Sang woo Ham

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Education

Purdue University West Lafayette, IN

Ph.D. in Civil Engineering; Advisor: Prof. Panagiota Karava; GPA: 3.85/4.0 Aug. 2016 – Aug. 2021

- **Thesis**: Energy Analytics for Eco-feedback Design in Multi-family Residential Buildings.
- **Related Courses**: Bayesian Data Analysis, Big Data Analytics, Uncertainty quantification.

Hanyang University Seoul, South Korea

M.S. in Architectural Engineering; Advisor: Prof. Jae-weon Jeong; GPA: 4.0/4.0 Mar. 2014 - Feb. 2016

- **Thesis**: Optimal supply air temperature ranges of various air-side economizers for a modular data center in South Korea.
- **Related Courses**: Building Automation and Control System, Data Mining, Computational Fluid Mechanics.

Hanyang University Seoul, South Korea

B.S. in Civil Engineering; GPA: 3.83/4.0 (SUMMA CUMLAUDE, 2nd rank out of 72) Mar. 2007 - Feb. 2014

- **Related Courses**: Heat Transfer, HVAC System Design

Professional and Research Experience

Lawrence Berkeley National Laboratory (LBNL) Berkeley, CA

Postdoctoral researcher Oct. 2021 - Present

A Low-cost, Scalable Control Solution for Grid-Interactive Small and Medium-Sized Commercial Buildings.
HP-Flex: Next Generation Heat Pump Load Flexibility.

- Development of hybrid modeling approach for model predictive control via deep learning.
- Conduct Model Predictive Control(MPC) experiment with the hybrid modeling approach in Flexlab.
- Conduct scalable and practical MPC experiments in real buildings (K-12 schools and small commercial buildings)

Building Genome and Intelligent Autonomous Building Energy Environmental Management System (iBEEMS)

- Conduct Flexlab test of iBEEMS controller to optimize HVAC energy, CO2 level, and particle matter concentrations.

Herrick Laboratory, Purdue University West Lafayette, IN

Graduate Research Assistant Aug. 2016 – Aug. 2021

Sociotechnical Systems to Enable Smart and Connected Energy-Aware Residential Communities.

- Development of Bayesian-based real-time heating and cooling energy prediction/energy normalization model for eco-feedback via visual/voice user-interactive devices.
- Development and installation of visual/voice Smart home interface (Smart-E) for multi-family residential buildings.

BMES Laboratory, Hanyang University Seoul, Korea

Graduate Research Assistant Mar. 2014 - Feb. 2016

Development of liquid desiccant and evaporative cooling assisted 100% outdoor air system.

- Develop numerical simulations and experiments of an indirect evaporative cooler and its control algorithms.

Undergraduate Research Assistant Mar. 2013 - Feb. 2014

Development of energy efficient modular data center for PUE below 1.5.

- Develop annual energy and CFD simulations for various economizers in a modular data center.

Publications

International Journal Papers

- **Ham, S.**, Kim, D., Barham, T., and Ramseyer, K. (2023). The first field application of a low-cost MPC for grid-interactive K-12 schools: Lessons-learned and savings assessment. *Energy and Buildings*, Vol.296, pp.113351. (link)
- Kim, H., **Ham, S.**, et. al. (2022). MySmartE – An eco-feedback and gaming platform to promote energy conserving thermostat-adjustment behaviors in multi-unit residential buildings. *Building and Environment*. Vol.221, pp.109252. (link)
- **Ham, S.**, Karava, P., Bilionis, I., and Braun, J. (2022). A scalable and practical method for disaggregating heating and cooling electrical usage using smart thermostat and smart metre data. *Journal of Building Performance Simulation*, Vol.15(2), pp.251-267. (link)

- **Ham, S.**, Karava, P., Bilionis, I., and Braun, J. (2021). A data-driven model for building energy normalization to enable eco-feedback in multi-family residential buildings with smart and connected technology. *Journal of Building Performance Simulation*, Vol.14(4), pp.343-365. (link)
- **Ham, S.**, Karava, P., Bilionis, I., and Braun, J. (2021). Real-time model for unit-level heating and cooling energy prediction in multi-family residential housing. *Journal of Building Performance Simulation*, Vol.14(4), pp.420-445. (link)
- Kim, H.-J., **Ham, S.-W.**, Yoon, D.-S., and Jeong, J.-W. (2017). Cooling performance measurement of two cross-flow indirect evaporative coolers in general and regenerative operation modes, *Applied Energy*, Vol.195, pp.268-277. (link)
- **Ham, S.-W.**, Lee, S.-J., and Jeong, J.-W. (2016). Operating energy savings in a liquid desiccant and dew point evaporative cooling-assisted 100% outdoor air system. *Energy and Buildings*, Vol.116, pp.535-552. (link)
- **Ham, S.-W.**, and Jeong, J.-W. (2016). Dew point evaporative heat exchanger (DPHX): Design and performance analysis. *Energy*, Vol.101, pp.132-145. (link)
- **Ham, S.-W.**, and Jeong, J.-W. (2015). Impact of aisle containment on energy performance in a data center with integrated water-side economizer. *Applied Thermal Engineering*, Vol.105, pp.372-384. (link)
- **Ham, S.-W.**, Jo, S.-Y., Dong, H.-W., and Jeong, J.-W. (2015). A simplified PEM fuel cell model for building cogeneration applications. *Energy and Buildings*, Vol.107, pp.213-225. (link)
- Kim, M.-H., Park, J.-Y., **Ham, S.-W.**, and Jeong, J.-W. (2015). Energy conservation benefit of water-side free cooling in a liquid desiccant and evaporative cooling-assisted 100% outdoor air system. *Energy and Buildings*, Vol.104, pp.302-315. (link)
- **Ham, S.-W.**, Park, J.-S., and Jeong, J.-W. (2015). Optimum supply air temperature ranges of various air-side economizers in a modular data center. *Applied Thermal Engineering*, Vol.77, pp.163-179. (link)
- **Ham, S.-W.**, Kim, M.-H., Choi, B.-N., and Jeong, J.-W. (2015). Energy saving potential of various air-side economizers in a Modular Data Center. *Applied Energy*, Vol.138, pp.258-275. (link)
- **Ham, S.-W.**, Kim, M.-H., Choi, B.-N., and Jeong, J.-W. (2015). Simplified server model to simulate data center cooling energy consumption. *Energy and Buildings*, Vol.86, pp.328-339. (link)
- Kim, M.-H., **Ham, S.-W.**, Park, J.-S., and Jeong, J.-W. (2014). Impact of integrated hot water cooling and desiccant assisted evaporative cooling system on energy savings in a data center. *Energy*, Vol.78, pp.384-396. (link)

Conference Proceedings

- **Ham, S**. and Kim, D. (2023) Field Demonstration of Low-Cost and Scalable MPC at a K-12 School and Practical Challenges, 2023 ASHRAE Annual Conference at Tampa, FL
- Paul, L., **Ham, S.**, Pritoni, M., Kim, D., Brown, R., and Feng, Jingjuan. (2023) Field Implementation of MPC for Heat Pump-Based Duel Fuel Systems in Small Commercial Buildings for Decarbonization, 2023 ASHRAE Annual Conference at Tampa, FL
- Casillas, A., **Ham, S.**, Helmns, D., and Paul, L. (2023) Considerations for Intelligently Sizing and Controlling TES Integrated HVAC Systems, 2023 ASHRAE Annual Conference at Tampa, FL
- Kim, H., **Ham, S.**, et. al. (2023). MySmartE – A Cloud-Based Smart Home Energy Application for Energy-Aware Multi-unit Residential Buildings. ASHRAE Transactions. Vol.129(1), pp.667-675. (link)
- **Ham, S.**, and Kim, D. (2022). Hybrid Modeling Approach For Better Identification Of Building Thermal Network Model And Improved Prediction. *International High Performance Buildings Conference (Accepted).*
- **Ham, S.**, and Karava, P. (2019). Online Building Energy Model to Evaluate Heating and Cooling-related Behavior Changes for Eco-feedback in a Multifamily Residential Building. *Proceedings of the 16th IBPSA Building Simulation Conference*, Rome, Italy, Sept. 2-4, 2019, Page 2379-2387. (link)
- **Ham, S.**, and Karava, P. (2018). Identifying Peer Groups in a Multifamily Residential Building for Eco-Feedback Design. *International High Performance Buildings Conference*, Paper 319. (link)
- **Ham, S.-W.**, Kim, H.-J., Cho, S.-H., and Jeong, J.-W. (2016). A Variable Volume and Temperature (VVT) Control Strategy for a Liquid-Desiccant and Dew Point Evaporative Cooler-Assisted 100% Outdoor Air System (LDEOS). *2016 ASHRAE Annual Conference*, St. Louis, MO, June. 25-29, 2016. (link)
- **Ham, S.-W.**, Kim, M.-H., and Jeong, J.-W. (2015). Performance improvement of liquid desiccant and evaporative cooling assisted 100% outdoor air system with dew point evaporative cooling. Conference proceedings of Architectural Institute of Korea, Vol.35(1), pp.227-228.
- **Ham, S.-W.**, Dong, H.-W., and Jeong, J.-W. (2014). Impact of Perforated Tile Open Areas on Airflow Uniformity and Air Management Performance in a Modular Data Center. ASim2014 (The 2nd Asia Conference of International Building Performance Simulation Association), pp. 66-74, (Nov. 27-28, Nagoya, Japan). (link)
- **Ham, S.-W.**, Kim, M.-H., Yoon, D.-S., and Jeong, J.-W. (2014). An experimental study on the fan control of computer room air handler in a modular data center with cold-aisle containment. Conference proceedings of Architectural Institute of Korea, Vol.34(2), pp.285-286.

- **Ham, S.-W.**, Park, J.-Y., and Jeong, J.-W. (2014). A Study of Direct Air-side Economizer Control Strategies for a Modular Data Center. Conference proceedings of Architectural Institute of Korea, Vol.34(1), pp.243-244.

Presentations

- Hobbs, G., Watts, R., **Ham, S.**, and Sipe, J. (2018). Smart and Connected Energy-Aware Residential Communities. *Indiana Housing conference*, September 2018.

Skills

- **Programming Language**: Python, R, Matlab, SQL, PLC (CIMON), git.
- **Computational Library**: Pyro, Pytorch, Stan, PyMC3, Tidyverse.
- **Software**: EnergyPlus, Open Studio, BCVTB, ANSYS Fluent, TRNSYS.

Experience

R book translation — West Lafayette, IN

Translator — May. 2018 - Aug. 2018

- Translation of Ch. 2 and 5 of **Efficient R programming** as a member of R Korea user group community

Scholarship, Awards, Certifications, Services, Membership, Patents

Scholarship

- Ross Fellow Scholarship, Purdue Univ., 2016 – 2019.
- Top scholarship, Hanyang Univ. 2013 – 2014.

Awards

- Spot awards – Recognition of Excellence, Lawrence Berkeley National Laboratory, 2023
- Excellent Paper Award, Conference proceedings of Architectural Institute of Korea, 2014/2016
- Excellence Award, 1st conference of undergraduate mock policy proposal on National Science and Technology Council, 2012.
- Outstanding contribution in reviewing for Energy and Buildings ,2018.

Certifications

- Engineer Building Facilities, National Technical Qualification Certificate, 2013.
- LEED AP OM, USGBC, 2012.

Services

- Reviewer of Energy and Buildings, 2018~
- Reviewer of Building and Environment, 2019~
- Reviewer of International Journal of Refrigeration, 2018~
- Reviewer of Journal of Building Performance Simulation, 2023~
- Member of ASHRAE TC 7.5
- President of Purdue Korean Tennis Club (PKTC), 2017-2018.

Membership

- ASHRAE student member, 2013~2022
- Member of Architectural Institute of Korea, 2013~2016