Li Song, Ph.D., P.E.

Professor, Lloyd G and Joyce Austin Presidential Professor, Associate Director for Research, School of Aerospace and Mechanical Engineering
Research Fellow, Institute for Resilient Environmental and Energy Systems
University of Oklahoma

I Biography

Li Song is a Professor and the Associate Director for Research of the School of Aerospace and Mechanical Engineering. Under her leadership, the department has formed five research clusters, created multi-disciplinary research teams, and experienced 40% increase of research proposal submissions in 2022. She is also appointed as Research Fellow of Institute for Resilient Environmental and Energy Systems, which represents one of the several clusters of University Strategic Plan. She has established Building Energy Efficiency Laboratory (BEEL) and secured more than $5 million research grants with 91 journal and conference proceeding publications.

I Earned Degrees

Ph.D.	2004	U. of Nebraska – Lincoln	Architectural Engineering
M.S.	1996	Harbin Institute of Technology	Mechanical Engineering
B.S.	1993	Shengyang University of Civil Engineering and Architecture	Thermal energy engineering for built environment

II Professional Registration

Member of ASHRAE since 2000
Member of ASME since 2009

III Employment

Research Fellow	Institute for Resilient Environmental and Energy Systems University of Oklahoma, Norman	08/22-present
Associate Director for Research	School of Aerospace and Mechanical Engineering University of Oklahoma, Norman	08/21-present
Professor	School of Aerospace and Mechanical Engineering University of Oklahoma, Norman	07/20-present
Associate Professor	School of Aerospace and Mechanical Engineering University of Oklahoma, Norman	07/15-07/20
Assistant Professor	School of Aerospace and Mechanical Engineering University of Oklahoma, Norman	08/09-07/15
V.P. of Engineering Technology	Building Energy Solutions & Technology Inc., Dallas (ww.bes-tech.net)	01/07-4/09
Technology Director	Building Energy Solutions & Technology Inc., Dallas (www.bes-tech.net)	08/04-12/06

IV. Leadership and Related Accomplishments

Associate Director for Research, School of Aerospace and Mechanical Engineering (AME)

1. Departmental proposal submissions increased 40% in 2022, exceeding $20 million.
2. Created five research cluster areas to assist with formulation of work groups and collaborative research efforts.
3. Created departmental SEED funding grants to support novel research ideas for large grant applications.
4. Developed proposal submission and research expenditure tracking matrices.
5. Mentored junior faculty members by providing guidance on proposal writing, connecting with other university-wide research groups and external collaborators including community outreach.
6. Developed tribal nation engagement to meet proposal requirements by Justice40, a new initiative from the Biden Administration.

Research Fellow, Institute for Resilient Environmental and Energy Systems (IREES)

1. Facilitated collaborative research initiatives between IREES and AME, connecting AME faculty with OU researchers as well as and other academic institutions, government organizations, community groups, and industry partners to support nascent ideas, ongoing research initiatives, proposal development, and trouble-shoot challenge areas.
2. Assisted with organizing seminars and reading groups to build an intellectual community within the IREES Energy and Infrastructure Signature Area that works toward new programs, publications, or collaborative grant-writing.
3. Organized ideation and teaming workshops to align faculty, particularly faculty in your home college/school, and partners to respond to large scale, multi-investigator proposals.

V. Publications

Refereed Journal Articles (Students/Former students are underlined)

J1. Wang, J., Tang, C.Y., Song, L. 2023. Analysis of predicted mean vote-based model predictive control in building HVAC systems. *Building and Environment*, in press

J2. Wang, G., Ghoddousi, S., Li, D., Song, L. 2022. Investigation of different cooling tower fan control strategies using COP of actual chillers and calibrated models of actual cooling towers and fans, *Energy and Buildings*, in press, available online https://doi.org/10.1016/j.enbuild.2022.112585.

J3. Li, D., Song, L., Wang, G. 2022. Energy and dehumidification performance investigation of different fan control modes of split residential air conditioners in hot and humid climates, 2022 ASHRAE Summer Conference. *ASHRAE Transactions,* in press.

J4. Wang, J., Tang, C.Y., Song, L. 2022. Analysis of precooling optimization for residential buildings. *Applied Energy* 323 (2022): 119574.

J5. Wang, Z., Hurt R., Wang, G., Song, L. 2022. Improving the nonlinear control performance of the supply fan at air handling units using a gain scheduling control strategy, *Science and Technology for the Built Environment*, DOI: 10.1080/23744731.2022.2040256.

J6. Wang, J., Jiang, Y., Tang, C.Y., Song, L. 2022. Development and validation of a second-order thermal network model for grid-interactive HVAC operation in residential buildings, *Applied Energy*, Vol. 306 (B):118124.

J7. Wang, Z., Wang, G., Song, L. 2020. Development of a Virtual Fan Airflow Meter for Electronically Commutated Motor Fan Systems, *Science and Technology for the Built Environment*, Vol. 27(3): 341-350.

J8. Wang, J., Tang, C.Y., Song, L. 2020. Design and analysis of optimal pre-cooling in residential buildings, *Energy and Buildings*, Vol. 216 (1):109951.

J9. Wang, J., Tang, C.Y., Song, L. 2020. Home envelope performance evaluation using a data driven method, *ASHRAE Transactions*, Vol. 126 (1).

J10. Wang, J., Tang, C.Y., Brambley, M.R., Song, L. 2019. Predicting home thermal dynamics using a reduced-order model and automated real-time parameter estimation, *Energy and Buildings*, Vol. 198: 305-317.

J11. Ogunsola, O., Wang, J., Song, L. 2019. Survey of particle production rates from process activities in pharmaceutical and biological cleanrooms, *Journal of Science and Technology for the Built Environment*, Vol. 25 (6): 692-704.

J12. Wang, Z., Andiroglu, E., Wang, G., Song. L. 2019. Accuracy Improvement of Virtual Pump Water Flow Meters using Calibrated Characteristics Curves at Various Frequencies, *Energy and Buildings*, Vol. 191: 143-150, https://doi.org/10.1016/j.enbuild.2019.03.021.

J13. Wang, G., Wang. Z., Song, L. 2018. Uncertainty analysis for different virtual pump water flow meters, *Journal of Science and Technology for the Built Environment*, Vol. 25(3): 297-308.

J14. Shabgard, H., Song, L., Zhu, W. 2018. Heat transfer and exergy analysis of a novel solar-powered integrated heating, cooling and hot water system with latent heat thermal energy storage, *Energy Conversion and Management*, Vol. 175: 121-131.

J15. Wang, G., Song, L. 2018. Performance assessment of variable frequency drives in heating, ventilation and air-conditioning systems, *Journal of Science and Technology for the Built Environment*, Vol. 24(10): 1075-1083.

J16. Shahahmadi, S., Song L. 2018. Valve flow meter enhancement through computing valve dynamics behaviors, *ASHRAE Transactions*, Vol. 124 (1). (**2018 ASHRAE Technical Paper Award**)

J17. Ogunsola, O., Song, L., Tang, C. Y. 2017. Minimization of electricity demand and cost for multi-zone buildings: Part I – modeling and validation, *Journal of Science and Technology for the Built Environment*, Vol.23 (6): 998-1012.

J18. Wang, G., Zheng, X., Andiroglu, E., Song, L. 2017. Energy and control performance investigation of air handling units with return air bypass. *ASHRAE Transactions*, Vol. 123 (1): 229-239.

J19. Rivas Prieto, A., Thomas, W. M., Song, L., Wang, G. 2017. In-situ fan curve calibration for virtual airflow sensor implementation in VAV systems, *ASHRAE Transactions*, Vol. 123 (1): 215-229. (**2017 ASHRAE Technical Paper Award**)

J20. Ogunsola, O., Song, L., Wang, Y. 2016. Analysis of passive thermal storage opportunities for optimal heating system design, *Science and Technology for the Built Environment*, Vol. 22 (3): 266-280.

J21. Wang, G., Kiamehr, K., Song, L. 2016. Development of a Virtual Pump Water Flow Meter with an Explicit Expression of Motor Power and Pump Head. *Energy and Building*. 117: 63-70. DOI:10.1016/j.enbuild.2016.02.003

J22. Andiroglu, E., Wang, G., Song, L., Kiamehr, K. 2016. Development of a virtual pump water flow meter using power derived from comprehensive energy loss analysis. *Science and Technology for the Built Environment*, Vol 22(2): 214-226.

J23. Wang, G., Kiamehr, K., Song, L. 2016. Development of a virtual pump water flow meter with a flow rate function of motor power and pump head, *Energy and Buildings*, 10.1016/j.enbuild.2016.02.003. Vol. 117: 63-70.
J24. Wang, O., Song, L., 2015. Application of a simplified thermal network model for real-time thermal load estimation, *Energy and Buildings*, Vol. 96: 309-318.
J25. Song, L., Wang, G. 2015. Integrated thermal-balance and data-driven methods to determine single duct variable air volume system cooling baseline in real-time for automatic energy audit, *Energy and Buildings*, Vol. 92: 363-373.
J26. Wang, G., Song, L. 2015. Investigation on energy and control performance of different damper control strategies in air handling units, *ASHRAE Transactions*, Vol. 121(1):110-122.
J27. Ogunsola, O., Song, L. 2014. Restoration of long-term missing gaps in solar radiation for building performance monitoring and analysis, *Energy and Buildings*, Vol. 82:580-591.
J28. Hu, J., Ogunsola, O., Song, L., McPherson, R., Zhu, M., Hong Y., Chen, S. 2014. Restoration of 1-24 hour dry-bulb temperature gaps for use in building performance monitoring and analysis-Part I, *HVAC&R Research*, Vol. 20(6):594-605.
J29. Hu, J., Ogunsola, O., Song, L., McPherson, R., Zhu, M., Hong Y., Chen, S. 2014. Restoration of missing climatic data with long-term gaps (up to 60 days) for use in building performance monitoring and analysis-Part II, *HVAC&R Research*, Vol. 20(6):606-615.
J30. Wang, G., Song, L. 2014. Energy Analysis, Optimal high limit control and engineering approach of air-side economizers, *ASHRAE Transactions,* Vol. 120 (2): 383-396.
J31. Ogunsola, O., Song, L. Wang, G. 2014. Development and validation of a time-series model for real-time thermal load estimation, *Energy and Buildings*, Vol. 76: 440-449.
J32. Wang, G., Song, L., Andiroglu, E. Shim, G. 2014. Investigations on a virtual airflow meter using projected motor and fan efficiencies, *HVAC&R Research*, Vol. 20(2):1-10.
J33. Shim, G., Song, L, Wang, G. 2014. Comparison of different fan control strategies on variable air volume systems through simulations and experiments, *Building and Environment*, Vol. 72: 212-222.
J34. Song, L., Wang, G. Brambley, M. 2013. Uncertainty analysis for a virtual valve flow meter at an air handling unit, *HVAC&R Research*. Vol. 19(3): 335-345.
J35. Wang, G., Song, L. 2013. Energy efficient air economizer control with low space humidity limit, *Energy and Buildings,* Vol. 64: 447-455.
J36. Wang, G., Song, L., Park, S. W. 2013. Estimation of induction motor circuit parameters and efficiency under variable frequencies, *ASHRAE Transactions*, Vol. 119(2):118-128.
J37. Hayes, T., Song, L., Dawson, M., Chancellor A. 2012. Heat balance analysis to validate the heat dissipation rate of a man-made lake as a heat rejection device in a power plant, *International Journal of Renewable Energy Research*, Vol. 2 (1): 78-83.
J38. Song, L., Joo, I and Guwana, S. 2012. Next-day daily energy consumption forecast model development and model implementation, *Journal of Solar Energy Engineering*, Vol. 134(3): 031002-1 to 031002-8.
J39. Swamy, A., Song, L., Wang, G. 2012. A virtual chilled water flow meter development at air handling unit level, *ASHRAE Transactions*, Vol. 118(1): 1013-1020.
J40. Song, L., Joo, I., Wang, G. 2012. Uncertainty analysis of a virtual water flow measurement in building energy consumption monitoring, *HVAC&R Research*, Vol. 18(5): 997-1010.
J41. Wang, G., Song, L. 2012. Air handling unit supply air temperature optimal control during economizer cycles, *Energy and Buildings*, Vol. 49: 310-316.

J42. Dong, D., Song, L. and Wei, G. 2008. Optimization of HVAC control to improve comfort and energy performance in a school, *Journal of Energy Engineering*, Vol. 105:6-22.
J43. Liu, M., Liu, G., Joo, I., Song, L. and Wang, G. 2005. Development of in-situ fan curve measurement for VAV AHU system, *Journal of Solar Energy Engineering*, Vol. 127 (2): 287-293.
J44. Song, L. and Liu, M. 2004. Optimal outside airflow control of integrated air handling unit system for large office buildings, *Journal of Solar Energy Engineering,* Vol. 126(1): 601-609.
J45. Liu, M. and Song, L. 2004. Simplified building and air handling unit model calibration and applications, *Journal of Solar Energy Engineering,* Vol. 126(1): 614-619.
J46. Song, L. and Liu, M. 2003. Improve energy and comfort performance of large office buildings using integrated interior and exterior air handling units, *ASHRAE Transaction*, Vol. 109(2):36-44.

Book chapters

B1. Song, L., Wang, G. Brambley, M. 2014. Building Automation System Embedded HVAC System Energy Performance Degradation Detector, Chapter 43, pp. 563-574, *Automated Diagnostics and Analytics for Buildi*ngs, B.L. Capehart and M.R. Brambley, eds., The Fairmont Press, Lilburn, Georgia.

Articles in Refereed Conference Proceedings

C1. Ejenakevwe, K. A., Wang, J., Song, L. 2022. Investigation of an IoT-Based approach for automated fault detection in residential HVAC systems, 2022 ASHRAE Summer Conference, TO-22-C025, June 25 – June 29, 2022, Toronto Canada.
C2. Jiang, Y., Song, L. 2022. Connected Home Energy Management for Grid-Interactive Operations: Consider Coupling Effect Among Appliances, 2022 ASHRAE Summer Conference, TO-22-C075, June 25 – June 29, 2022, Toronto Canada.
C3. Wang, Z., Hurt, R.D., Song, L., Andiroglu, E., Wang, G. 2022. Preliminary Investigation of Active Demand Flexibility Control at Air Handling Units Using Energy Feedback Control, 2022 ASHRAE Winter Conference, LV-22-C010, January 29 – February 2, 2022.
C4. Ejenakevwe, K. A., Song. L. 2021. Review of fault detection and diagnosis studies on residential HVAC systems, Proceedings of International Mechanical Engineering Congress and Exposition, IMECE2021-72745, November 1-5, 2021, Virtual.
C5. Starks. J., Song, L., Allen, J. K., Mistree, F. 2021. Integrating User Preferences into Improved Home Appliance Scheduling, 2021 ASME International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, DETC2021-70244, August 17-19, 2021, virtual
C6. Jiang, Y., Song, L., Allen, J. K., Mistree, F. 2021. Home Energy Management Systems (HEMS): Coupled Flexible Load Management in Homes, 2021 ASME International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, IDETC-71680, August 17-19, 2021, virtual.
C7. Hurt, R. D, Wang, G., Song. L. 2020. Evaluation of cooling coil valve response performance with advanced controls, 2020 ASHRAE Virtual Conference, VC-20-C027, June 29-July 2, 2020, virtual.
C8. Hakizimana, E., Shabgard, H., Song. L. 2020. Preliminary energy performance study of an integrated heating, cooling, and hot water system with latent heat thermal energy storage in

different U.S. climate zones, 2020 ASHRAE Virtual Conference, VC-20-C032, June 29-July 2, 2020, virtual.

C9. Wang, J., Tang, C. Y., Song. L. 2019. Model-based home envelope performance evaluation – A use case of data from connected thermostats, 2019 ASHRAE summer conference, KC-19-A020, June 22-26, 2019, Kansas City, MO.

C10. Wang, G., Z. Wang, Z. Han, L Song. 2019. An Approach for Motor Efficiency with Variable Frequency Drives, 2019 ASHRAE Annual Conference Proceedings, KC-19-A028, June 22–26, 2019, Kansas City, MO, USA.

C11. Hamidreza, S., Song, L., Zhu, W. 2018. Demand responsive solar-powered integrated cooling, heating and hot water system, Proceedings of 3rd Thermal and Fluids Engineering Conference, TFEC-2018-21723, Fort Lauderdale, FL.

C12. Kiamehr, L.K., Wang, G., a, S., Song, L. 2017. Experimental investigation on energy performance of variable frequency drives in HVAC systems, Proceedings of the 2017 AEI Conference, PP: 456-469, Oklahoma City, OK.

C13. Shahahmadi, S., Rivas Prieto, A., Song, L., Wang, G. 2017. Energy savings potential in a medical facility through costume minimum airflow resets, Proceedings of the 2017 AEI Conference, PP: 432-439, Oklahoma City, OK.

C14. Wang, G., Song, L. Wang, L. 2017. Energy efficient economizer controls for air handling units without humidity sensors, Proceedings of the 2017 AEI Conference, PP: 419-431, Oklahoma City, OK.

C15. Kiamehr, L. K., Rivas Prieto, A., Thomas, M.W., Wang, G., Song, L. 2016. Evaluation of Fault Detection and Diagnosis Methods for Air and Water Distribution Systems Using Virtual Flow Meters, ASHRAE 2016 Annual Conference, ST-16-C023, St. Louis MO.

C16. Rivas Prieto, A., Song, L., Wang, G. 2016. Uncertainty Studies of Airflow Measurements in Non-Ideal Conditions in Variable Air Volume Air Handling Units, accepted by ASHRAE summer conference, ST-16-C033, St. Louis MO.

C17. Song, L., Wang, G. Brambley, M. 2014. Building automation system embedded HVAC system energy performance degradation detector*, Proceedings of International Conference of Enhanced Building Operations,* ESL-IC-14-09-13, Beijing, China.

C18. Ogunsola, O., Song, L. 2014. Investigation of building passive thermal storage for optimal heating system design, *Proceedings of ASME 2014 International Mechanical Engineering Congress and Exposition,* IMECE2014-37128, Montreal, Canada.

C19. Ogunsola, O., Song, L. 2013. Performance analysis of simplified models of cooling load for a typical office building, *Proceedings of ASME 2013 International Mechanical Engineering Congress and Exposition,* IMECE2013-64040, San Diego CA.

C20. Andiroglu, E., Wang, G., Song, L.2013. Development of a virtual water flow meter using pump head and motor power, *Zero Energy Mass Customization Housing (ZEMCH2013) International Conference,* Miami, FL.

C21. Shim, G., Song, L., Wang, G. 2013. Using integration of thermal-balance based and data-driven models to determine single duct variable air volume system cooling baseline, *Proceedings of ASME 2013 International Mechanical Engineering Congress and Exposition,* ES-FuelCell-18402, Minneapolis, MN.

C22. Song, L., Wang, G., Brambley, M. 2013. Uncertainty propagation in device characteristic based virtual sensors, *ASHRAE Transactions*, Vol. 119(1): 1-8.

C23. Song, L., Wang, G., Swamy, A., Shim, G. 2012. In-situ resistance coefficient and experimental analysis of a virtual chilled water flow meter at air handling unit level,

Proceedings of ASME 2012 International Mechanical Engineering Congress and Exposition, IMECE2012-87634, Houston TX.

C24. Thomas, W., Song, L., Wang, G., Shim, G. 2012. Air-handling unit supply air temperature optimal economizer control experiment, *Proceedings of ASME 2012 International Mechanical Engineering Congress and Exposition*, IMECE2012-87109, Houston TX.

C25. Shim, G., Song, L., Wang, G. 2012. Analytical model and analysis of different fan control strategies on VAV systems, *Proceedings of ASME 2012 International Mechanical Engineering Congress and Exposition, IMECE2012-88191*, Houston TX.

C26. Ogunsola, O., Song, L. 2012. Review and evaluation of using R-C thermal modeling of cooling load prediction for HVAC system control purpose, *Proceedings of ASME 2012 International Mechanical Engineering Congress and Exposition,* IMECE2012-86988, Houston TX.

C27. Braneski, B., Song, L. 2012. Air handling unit level fault signature development using EnergyPlus, *Proceedings of ASME 2012 International Mechanical Engineering Congress and Exposition,* IMECE2012-87574, Houston TX.

C28. Song, L., Swamy, A., Shim, G., Wang, G. 2011. Feasibility study of developing a virtual chilled water flow meter at air handling unit level, *Proceedings of International Conference of Enhanced Building Operation,* ESL-IC-11-11-028, New York City.

C29. Hayes, T., Song, L., Dawson, M., Chancellor, A. 2011. Heat balance analysis to validate the heat dissipation rate of a man-made lake as a heat rejection device in a power plant, *Proceedings of International Conference of Enhanced Building Operation*, ESL-IC-11-11-027, New York City.

C30. Song, L., Joo, I., Guwana, S. 2010. Minimize on-peak and off-peak demands for a thermal storage system – forecast model analysis to predict next day daily average load and model application, *Proceedings of the 4th International Conference on Energy Sustainability*, ES2010-90472, Phoenix, Arizona.

C31. Song, L., Joo, I., Guwana, S. 2009. Real-time forecast model analysis of daily average building load for a thermal storage system control, *Proceedings of 9th International Conference of Enhanced Building Performance,* ESL-IC-09-11-03, Austin TX.

C32. Joo, I., Song, L., Liu, M., Douglas, B. 2008. Optimal control in three-deck multi-zone air-handling unit, *Proceedings of 16th Symposium on Improving Building Systems in Hot and Humid Climates,* ESL-HH-08-12-17, Dallas, TX.

C33. Joo, I., Song, L., Liu, M., Carico, M. 2008. Demand-based optimal control to save energy, *Proceedings of 16th Symposium on Improving Building Systems in Hot and Humid Climates,* ESL-HH-08-12-16, Dallas TX.

C34. Song, L., Joo, I., Liu, M. 2005. Energy use and performance of a new variable primary-flow chilled water system, *Proceedings of 2005 International Solar Energy Conference sponsored by ASME*, ISEC2005-76066, Orlando, FL.

C35. Song, L., Joo, I., Dong, D., Liu, M. 2003. Optimizing HVAC control to improve building comfort and energy performance, *Proceedings of the International Conference for Enhanced Building Operations*, ESL-IC-03-10-11, Berkeley, CA.

C36. Liu, G., Joo, I., Song, L., Liu, M. 2003. Development of in-situ fan curve measurement with one airflow measurement, *Proceedings of International Conference of Enhanced Building Operations*, ESL-IC-03-10-29, Berkeley, CA.

C37. Song, L., Liu, M. 2003. Optimal outside airflow control of integrated air handling unit system for large office buildings, *Proceedings of ASME Solar Energy Conference,* ISEC2003-44027, Kohala Coast, Hawaii.
C38. Liu, M., Song, L. 2003. Simplified building and air handling unit model calibration and applications, *Proceedings of ASME Solar Energy Conference,* ISEC 2003-44023, *ISEC 2003*, Kohala Coast, Hawaii.
C39. Song, L., Liu, M., Claridge, D.E., Haves, P. 2003. Study of on-line simulation for whole building level energy fault detection, *Proceedings of Building Integration Solutions*, ASCE40699 (2013)14, Austin TX.
C40. Wang, G., Joo, I., Song, L., Liu, M. 2003. Integrated whole facility system optimization through continuous commissioning: a case study, *Proceedings of Building Integration Solutions*, ASCE40699 (2013)12, Austin TX.
C41. Liu, M., Joo, I., Song, L., Wang, J. 2003. Implementation and demonstration of continuous commissioning leading energy retrofit process, *Proceedings of National Conference on Building Commissioning,* Palm Springs, CA.
C42. Song, L., Liu, M. 2002. The integrated air handling unit versus the two dedicated air handling unit system, *Proceedings of Thirteenth Symposium on Improving Building Systems in Hot and Humid Climates*, ESL-HH-02-05-08, Houston, Texas.
C43. Song, L., Liu, M. 2001. An integrated air handling unit system for large commercial buildings, *Proceedings of the International Conference for Enhanced Building Operations*, ESL-IC-01-07-12, Austin, TX.
C44. Li, D., Song, L., Zhao, X. 1998. Research of development and application for LabView, *Fifth National Computer Application Academic Discussion*, Beijing, China.
C45. Liu, X., Song, L. 1998. Approximate calculation forms of air-conditioning system load of four kinds of commercial buildings,*'98 Proceedings of National HVAC Annual Academic Conference,* Beijing, China.

A. <u>Invited talks</u>

1. Host and speaker, *"Applying virtual airflow meter technology in commercial buildings"*, four-day workshop, June 17 to 20, 2019 Norman OK.
2. Speaker*, "Virtual sensors and a systematic data connection framework for advanced building comfort system diagnosis and optimal control",* Lunch Seminar Series in College of Architecture*,* October 18, 2017, Norman OK.
3. Speaker, *"Design a systematic data connection framework for advanced building comfort system diagnosis and optimal controls",* Texas A&M Fall 2017 Graduate MEEN 681 Seminar Series*,* October 4, 2017, College Station, TX.
4. Speaker*, "Building performance degradation detection through enhanced virtual sensor technologies",* News Release Conference of Better Buildings in China*,* July 24, 2017, Beijing, China.
5. Speaker, *"Building performance degradation detection through enhanced virtual sensor technologies",* The Dalian University of Technology Graduate Seminar Series*,* July 7, 2017, Dalian, China.
6. Keynote speaker*, "New Challenges for 21st Century Architects and Mechanical Engineers",* 2013 Global Conference on Educational Robotics*,* July 10, 2013, Norman OK.

B. Other Publications and Presentations

1. Jiang, Y., Song, L., Allen, J. K., Mistree, F. 2021. Design of a home energy management system (HEMS), 2021 AIAA, March 22, 2021, virtual
2. Final Project Report: Song, L. Wang, G., Brambley M. R., 2018. Demonstration of a building automation system embedded performance degradation detector using virtual meters, Research project: EW201407, November 2018.
3. Final Project Report: Song, L. Miller, P.D., 2017. Prototype design of a virtual energy meter for enhanced building operations, Research project: OCAST AR15-062, November 2017.
4. Poster Presentation: Song. L. 2017. Demonstration of a building automation system embedded performance degradation detector using virtual meters, 2017 SERDP and ESTP Symposium, November 28, Washington D.C.
5. Presentation: Wang, J., Tang, C.Y., Song, L. 2017. Describe home thermal dynamics using a second-order home thermal model and real-time parameter estimation, 2017 AIAA/ASME Oklahoma Symposium, Tulsa, OK.
6. Presentation: Shahahmadi, S., Song, L. 2017. Energy savings potential in a medical facility through costume minimum airflow resets, 2017 AIAA/ASME Oklahoma Symposium, Tulsa, OK.
7. Final Project Report: Ogunsola, O., Wang, J., Song, L. 2016. Survey of particle production rates from process activities in pharmaceutical and biological cleanrooms, ASHRAE research project 1399-RP under the guidance of Research Committee 9.11 and 1399 PMS, May 2016.
8. Presentation: Shahahmadi, S., Song, L. 2016. Control valve stiction study for enhancing valve flow meter accuracy, 2016 AIAA/ASME Oklahoma Symposium, Norman, OK.
9. Presentation: Rivas Prieto, A., Song, L., Wang, G. 2016. Uncertainty Studies of Airflow Measurements in Non-Ideal Conditions in Variable Air Volume Air Handling Units, 2016 AIAA/ASME Oklahoma Symposium, Norman, OK.
10. Presentation: Ogunsola, O., Junke, W., Song, L. 2016. Survey of particle production rates from process activities in pharmaceutical and biological cleanrooms, 2016 AIAA/ASME Oklahoma Symposium, Norman, OK.
11. Presentation: Ogunsola, O., Song, L. 2016. Investigation of methodologies for minimizing buildings electricity demand and cost, 2016 AIAA/ASME Oklahoma Symposium, Norman, OK.
12. Presentation: Ogunsola, O., Song, L. 2014. Investigation of building passive thermal storage for optimal heating system design, 2014 AIAA/ASME Oklahoma Symposium, Oklahoma City, OK.
13. Final Project Report: Hong Y., Song, L., McPherson, R., Zhu, M., Hu, J. Developing Standard Procedures for Filling Climatic Data Gaps for use in Building Performance Monitoring and Analysis, ASHRAE research project 1413-RP under the guidance of Research Committee 4.2 and 1413 PMS, September 2013.
14. Final Project Report: Tassevigen, D.J., Huang, Y., Lutes, R., Brambley, M. R., Song, L., Automated fault detection algorithms for use with a virtual chilled-water flow meter for air-handling units, Research project from U.S. Department of Energy under contract DE-AC05-76RL01830, October 2012.
15. Seminar: Song, L., Wang, G., *Unit level energy monitoring fault detection and diagnosis for high energy performance buildings*, AEI/ASHRAE EXPO 2012, March 7, Omaha NE.

16. Seminar: Wang, G., Song, L., Park, S.W., Estimation of induction motor efficiency under variable frequencies, AEI/ASHRAE EXPO 2012, March 7, Omaha NE.
17. Presentation: Swamy, A., Song, L., Wang, G., *A virtual flow meter development at air handling unit level for high energy performance buildings*, 2011 AIAA/ASME Oklahoma Symposium, Norman OK.
18. Presentation: Dawson, M., Haben, M., Hayes, T., Kimmel, J., Song, L., *Using evaporation heat transfer in a lake to enhance the efficiency of the generator condenser*, 2011 AIAA/ASME Oklahoma Symposium, Norman OK.
19. Final Project Report: Liu, M., Song, L., Claridge, D.E., 2003. *Development of whole building fault detection methods*, the California Public Interest Energy Research Program, Report HPCBS#E5P23T1c.
20. Final Project Report: Liu, M., Claridge, D. and Song, L., 2002. *Potential of on-line simulation for fault detection and diagnosis in large commercial buildings with built-up HVAC systems*," Lawrence Berkeley National Laboratory.

VI. Mentoring and Teaching

A. Individual Student Guidance

M.S. Students

Completed:

1. Atul Swamy. Thesis: *Non-intrusive unit level water flow measurements*. **Papers: J39, C23, C28.** He started in Fall 2009 and completed in Fall 2011. He is currently working as a Senior Mechanical Engineer in Johnson Controls.
2. Briana Braneski. Thesis: *Use air handling unit level energy index to identify system operation faults*. **Paper: C27.** She started in Fall 2011 and completed in Spring 2013. She is currently working at Chevron Corporation in Houston, TX.
3. Guyjin Shim. Thesis: *Using integration of thermal-balanced and data-driven models to determine cooling load and fan power baseline for a single duct variable air volume systems.* **Papers: J32, J33, C21, C23-25, C28.** He started master in Fall 2012 and finished his master in Summer 2013. He went back to Korea and working in his home town.
4. Daniel Cabrera Mora. *Improve indoor environment control for an incubator.* He started in Spring 2012 and finished in Fall 2013. Co-chaired with Dr. Lai. He started working at HP, Oklahoma City, in January 2014.
5. Wesley M. Thomas. Thesis: *Simulation and experiments of air-handling unit supply air temperature optimal control.* **Papers: J19, C15, C24.** He started in Fall 2012 and finished in Summer 2014.
6. Junke Wang. Thesis: *Control and energy performance study of different secondary chilled wáter pump operations*. He was a visiting master student from China and defended his thesis in June 2016 in his home university (Beijing University of Architectural and Civil Engineering). He is currently working on his Ph.D. with me.
7. Alejandro Rivas Prieto. Thesis*: Uncertainty study of in-situ airflow measurements for fan curve calibration in air handling units*. **Papers: J19, C13, C15-16.** He started in Spring 2015 and finished in Fall 2016. He currently works as a design engineer in Miami FL.
8. Shima Shahahmadi. Dissertation: *Numerical and experimental study of control valve characteristics and their impacts on HVAC system control stability.* **Papers: J16, C12-13.** She transferred from Ph.D. program to the master program in Spring 2018 and graduated in Fall 2018. She is currently working as a mechanical engineer in Climate Master in OKC.

9. David Lee. Thesis: Study of an automated AHU energy performance auditor using a cloud-based data acquisition system. He started in Fall 2017 and finished in Spring 2019.
10. Tianyang Zhao. Non-Thesis. He started in Fall 2017 and finished in Spring 2019.
11. Emmanuel Hakizimana. Thesis: Solar-powered integrated heating, cooling and hot water system with latent heat thermal energy storage. **Papers: C8.** He started in August 2018 and finished in Summer 2020.
12. Rodney R. Hurt. Thesis: Distributed energy feedback control for demand response operations in commercial HVAC systems. **Papers: J5, C3, C7.** He started in Summer 2019 as a M.S. and finished in August 2021.
13. Marwan Hashen. Thesis topic: Analysis and application of virtual-flow meter technology for chiller-water valve and outside-air controls. August 2021 to May 2022.
14. Luyao Xie. Thesis topic: Development of Envelope Evaluation Benchmarks Using EnergyPlus and Data-Driven Thermal Model. She started her M.S in August 2021 and graduated in December 2022.

Ph.D. students

Completed:

1. Oluwaseyi Ogunsola. Dissertation: *Investigation of methodologies for minimizing buildings electricity demand and cost.* **Papers: J11, J17, J20, J24, J27-29, J31, C18-19, C31.** He started in Fall 2011 and graduated in Spring 2016. He was awarded with eight scholarship and fellowship during his Ph.D. study.
2. Junke Wang. Dissertation: *Design and analysis of building thermal model for grid-interactive efficient operations*. **Papers: J1, J4, J6, J8-11, and C1, C9.** He started his Ph.D. at OU in Summer 2017 and graduated in Fall 2020. He currently is a postdoc fellow at Pacific Northwest National Laboratory.

In progress

1. Yilin Jiang. Dissertation: Smart networked energy management system for homes (home-EMS). **Papers: J6, C2, C6.** She started her Ph.D. in January 2020 after finishing her M.S. in Math and will defend her dissertation in Summer 2023.
2. Kevwe Andrew Ejenakevwe. Dissertation: Learning-based energy performance degradation detection for residential comfort systems. **Papers: C1, C4.** He started his Ph.D. in Spring 2021.
3. Nurayn Tiamiyu. Dissertation: District geothermal system design and operation. He started his PH.D. in Fall 2022.

B. Courses taught

AME 4653: Air-Conditioning Systems (Design of Building Environmental Systems)

Course description:

This course is a building mechanical system design course. It is required for Architectural Engineering students at the University of Oklahoma but is an elective course for Mechanical Engineering students. The course was designed in Fall 2009 and was offered in Spring 2010. The course is designed to prepare students with the theory and design knowledge of building mechanical systems, which is necessary for human comfort or to create a specified indoor environment for production and/or research. Properties such as temperature, humidity, air purity, air distribution and noise in are discussed and appropriate ways of controlling them are presented.

My contribution:

I offered this course as brand-new course in AME since Spring 2010 until present, once a year. Enrollment has gone from initial 10 students to currently close to 50 students.

AME 5740: Design of Energy Efficient Systems in Buildings
Course description:
This is a graduate course. It is designed to prepare students with the analytical analysis skills to design energy efficient systems for buildings. The topics include building HVAC control principles and understanding of the control and mechanical elements (control valves, dampers, fans and coils) and methods of modeling them and their energy consumption for different types of systems. Further, methods for identifying optimal solutions to minimize energy consumption will be covered. At the end of the course, students will attain the skills to design energy efficient HVAC systems and will also gain an appreciation of the relative contribution of each component to the total building energy consumption.
My contribution:
I offered this course as a brand-new course in AME since 2010 until present, once a year.

AME 2213: Thermodynamics
Course description:
It focuses on properties of pure substances, ideal gas behavior, first and second law analysis and application to energy conversion and power cycles.
My contribution:
This course is a fundamental course in AME.

AME 4553: *Design Practicum (Capstone)*
Course description:
It focuses on development of student's ability to apply his/her acquired knowledge to solve engineering problems and to design realistic systems, components and/or processes and the development of student's ability to function in a team environment to gain organization and communication skills to understand professional and ethical responsibilities, to promote initiative, innovation and excellence and to foster life-long learning.
My contribution:
This course is a senior design course in AME. I established a project management scheme and a brand-new rubric to quantitively evaluate student performance throughout the semester.

VII. Service

A. Professional Contributions

1. The Chair of ASHRAE Technical Committee 7.5 Smart Buildings
   July 2022 to present
2. The Vice Chair of ASHRAE Technical Committee 7.5 Smart Buildings
   July 2020 to June 2022
3. The Research Chair of ASHRAE Technical Committee 7.5 Smart Buildings
   July 2018 to June 2020

4. Technical advisory group member for Building Optimization Performance Testing (BOPTEST) by Lawrence Berkeley National Laboratory, Pacific Northwest National Laboratory and National Renewable Energy Laboratory.
   August 2018 to present
5. An alternate of ASHRAE handbook committee
   January 2017 to present
6. Invited external thesis and dissertation defense committee member, Institute of Building Energy, in Dalian University of Technology
   July 2017
7. Journal and conference paper reviewers
   Journal of Science and Technology for the Built Environment, Energy and Buildings, International Journal of Heat Transfer, ASHRAE Transactions, ASME annual conference, ASHRAE annual conference (2009-present)
8. The committee secretary for ASHRAE TC7.5 Smart Buildings
   July 2017 to June 2018
9. The technical sub-committee (Building Operation Dynamics) chair for ASHRAE TC7.5 Smart Buildings
   January 2014 to June 2017

B. Contributions to the university, college and department at OU

1. Search committee chair, Sustainable Energy System Simulation, January 2021 to May 2021
2. Search committee member, Urban Climate, September 2021 to January 2022
3. Search committee member, ECE Power Engineering, September 2019 to December 2021
4. Member, Academic Program Review Committee, the University of Oklahoma, August 2021 to present.
5. Member, College Tenure/Promotion Committee, the University of Oklahoma, August 2021 to present.
6. Speaker, 2020 Halliburton Women's Welcome.
7. Member, Clean and Green Committee to Combat Covid, the University of Oklahoma, July 2020 to December 2020.
8. Library liaison, AME, July 2009 to present.
9. Member, Research council, the University of Oklahoma, August 2017 to May 2020.
10. Member, Committee A (the advisory committee for the school director), July 2017 to June 2019.
11. Member, Dean's evaluation committee, September 2017 to August 2018.
12. Project manager, Energy Initiative, College of Engineering (CoE) Strategic Plan 2014~2018, Executive Committee from May 2014 to May 2018.
13. Member, UG mechanical engineering curriculum committee, September 2010 to July 2017.
14. The faculty advisor of OU student ASHRAE branch. I established the branch in September 2010 and continuously served until September 2018.

VIII Grants and Contracts

(The amount and percentage are based on the fund received by OU)

1. Advanced HVAC Load Management using Cascade Controls Integrating Chillers, Air Handling Units, and Terminal Boxes, University of Miami, PI: L. Song (100%), $269,395, contract negotiation.
2. Performance demonstration of an integrated water-source heat pump water heater system to meet simultaneous heating and cooling demands at military installations, DoD ESTCP program, PI: L. Song (100%), $1,184,269, contract negotiation.
3. Intelligent HVAC Load Management for Energy Efficient and Disaster Resilient Building Operations, Oklahoma Gas & Electric under the contract with DoD ESTCP program, PI: L. Song (100%), $603,375, August 2020 to July 2024.
4. Smart networked energy management system for homes (home-EMS), OCAST, PI: Li Song (33%), co-PIs: J.K. Allen, F. Mistree, $90,000, July 2020 to March 2023.
5. Performance demonstration of an occupancy sensor-enabled integrated solution for commercial buildings, University of Miami, PI: L. Song (100%), $283,433 (20% non-federal cost share), May 2019 to June 2023.
6. Development and validation of a system for total performance deficiency/fault detection and optimal comfort control for homes, DOE Residential Building Integration Program, PI: L. Song (70%), co-PIs: Choon Yik Tang (OU), $1.29 Million (25% non-federal cost share), May 2019 to January 2023.
7. Transactive-control based connected home solution for existing residential units and communities: Controls Testing, Pacific Northwest National Laboratory, PI: L. Song (100%), $74,217, April 2021 to March 2022.
8. Air diffusion performance study of non-isothermal jet in a paint hanger, Tinker Air Force Base, PI: L. Song (50%), co-PI: D.K. Walters (50%), $139,877. May 2020 to July 2021.
9. Transactive-control based connected home solution for existing residential units and communities: Controls Testing, Pacific Northwest National Laboratory, PI: L. Song (100%), $68,064, May 2020 to March 2021.
10. Virtual flow meter technology transfer, Singapore Building Construction Authority Academy, PI: L. Song (100%), $29,000, August 2018 to December 2020.
11. Demonstration of a building automation system embedded performance degradation detector using virtual water/air flow meters, Environmental Security Technology Certification Program of U.S. Department of Defense, PI: L. Song (100%), $940,731, October 2014 to November 2018.
12. Prototype design of a virtual energy meter for enhanced building operations, Oklahoma Center for the Advancement of Science and Technology (OCAST), PI: L. Song (60%), co-PI: D. P. Miller, $90,000, August 2015 to December 2017.
13. Survey of particle production rates from process activities in pharmaceutical and biological cleanrooms, American Society of Heating, Ventilation and Air-Conditioning Engineers, PI: L. Song (100%), $237,346, April 2014 to March 2016.
14. Develop and test virtual air-handler energy use performance monitor, Building Technologies Office of U.S. Department of Energy, PI: L. Song (100%), co-PI: G. Wang, $100,000, April 2012 to October 2012.
15. Developing standard procedures for filling climate data gaps for use in building performance monitoring and analysis, ASHRAE TC4.2, PI: Y. Hong, co-PIs: L. Song (50%), R. McPherson, M. Zhu. $118,934, September 2011 to September 2013.

16. Summer research collaboration: Development of automated FDD, control, and self-correcting algorithms, Pacific Northwest National Laboratory (PNNL), PI: L. Song (100%), $34,992, June 2011 to March 2012.

IX. Awards and Media Coverage

1. "Professor transforms old home into full-scale lab", Oklahoma News Channel 4, December 2022
2. "The thermal house that Song Built: 1940's home transformed to research lab", Journal Record, December 2022.
3. "OU researchers developing smart AC system", Journal Record, August 2019.
4. "Getting smarter about your home", Energy Design Update, May 2019.
5. 2019 Lloyd G. and Joyce Austin Presidential Professorship, April 2019.
6. 2018 Technical Paper Award, ASHRAE, Kansan City, MO, June 2019.
7. 2017 Technical Paper Award, ASHRAE, Houston, TX, June 2018.
8. "OU researcher uses sensors to boost airflow efficiency." The Oklahoman. July 11th 2014.
9. "Now, a formula to halve power bills." Times of India, February 24th 2014.
10. Development of an automated unit-level energy monitoring fault detection and diagnostic (ULEM - FDD) for high energy performance buildings, awarded as one of the five 2011 ConocoPhillips Energy Prize finalists. Total prize is $25,000. Awardees: L. Song and G. Wang.
11. An innovative air-handling design for research lab facilities is awarded for 2006 Bes-Tech Innovation of Technology Award. Total prize is $5,000. Awardee: L. Song.
12. Milton E. Mohr Research Fellowship, University of Nebraska, 2003. Total prize is $1,000. Awardee: L. Song.
13. Excellent class advisor, Beijing Institute of Civil Engineering and Architecture (Beijing University of Architecture), 1997-1998.
14. Excellent teaching award (Beijing University of Architecture and Civil Engineering), 1998.
15. Student awards under my advisement:
    - Amber Kapoor (2014 to 2015):
      - 2015 NSF Graduate Fellowship.
    - Oluwaseyi Ogunsola (2011 to 2016)
      - Cleo Cross International Student Scholarship, University of Oklahoma (2015).
      - Jim and Bee Close and John E. Francis Fellowship for Outstanding Academic and Research Performance, School of Aerospace and Mechanical Engineering, University of Oklahoma (2015).
      - ASHRAE OCCF Scholarship for contribution to HVAC&R research (2015).
      - Recipient of British Petroleum (BP) Fellowship, School of Aerospace and Mechanical Engineering, University of Oklahoma (2014).
      - ASHRAE OCCF Scholarship for contribution to HVAC&R research (2014).
      - Graduate College International Travel Scholarship, University of Oklahoma (2014).
      - Conference Travel Award, School of Aerospace and Mechanical Engineering, University of Oklahoma (2014).
      - Phi Kappa Phi Honor Society, University of Oklahoma, (2013).
    - Alejandro Rivas Prieto (2015 to 2016)
      - OU VENOKAL scholarship award (2016).

- ASHRAE OCCF Scholarship for contribution to HVAC&R research (2015).

- Junke Wang (2015 to Present)
  - Frank Chuck Mechanical Engineering Scholarship (2019).
  - GGoE Dissertation Excellence Award (2020)

X Patents and Invention Disclosures

1. A virtual flow meter method and system for controlling an air-handling unit, provisional patent filed in May 2013 through the University of Oklahoma. Docket Number: 5839.117; Inventors: L. Song and G. Wang.
2. A smart performance monitoring and energy-cost prediction system for home HVAC systems, disclosure filed in January 2017 through the University of Oklahoma. Invention Disclosure Number: 2017-028; Inventors: L. Song and C.Y. Tang.
3. Self-powered low-cost smart air/water pressure sensor, disclosure filed in January 2017 through the University of Oklahoma. Invention Disclosure Number: 2017-027; Inventors: Y. Liu and L. Song.
4. Flow device and control system and method for HVAC system monitoring, provisional patent filed in January 2018 through the University of Oklahoma. Docket Number: 5839.147; Inventors: L. Song and G. Wang.
5. Monitoring system for residential HVAC systems, provisional patent filed in February 2018 through the University of Oklahoma. Docket Number: 5839.148; Inventors: L. Song and C.Y. Tang.
6. Flow device and control system and method for HVAC system monitoring, **the Notice of Allowance was issued in July 2020**. Docket Number: 5837.157; Inventors: L. Song and G. Wang.
7. Monitoring system for residential HVAC systems, **the Notice of Allowance was issued in March 2021**. Docket Number: 5837.158; Inventors: L. Song and C.Y. Tang.
8. System and method for residential HVAC control, provisional patent filed in May 2021 through the University of Oklahoma. Docket Number: 5839.166; Inventors: L. Song, C.Y. Tang., J.K. Wang, Y.L. Jiang.