQTT broker), and Flask that achieved simultaneous data acquisition, storage, and association between the robot, the payload, and the robot PC.

- Improving Post-Occupancy Evaluation Engagement Using A Social Robot *Feb.2022 - Nov.2022*
  - Designed a framework to conduct a post-occupancy evaluation using a social robot via haptic and verbal interactions
  - Conducted a user study and a statistical analysis using a post-hoc Wilcoxon signed-rank test
  - The results reveal that participants were more responsive and provided more detailed feedback to social robots than traditional web-based surveys.

- Iterative Learning Control (ILC) on a VAV Reheat System *Feb. 2022 - Nov. 2022*
  - Designed an ILC feedforward controller that can overcome model discrepancies like forecast outdoor weather differences
  - The proposed control method achieved fast convergence in 3 days of roll-out on a numerical study on a real VAV reheat system

Ph.D. Researcher - Building Modeling and Controls May 2023 - - Aug. 2023
Lawrence Berkeley National Lab, Berkeley, CA ***Supervisor: Dr. Tianzhen Hong***

- Developed a novel physics-consistent neural network base Model Predictive Control (MPC) to optimize energy flexibility in tropic office buildings
- Designed an optimal control framework with on-site renewable energy and energy storage, demonstrating 20% self-sufficiency improvement

Ph.D. Researcher - HVAC System Performance Analysis Oct. 2022 - - May 2023
Pacific Northwest National Lab, Richland, WA ***Supervisor: Dr. Mike Brambley***

- Created a gradient-boosting-based machine learning framework for accurate (less than 10% prediction error) energy consumption predictions over weeks for packaged air conditioning units with limited information

Consultant (Contract) May 2022 - - May 2023
U.S. General Services Administration (GSA), Washington D.C.

- Investigated the U.S. GSA Total Estimated Cost Impact (TECI) Metrics Evaluation project for energy, carbon emissions, fault detection, and cost analysis
- Worked on data analysis as part of the GSA National Outdoor Air Verification (NOVA) project for ventilation, energy, wellness, and indoor air quality (IAQ)

Research Assistant Aug. 2012 - - Jul. 2015
University of California, Merced, Merced, CA

- Model Predictive Control of Air Handling Unit (AHU) Energy Efficiency *Aug. 2012 - Jul. 2015*
  - Established an ETL (Extract, Transform, and Load) process to automatically download and pre-process building data used to be finished by a five-undergraduate-researcher group.
  - Designed an MPC optimal control strategy of an AHU with real-world data from a lab building on campus with a potential energy consumption reduction of up to 27.8%.
  - Developed a linear regression model with physical-based parameters of HVAC system energy balance that predicts the dynamics with coefficients of determination larger than 0.98.
  - Improved 18% modeling accuracy based on Butterworth and Savitzky-Golay digital low-pass filter for air flow rate data smoothing

Industry Experience

Mechanical Engineer Aug. 2015 - - Jul. 2019

Gayner Engineers, San Francisco, CA

- HVAC System and Building Automation System (BAS) design for critical commercial buildings of healthcare, life science laboratory, library, and higher education
- Conducted building energy simulations and sustainability coordination for green building rating system (LEED, CalGreen, EnergyStar, and PG&E Saving by Design) based on California Title 24 and ASHRAE 90.1
- Commissioned and Energy Audited Mechanical, Electrical, and Plumbing (MEP) systems and medical equipment for healthcare and laboratory buildings
- Produced engineering drawings using AutoCAD, and Autodesk Revit
- Developed python-based API and scripts for BAS data collection, CAD, and energy simulation software to improve working efficiency (First in the company to do so)
- Coordinated with clients, vendors, contractors, and co-consultants in project management.

Teaching Experiences

Sole Instructor

Carnegie Mellon University, Pittsburgh, PA

48722, Building Performance Modeling Spring 2022, 2023 & 2024

- Serving as the sole instructor of a graduate-level course: Building Performance Modeling on a capacity of 30-student class
- Teaching whole-building simulations using EnergyPlus, eQuest, IES VE, and Revit CEA.
- Achieved learning objectives with students with diverse academic and professional backgrounds

Teaching Assistant

Carnegie Mellon University, Pittsburgh, PA

48768, Indoor Environmental Quality	Fall 2021
48729, Sustainability, Health and Productivity	Fall 2021
48722, Building Performance Modeling	Spring 2021
48721, Building Controls and Diagnostics	Spring 2021
48116, Building Physics	Fall 2020

Teaching Assistant
University, of California, Merced, Merced, CA

ME 021, Engineering Computing	Fall 2014, Summer 2014 & Fall 2013
ME 140, Vibration and Control	Spring 2014 and Spring 2013
ME 142, Mechatronics	Spring 2014
ENGR 065, Circuit Theory	Summer 2013

Journal Publications

1. **Wei Liang**, Yiting Zhang, Adrian Chong, Erica Cochran Hameen, and Vivian Loftness. Exploring gaussian process regression for indoor environmental quality: Spatiotemporal thermal and air quality modeling with mobile sensing. *Building and Environment*, 281:113143, 2025. ISSN 0360-1323. doi: 10.1016/j.buildenv.2025.113143

2. **Wei Liang**, Han Li, Sicheng Zhan, Adrian Chong, and Tianzhen Hong. Energy flexibility quantification of a tropical net-zero office building using physically consistent neural network-based model predictive control. *Advances in Applied Energy*, 14:100167, 2024a. ISSN 2666-7924. doi: 10.1016/j.adapen.2024.100167

3. Irfan Qaisar, **Wei Liang**, Kailai Sun, Tian Xing, and Qianchuan Zhao. An experimental comparative study of energy saving based on occupancy-centric control in smart buildings. *Building and Environment*, 268:112322, 2024. ISSN 0360-1323. doi: 10.1016/j.buildenv.2024.112322

4. Ruoxin Xiong, Ying Shi, Haoming Jing, **Wei Liang**, Yorie Nakahira, and Pingbo Tang. Calibrating subjective data biases and model predictive uncertainties in machine learning-based thermal perception predictions. *Building and Environment*, 247:111053, 2024. ISSN 0360-1323. doi: 10.1016/j.buildenv.2023.111053

5. **Wei Liang**, Sizhe Ma, Erica Cochran, and Katherine A Flanigan. Distributed MPC-ILC thermal control design for large-scale multi-zone building hvac system. *SIGENERGY Energy Inform. Rev.*, 3(2):34–46, June 2023. doi: 10.1145/3607114.3607118

6. **Wei Liang**, Rebecca Quinte, Xiaobao Jia, and Jian-Qiao Sun. Mpc control for improving energy efficiency of a building air handler for multi-zone vavs. *Building and Environment*, 92:256–268, 2015. ISSN 0360-1323. doi: 10.1016/j.buildenv.2015.04.033

7. Furui Xiong, Zhichang Qin, Carlos Hernández, Yousef Sardahi, Yousef Narajani, **Wei Liang**, Yang Xue, Oliver Schütze, and Jianqiao Sun. A multi-objective optimal pid control for a nonlinear system with time delay. *Theoretical and Applied Mechanics Letters*, 3(6):063006, 2013. ISSN 2095-0349. doi: 10.1063/2.1306306

8. Carlos Hernández, Yousef Naranjani, Yousef Sardahi, **Wei Liang**, Oliver Schütze, and Jian-Qiao Sun. Simple cell mapping method for multi-objective optimal feedback control design. *International Journal of Dynamics and Control*, 1(3):231–238, 2013. doi: 10.1007/s40435-013-0021-1

Peer-reviewed Conference Publications

1. **Wei Liang** and Adrian Chong. Learning adaptive mixed-mode ventilation policies via adversarial inverse reinforcement learning. In *ICML 2025 CO-BUILD Workshop on Computational Optimization of Buildings*, 2025

2. **Wei Liang**, Yiting Zhang, Ji Zhang, and Erica Cochran Hameen. An expeditious spatial mean radiant temperature mapping framework using visual slam and semantic segmentation, 2024b. In 2024 CVPR Computer Vision in the Built Environment Workshop

3. **Wei Liang** and Michael R Brambley. Event-based energy impact tracking and forecasting with limited measurements for rooftop units. *ASHRAE Transactions*, pages 239–248, 2024. doi: 10.63044/s24lia26

4. **Wei Liang**, Sizhe Ma, Erica Cochran Hameen, and Katherine Flanigan. Integrated MPC-ILC control design for thermal control of a large-scale multi-zone building hvac system. In *Proceedings of the 9th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*, BuildSys '22, page 129–138, New York, NY, USA, 2022a. Association for Computing Machinery. ISBN 9781450398909. doi: 10.1145/3563357.3564068

5. **Wei Liang**, Ruoxin Xiong, Pengkun Liu, Pingbo Tang, and Erica Cochran Hameen. Improving post-occupancy evaluation engagement using social robots. In *Proceedings of the 9th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*, BuildSys '22, page 159–167, New York, NY, USA, 2022b. Association for Computing Machinery. ISBN 9781450398909. doi: 10.1145/3563357.3564071

6. Eric Kumar, Erica Cochran Hameen, and **Wei Liang**. Global marginal carbon footprint evaluation of internet services with building energy models. In *BuildSIM-Nordic 2020*. IBPSA-Nordic, SINTEF Academic Press, 2020

7. Yousef Sardahi, Yousef Naranjani, **Wei Liang**, Jian-Qiao Sun, Carlos Hernandez, and Oliver Schuetze. Multi-objective optimal control design with the simple cell mapping method. In *ASME 2013 International Mechanical Engineering Congress and Exposition*, page V04BT04A025. American Society of Mechanical Engineers, 2013. doi: 10.1007/s40435-013-0021-1

Invited Talks

- "Event-based energy impact tracking and forecasting with limited measurements for rooftop units," Oral Presentation at ASHRAE Annual Conference 2024, Indianapolis, IN, USA, Jun 25, 2024.
- "An expeditious spatial mean radiant temperature mapping framework using visual slam and semantic segmentation," Oral Presentation at The IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2024, Seattle, WA, USA, Jun 17, 2024
- "Introduce Robotics to Building Management," Invited Guest Lecture at The Florida Agricultural & Mechanical University, Tallahassee, FL, USA, Nov 15, 2023
- "Improving Post-Occupancy Evaluation Engagement Using Social Robots," Oral Presentation at the 9th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation, BuildSys'22, Boston, MA, USA, Nov 10, 2022
- "Integrated MPC-ILC Control Design for Thermal Control of a Large-Scale Variable Air Volume Reheat Systems in Buildings," Oral Presentation at the 9th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation, BuildSys'22, Boston, MA, USA, Nov 9, 2022
- "Post-occupancy Evaluation," Invited Guest Lecture at Carnegie Mellon University, Pittsburgh, PA, USA, Sept 29, 2021

- "An Automatic Mobile Sensing Platform for Indoor Air Quality Measuring," Invited Guest Lecture at Carnegie Mellon University, Pittsburgh, PA, USA, Oct 7, 2020
- "MPC control for improving energy efficiency of a building air handler for multi-zone VAVs," Invited Talk at The University of Texas at San Antonio, San Antonio, TX, USA, Apr 24, 2015

Research Projects

- "AI-Driven Climate Resilient Cooling: Robust Reinforcement Learning for Mixed-Mode Ventilation," Japan Science and Technology Agency (JST) and the Agency for Science, Technology and Research of Singapore (A*STAR) Joint Grant call, **Lead Researcher**, Apr.2025-Now, S$34,500.
- "Towards Sustainable Cooling: Occupant-Centric Mixed-Mode Ventilation Control as a Climate Adaptation Solution," KU-NUS University Strategic Partner Funds, **Lead Researcher**, Nov.2024-Now, S$20,000.
- "Comparative Energy Analysis and Optimization of Radiant Cooling Panels in Tropical Climates," Gift from SANKEN SETSUBI KOGYO CO., LTD., **Lead Researcher**, Feb.2024-Now, S$200,000.
- "An automatic mobile sensing platform for indoor environmental quality assessments, **PI**, Fund for Research & Creativity / Graduate Student Assembly Travel Fund / Scholarly Project Funding, Carnegie Mellon University, PI, Oct.2020-May.2024, $10,164.
- "Total Estimated Cost Impact (TECI) Metrics Evaluation project," General Services Administration, Participating researcher, Oct.2022-May.2023, $300,000.
- "National Outdoor Air Verification (NOVA) Project," General Services Administration, Participating researcher, Oct.2022-May.2023, $300,000.

Awards and Honors

Carnegie Mellon University, Pittsburgh, PA, USA

Graduate Student Assembly Scholarly Project Funding	2020, 2021, 2022, 2023
School of Architecture - letter of commendation	2020, 2021

University of California, Merced, CA, USA

Mechanical Engineering Bobcat Award	2014
UC Merced Graduate Summer Fellowship	2013

Nanjing University, Nanjing, Jiangsu, China

People's Scholarship	2010

Certifications and Organizations

Professional Mechanical Engineer (M38549) Jun. 2017 - - Now

Board for Professional Engineers, Land Surveyors, and Geologists - California

Full Member Feb. 2016 - - Now

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

LEED AP BD+C Jun. 2017 - - Now
Green Business Certification, Inc.

Deep Learning Specialization (4LJHJDPJMNVS) Jul. 2018 - - Now
Coursera

Service

- **Reviewer**: Building and Environment (2015-2019, 2025-Now), Energy and Buildings (2025-Now), Developments in the Built Environment (2022-Now), Building Simulation (2024-Now)
- **Organizing Committee**: 1st International Symposium on Building Performance and Diagnostics: From People to Cities, April 4, 2025, Pittsburgh, PA, USA

Technical Skills

Expertise

- Proficient: Building HVAC System, Building Energy Simulation, Indoor Environmental Quality, Model Predictive Control, Adaptive Control, Iterative Learning Control, Optimal Control
- Advanced: Nonlinear Control, Building Automation System, Numerical Optimization, Machine Learning, Smart Grid, Reinforcement Learning, Robotics
- Intermediate: Statistical Data Analysis, Construction Management, Robotics, Computer Vision

Computing

- Programming Languages: Python, MATLAB, Julia, R, C, C++
- Software: EnergyPlus, IES VE, Design Builder, Modelica, Trace 700, eQuest, HOMER Pro
- Typesetting: LaTeX, Microsoft Office, Scientific Word, Pages
- Operating Systems: MacOS, Ubuntu, Raspbian, Windows
- Building Management System: AutomatedLogic Controls, Honeywell IQ, Siemens Apogee, Niagara Tridium
- Drawing Production: Autodesk Revit, AutoCAD, BlueBeam, Adobe Acrobat DC, Rhino, Grasshopper

Courses

- **At CMU:** Introduction to Machine Learning, Computer Vision, SLAM, Optimal Control and Reinforcement Learning, Adaptive Control and Reinforcement Learning, Human-Robot Interaction, Sensing and Sensors, On-Device Machine Learning, Off-grid Electricity Systems, HVAC and Power Supply for Low Carbon Buildings, Productivity, Health and the Sustainability of Buildings, Building Performance Modeling, Building Control and Diagnostics, GIS
- **At UCM:** Nonlinear Controls, Linear Controls, Numerical Linear Algebra, Numerical Analysis, Fractional Order Mechanics, Continuum Mechanics, Partial Differential Equations
- **At NJU:** Fundamentals of Acoustics, Sound and Structural Vibration, Electroacoustics, Ultra-acoustics, Audio-frequency Signal Processing Signals and Systems, Digital Signal Processing, Fluid Mechanics, Probability and Stochastic Process, Method of Mathematical Physics

References

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