

**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. The trained control agent addresses the challenge of frequent and unnecessary window operations in direct RL agents.
- Proposed a novel research project utilizing Large Language Models (LLMs) within an agentic framework to automatically generate building system control sequences/diagrams based on user-defined preferences
- Developed a suboptimal rule-based control algorithm for mixed-mode ventilation (MMV) and deployed it using the NETx automation API in an actual BMS 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, BCA, and GBIC, with confirmed success

**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 segmentations

- 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 °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  
ME 140, Vibration and Control  
ME 142, Mechatronics  
ENGR 065, Circuit Theory

Fall 2014, Summer 2014 & Fall 2013  
Spring 2014 and Spring 2013  
Spring 2014  
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**, Yiting Zhang, Ji Zhang, and Erica Cochran Hameen. An expeditious spatial mean radiant temperature mapping framework using visual slam and semantic segmentation, 2024b. Accepted by 2024 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshop

2. **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
3. **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
4. **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
5. 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
6. 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

- “Mixed-mode Ventilation in Tropics,” Oral Presentation at The University of Tokyo, Tokyo, Japan, Dec 11, 2024.
- “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 GuSH Research Grant  
School of Architecture - letter of commendation

2020, 2021, 2022, 2023  
2020, 2021

### University of California, Merced, CA, USA

Mechanical Engineering Bobcat Award  
UC Merced Graduate Summer Fellowship

2014  
2013

### Nanjing University, Nanjing, Jiangsu, China

People’s Scholarship

2010

## Certifications and Organizations

### Professional Mechanical Engineer (M38549)

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

Jun. 2017 - - Now

### Full Member

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

Feb. 2016 - - Now

### LEED AP BD+C

*Green Business Certification, Inc.*

Jun. 2017 - - Now

## 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: L<sup>A</sup>T<sub>E</sub>X, 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

*Dr. Erica Cochran Hameen*

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