Yapan Liu

Built Environment Science and Technology (BEST) Laboratory
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(Online Version. Updated 2/21/2024)

EDUCATION

Ph.D. in Mechanical and Aerospace Engineering August 2019 – May 2024 (Expected)
Syracuse University *Syracuse, NY*

- Specialization: Building Control and Simulation, Data Analysis and Visualization
- Advisor: Dr. Bing Dong

M.S. in Mechanical and Aerospace Engineering August 2016 – May 2018
Syracuse University *Syracuse, NY*

- Specialization: Design and Manufacturing, 3D Modeling, Quality Engineering
- Advisor: Dr. Young B. Moon

B.E. in Mechanical Engineering September 2010 – June 2014
Yangzhou University *Yangzhou, China*

- Specialization: Mechanical Design, Manufacturing and Automation

ACADEMIC DISTINCTIONS

- 2024 - Homer Addams Award Nomination, *ASHRAE* [LINK]
- 2024 - Cover Article, Journal of Building Simulation [LINK]
- 2023 - Student Features, Center of Excellence (CoE), *Syracuse University* [LINK]
- 2023 - Research Highlights, *Syracuse University News* [LINK]
- 2022 - Best Paper Award, *Journal of Building and Environment* [LINK]

RESEARCH AREA

- Big Data Analytics
- Building Controls and Simulation
- Building Energy Modeling (Energy Plus)
- Occupant Behavior in Buildings
- Machine Learning in Building Control
- Building Sensing and Energy monitoring

TECHNICAL SKILLS

- *Programming languages and tools:* Python, MATLAB, R, C, Javascript, Energy Plus, ArcGIS, QGIS
- *Skills:* Building Sensing and Simulation, Data Visualization and Analytics, Web Development, 3D Modeling

RESEARCH PROJECTS

CAREER: Holistic Assessment of the Impacts of Connected Buildings and People on Community Energy Planning and Management

National Science Foundation, 2019 – 2023

- Analyzed hundreds-GB of geospatial and time-series data using big data analytics
- Applied machine learning to model urban-scale human mobility and occupant behaviors
- Created an urban-scale V2B2G (Vehicle-to-Building-to-Grid) integration control framework with large scale building simulations

Net-Zero Energy Retrofit. Living lab at winding Ridge Road, Syracuse, NY

New York State Energy Research and Development Authority (NYSERDA), 2021

- Implemented an energy monitoring network with automated data collection for dormitories
- Calibrated EnergyPlus models using collected data to inform retrofit strategies and assess impacts

ASHRAE Global Occupant Behavior Database

American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2021-2022

- Led the creation of a global database on occupant behavior, enhancing research collaboration.
- Processed raw data for EnergyPlus simulations, achieving measurable energy savings.
- Expanded the BRICK Schema to enrich dataset utility and interoperability.
- Managed database maintenance, ensuring its accessibility and benefit to the public

Residential Electrical Vehicles Charging Data Analytics

Salt River Project, Arizona, 2022

- Analyzed residential power meter data to model EV charging patterns using machine learning
- Evaluated the impact of utility rate plans on charging behaviors

Large Scale Building Indoor Air Quality and Water Quality Study

2022 - 2023

- Conducted comprehensive analysis of outdoor air and water quality, and building stocks information
- Designed and executed a sampling plan for studying indoor air and water quality

Occupant-Centric Based HVAC Control in Educational Office

Advanced Research Projects Agency–Energy (ARPA-E), 2021

- Developed an occupancy monitoring system and automated data acquisition pipeline
- Programmed Python algorithms for HVAC control via BACnet communication

Power Outage Impacts – Insights from the Human Mobility Data

National Renewable Energy Laboratory (NREL), 2022

- Investigated household impacts of power outages through human mobility modeling

PROFESSIONAL EXPERIENCE

Research Assistant August 2019 – Present

BEST Lab, Syracuse University *Syracuse, NY*

- Oversaw research project timelines and authored comprehensive reports
- Disseminated findings through scholarly journal publications
- Enhanced building energy models with occupant behavior integration in EnergyPlus
- Created advanced building-to-grid and HVAC control algorithms based on ASHRAE Guideline 36
- Collaborated with global researchers on urban scale building occupant behavior and energy flexibility, co-authoring six journal articles (IEA EBC Annex 79 and 81, 2019-2023)
- Designed a benchmarking website for machine learning models focused on occupant behavior
- Created advanced building-to-grid and HVAC control algorithms (e.g. MPC, Reinforcement Learning)
- Developed various advanced data visualization techniques to present research findings

Graduate Research Assistant May – September 2017

Dept. of Mechanical and Aerospace Engineering, Syracuse University *Syracuse, NY*

- Evaluated the vulnerability of a sample Cyber Manufacturing System (CMS)
- Enhanced the security of CMS through data analysis and image processing

Project Team Co-Lead July – September 2017

Marquardt Switches Inc. *Cazenovia, NY*

- Collaborated with a cross-functional team of 6 engineers to build and optimize an assembly line
- Gathered relevant data, constructed a robust model, and executed simulations in Arena software
- Analyzed and optimized simulation results reducing the number of operators from 6 to 5

Mechanical Engineer September 2018 – August 2019
UsPLM, Inc. (Now AutoModality) *Syracuse, NY*

- Presented UsPLM product at various domestic and international conferences
- Designed 3D drone models and created animations using Onshape and Blender software
- Analyzed flight log data and simulated drone missions in 3D environments

Product Development Engineer July 2014 – April 2015
Jiangsu Olive Sensors High-tech Co. Ltd. *Yangzhou, China*

- Collaborated with a team of 10 engineers to develop 6 new products
- Reviewed product design using NX software and led the pre-production process

TEACHING INTEREST

- Statics
- CAD/CAM Systems
- Simulation and Data Analytics
- Mechanical Engineering Laboratory
- Statistics for Engineers
- Machine Learning for Engineers
- Control and Optimization for Building Energy Systems

TEACHING EXPERIENCE

ECS 221: Statics (Undergraduate) January - May 2022
Teaching Assistant, Dr. Teng Zhang *Syracuse University*

- Taught weekly recitation sessions, solidifying students' understanding of course materials on topics including Fundamentals of static equilibrium, Vector algebra, Forces, moments, equivalent force systems, free body diagrams and equilibrium problems in two and three dimensions, analysis of structures and machines and centroids and moments of inertia
- Assisted in preparing and grading homework, quizzes, and exams

MAE 600: Machine Learning for Mechanical Engineers (Graduate) Fall 2020 and Fall 2021
Guest Speaker, Dr. Bing Dong *Syracuse University*

- Gave lectures on the topic of "Reinforcement Learning"
- Presented recent research on building control utilizing Reinforcement Learning

MEE 416: Mechanical Engineering Laboratory (Undergraduate) August - December 2021
Teaching Assistant, Dr. Jianshun "Jensen" Zhang *Syracuse University*

- Taught students to conduct various mechanical engineering labs on topics including Beam Bending, Forced Convection Heat Transfer, Linear Inverted Pendulum, and Air Conditioning and Refrigeration
- Graded homework, presentations and reports, and answered students' questions

MAE 600: Control and Operation of Building Energy Systems (Graduate, Undergraduate) February - May 2021
Teaching Assistant, Dr. Bing Dong *Syracuse University*

- Taught on topics including Indoor Air Quality, Convex Optimization, Model Predictive Control (MPC), State Space Model, etc.
- Assisted in designing and grading homework, projects, and presentations
- Hosted office hours and answered students' questions

MFE: 634 Product Quality and Engineering (Graduate) January – May 2018
Teaching Assistant, Dr. Jorge Luis Romeu *Syracuse University*

- Mentored graduate students to analyze data in Minitab and manage projects in Companion software
- Graded 36 quizzes on a weekly basis and assisted in grade analysis and distribution
- Hosted office hours and addressed students' questions from lectures and assignments

PUBLICATION

- **Liu, Y.**, & Dong, B. (2023, August). Modeling urban scale human mobility through big data analysis and machine learning. In *Building Simulation* (pp. 1-19). Beijing: Tsinghua University Press.
- Li, H., Johra, H., de Andrade Pereira, F., Hong, T., Le Dréau, J., Maturo, A., ... & Dong, B. (2023). Data-driven key performance indicators and datasets for building energy flexibility: A review and perspectives. *Applied Energy*, 343, 121217.
- **Liu, Y.**, Dong, B., Hong, T., Olesen, B., Lawrence, T., & O'Neill, Z. (2023). ASHRAE URP-1883: Development and Analysis of the ASHRAE Global Occupant Behavior Database. *Science and Technology for the Built Environment*, 1-33.
- Luo, N., Fierro, G., **Liu, Y.**, Dong, B., & Hong, T. (2022). Extending the Brick schema to represent metadata of occupants. *Automation in Construction*, 139, 104307.
- Dong, B., **Liu, Y.**, Mu, W., Jiang, Z., Pandey, P., Hong, T., ... & Zhou, X. (2022). A global building occupant behavior database. *Scientific data*, 9(1), 1-15.
- Dong, B., Markovic, R., Carlucci, S., **Liu, Y.**, Wagner, A., Liguori, A., ... & Kang, X. (2022). A guideline to document occupant behavior models for advanced building controls. *Building and Environment*, 109195.
- Pisello, A. L., Pigliautile, I., Andargie, M., Berger, C., Bluyssen, P. M., Carlucci, S., ... & Wei, S. (2021). Test rooms to study human comfort in buildings: A review of controlled experiments and facilities. *Renewable and Sustainable Energy Reviews*, 149, 111359.
- Dong, B., **Liu, Y.**, Fontenot, H., Ouf, M., Osman, M., Chong, A., ... & Carlucci, S. (2021). Occupant behavior modeling methods for resilient building design, operation and policy at urban scale: A review. *Applied Energy*, 293, 116856.
- Wu, W., Dong, B., Wang, Q. R., Kong, M., Yan, D., An, J., & **Liu, Y.** (2020). A novel mobility-based approach to derive urban-scale building occupant profiles and analyze impacts on building energy consumption. *Applied Energy*, 278, 115656.
- Salim, F. D., Dong, B., Ouf, M., Wang, Q., Pigliautile, I., Kang, X., ... & Yan, D. (2020). Modelling urban-scale occupant behaviour, mobility, and energy in buildings: A survey. *Building and Environment*, 183, 106964.
- Wu, M., Song, J., Lin, L. W. L., Aurelle, N., **Liu, Y.**, Ding, B., ... & Moon, Y. B. (2018). Establishment of intrusion detection testbed for CyberManufacturing systems. *Procedia Manufacturing*, 26, 1053-1064.

CONFERENCES

Presentations

Occupant Centric Building HVAC System Control (Demo) — October, 2022
2022 NYS Innovation Summit — *Buffalo, NY*

Exploring Urban Scale Human Mobility Through Big Data Analysis and Machine Learning — September, 2022
9th Expert Meeting of Annex 79 and OB-22 Symposium — *Online*

Occupant Centric Building HVAC System Control (Demo) — May, 2022
2022 ARPA-E Energy Innovation Summit — *Denver, Colorado*

Deriving Urban-scale Building Occupant Behavior Patterns through Big Data Analysis — April, 2021
6th Expert Meeting of Annex 79 and OB-21 Symposium — *Online*

Conference Attendance

9th Expert Meeting of Annex 79 and OB Symposium	September 2022 - *Online*
4th Plenary Meeting of Annex 81	April 2022 - *Online*
2nd Working Meeting of Annex 82	May 2022 - *Online*
6th - 8th Expert meeting of Annex 79	2021 - 2022 - *Online*
4th - 5th Expert Meeting of Annex 79 and OB Symposium	2020 - *Online*
ACM BuildSys 2019	November 2019 - *Columbia University*
Design Future Building Management Tools	October 2019 - *Carleton University*

SERVICE

Invited Reviewer, *IEEE Transactions on Smart Grid*	2023
Invited Reviewer, *Journal of Thermal Science and Engineering Applications*	2022
Invited Reviewer, *Journal of Building Simulation*	2020
Student President, ASHRAE Student Branch, Syracuse University, Syracuse, NY	November 2022 – Present
Student Leader, Chinese American Friendship Association, Syracuse, NY	August 2017 – June 2018
Disaster Relief Volunteer, NAMB, Johnsonville, SC and Carolina, Puerto Rico	March and December 2017
Global Graduate Ambassadors Orientation Leader, Syracuse University, Syracuse, NY	August 2017