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

School of Aerospace and Mechanical Engineering
University of Oklahoma

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I Earned Degrees

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

II Professional Registration

Professional Engineer (Mechanical), State of Texas #96744 since 2006
Member of ASHRAE since 2000
Member of ASME since 2009

III Employment

Associate Professor	**School of Aerospace and Mechanical Engineering University of Oklahoma, Norman**	**07/15-present**
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
Research Assistant	University of Nebraska – Lincoln	08/00-08/04
Assistant Professor	Beijing University of Civil Engineering and Architecture, Beijing	07/96-08/00

IV. Publications

A. Refereed Publications

Refereed Journal Articles (Students/Former students are underlined)

J1. Ogunsola, O., Wang, J., Song, L. Survey of particle production rates from process activities in pharmaceutical and biological cleanrooms, *Journal of Science and Technology for the Built Environment*, **in press**.

J2. Wang, Z., Andiroglu, E., Wang, G., Song. L. Accuracy Improvement of Virtual Pump Water Flow Meters using Calibrated Characteristics Curves at Various Frequencies, Energy and Buildings, **in press**.

J3. 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*, DOI: 10.1080/23744731.2018.1526015.

J4. 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.

J5. 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*, in press, DOI: 10.1080/23744731.2018.1469947, available online April 2018.

J6. Shahahmadi, S., Song L. 2018. Valve flow meter enhancement through computing valve dynamics behaviors, *ASHRAE Transactions*, Vol. 124 (1). (**2018 ASHRAE Technical Paper Award**)

J7. 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.

J8. 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.

J9. 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**)

J10. 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.

J11. 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

J12. 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.

J13. 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.

J14. Ogunsola, O., Song, L., 2015. Application of a simplified thermal network model for real-time thermal load estimation, *Energy and Buildings*, Vol. 96: 309-318.
J15. 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.
J16. 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.
J17. 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.
J18. 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.
J19. 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.
J20. 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.
J21. 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.
J22. 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.
J23. 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.
J24. 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.
J25. Wang, G., Song, L. 2013. Energy efficient air economizer control with low space humidity limit, *Energy and Buildings*, Vol. 64: 447-455.
J26. 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.
J27. 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.
J28. 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.
J29. 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.
J30. 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.
J31. Wang, G., Song, L. 2012. Air handling unit supply air temperature optimal control during economizer cycles, *Energy and Buildings*, Vol. 49: 310-316.
J32. 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.

J33. 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.
J34. 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.
J35. 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.
J36. 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 Build*ings, B.L. Capehart and M.R. Brambley, eds., The Fairmont Press, Lilburn, Georgia.

Articles in Refereed Conference Proceedings

C1. Wang, J., Tang C. Y., Song. L. Model-based home envelope performance evaluation – A use case of data from connected thermostats, submitted for 2019 ASHRAE summer conference, under review.
C2. 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.
C3. Kiamehr, L.K., Wang, G., Shahahmadi, 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.
C4. 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.
C5. 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.
C6. 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.
C7. 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.
C8. 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.
C9. 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.

C10. 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.

C11. 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.

C12. 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.

C13. Song, L., Wang, G., Brambley, M. 2013. Uncertainty propagation in device characteristic based virtual sensors, *ASHRAE Transactions*, Vol. 119(1): 1-8.

C14. 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.

C15. 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.

C16. 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.

C17. 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.

C18. 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.

C19. 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.

C20. 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.

C21. 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.

C22. 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.

C23. 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.

C24. 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.

C25. 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.

C26. 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.

C27. 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.

C28. 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.

C29. 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.

C30. 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.

C31. 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.

C32. 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.

C33. 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.

C34. 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.

C35. Li, D., Song, L., Zhao, X. 1998. Research of development and application for LabView, *Fifth National Computer Application Academic Discussion,* Beijing, China.

C36. 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.

B. <u>Invited talks</u>

1. *"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.
2. *"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.

3. *"Building performance degradation detection through enhanced virtual sensor technologies"*, News Release Conference of Better Buildings in China, July 24, 2017, Beijing, China.
4. *"Building performance degradation detection through enhanced virtual sensor technologies"*, The Dalian University of Technology Graduate Seminar Series, July 7, 2017, Dalian, China.
5. *Keynote speaker, "New Challenges for 21st Century Architects and Mechanical Engineers"*, 2013 Global Conference on Educational Robotics, July 10, 2013, Norman OK.

C. Other Publications and Presentations

1. 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.
2. 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.
3. 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.
4. 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.
5. 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.
6. Presentation: Shahahmadi, S., Song, L. 2016. Control valve stiction study for enhancing valve flow meter accuracy, 2016 AIAA/ASME Oklahoma Symposium, Norman, OK.
7. 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.
8. 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.
9. Presentation: Ogunsola, O., Song, L. 2016. Investigation of methodologies for minimizing buildings electricity demand and cost, 2016 AIAA/ASME Oklahoma Symposium, Norman, OK.
10. 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.
11. 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.
12. 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.

13. 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.
14. Seminar: Wang, G., Song, L., Park, S.W., Estimation of induction motor efficiency under variable frequencies, AEI/ASHRAE EXPO 2012, March 7, Omaha NE.
15. 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.
16. 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.
17. 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.
18. 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.

V. Teaching

A. Individual Student Guidance

M.S.

Completed:

1. Atul Swamy. Thesis: *Non-intrusive unit level water flow measurements*. **Papers: J29, C14, C19.** 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: C18.** 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: J22, J23, C12, C14, C15, C16, C19.** 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: J9, C6, C15.** 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: J9, C4, C6, C7.** 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: J6, C3, C4.** 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.

In progress

1. David Lee. Thesis: Study of an automated AHU energy performance auditor using a cloud-based data acquisition system. He started in Fall 2017 and will finish in Spring 2019.
2. Tianyang Zhao. Non-Thesis. He started in Fall 2017 and will finish in Spring 2019.

Ph.D.

Completed:

1. Oluwaseyi Ogunsola. Dissertation: *Investigation of methodologies for minimizing buildings electricity demand and cost.* **Papers: J1, J7, J14, J17, J18, J19, J20, C9, C10, C17.** He started in Fall 2011 and graduated in Spring 2016. He was awarded with eight scholarship and fellowship during his Ph.D. study.

In progress

1. Junke Wang. Dissertation: *Thermal modeling for residencial building termal load forecast to enable human-in-the-loop demand management*. **Papers: J1, C1 and three more under construction.** He started working with me as a visiting student from China by the sponsorship from my research laboratory since Fall 2015 and started his Ph.D. at OU in Summer 2017. He plans to finish his Ph.D. in Fall 2019.
2. Emmanuel Hakizimana. Dissertation: Solar-powered integrated heating, cooling and hot water system with latent heat thermal energy storage. He started in August 2018.

Transferred:

1. 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.* He started his Ph.D. in Fall 2010 and transferred to the master program in Spring 2013.
2. Amber Kapoor. Dissertation: *Study of energy-based economizer for optimal outdoor air control*. She started in Fall 2014. She was awarded by NSF graduate fellowship in September 2015 and transferred to pursue her Ph.D. in the University of Massachusetts, Amherst in Spring 2016.
3. Shima Shahahmadi. Dissertation: *Numerical and experimental study of control valve characteristics and their impacts on HVAC system control stability.* She started in Spring 2016 and transferred to the master program in Spring 2018.

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.

VI. Service

A. Professional Contributions

1. 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)
2. The research chair of ASHRAE TC7.5 Smart Buildings
   July 2018 to present
3. An alternative member for ASHRAE handbook committee
   January 2017 to present
4. A guest professor in the Dalian University of Technology
   July 2017 to present
5. A guest professor in the Beijing University of Architecture
   July 2014 to present
6. The committee secretary for ASHRAE TC7.5 Smart Buildings
   July 2017 to June 2018
7. 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. Member, Research council, The University of Oklahoma, August 2017 to present.
2. Member, Committee A (the advisory committee for the school director), July 2017 to present.
3. Member, Dean's evaluation committee, September 2017 to August 2018.
4. Project manager, Energy Initiative, College of Engineering (CoE) Strategic Plan 2014~2018, Executive Committee from May 2014 to present.
5. Member, UG mechanical engineering curriculum committee, September 2010 to July 2017.
6. The faculty advisor of OU student ASHRAE branch. I established the branch in September 2010 and continuously served until September 2018.

VII Grants and Contracts

1. Performance demonstration of an occupancy sensor-enabled integrated solution for commercial buildings, DOE BENEFIT Program, PI: G. Wang (University of Miami), co-PI: L. Song (40%), $699,434 (20% cost share), contract negotiation.
2. 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 (35%), co-PIs: Choon Yik Tang, M. Brambley (PNNL), G. Wang (University of Miami), $1.34 Million (25% cost share), contract negotiation.
3. Transactive-control based connected home solution for existing residential units and communities, Pacific Northwest National Laboratory, PI: L. Song (100%), multi-year contract, the contract of $50,000 for FY2019 is in place.

4. 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 (56%), M. Brambley (PNNL), G. Wang (University of Miami), $940,731, October 2014 to November 2018.
5. 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.
6. 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.
7. Develop and test virtual air-handler energy use performance monitor, Building Technologies Office of U.S. Department of Energy, PI: L. Song (70%), co-PI: G. Wang, $100,000, April 2012 to October 2012.
8. 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.
9. 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.

VIII Awards and Media Coverage

1. 2018 Technical Paper Award, ASHRAE, Kansan City, MO, June 2019.
2. 2017 Technical Paper Award, ASHRAE, Houston, TX, June 2018.
3. "OU researcher uses sensors to boost airflow efficiency." The Oklahoman. July 11th 2014.
4. "Now, a formula to halve power bills." Times of India, February 24th 2014.
5. 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.
6. 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.
7. Milton E. Mohr Research Fellowship, University of Nebraska, 2003. Total prize is $1,000. Awardee: L. Song.
8. Excellent class advisor, Beijing Institute of Civil Engineering and Architecture (Beijing University of Architecture), 1997-1998.
9. Excellent teaching award (Beijing University of Architecture and Civil Engineering), 1998.
10. 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).

o Alejandro Rivas Prieto (2015 to 2016)
- OU VENOKAL scholarship award (2016).
- ASHRAE OCCF Scholarship for contribution to HVAC&R research (2015).

XI 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 files 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, patent filed in December 2018 through the University of Oklahoma. Docket Number: 5837.157; Inventors: L. Song and G. Wang.
7. Monitoring system for residential HVAC systems, provisional patent files in January 2019 through the University of Oklahoma. Docket Number: 5837.158; Inventors: L. Song and C.Y. Tang.