Shichao Liu, Assistant Professor

CONTACT INFORMATION	Architectural Engineering & Fire Protection Engineering	
	Building Occupants Signals Synthesis (BOSS) Lab	508-831-6329
	Worcester Polytechnic Institute (WPI)	www.scliu.com
	Worcester, MA 01609, USA	sliu8@wpi.edu
	(Updated in March 2022)	

BACKGROUND

EDUCATION

The University of Texas at Austin, Texas, USA
Ph.D., Civil Engineering 2014

Tianjin University, Tianjin, China
M.S., Architectural Engineering 2009
B.S., Building Environment and Energy Engineering 2007

WORK EXPERIENCE OTHER THAN TEACHING

Assistant professor Jan. 2018 to present
Civil and Environmental Engineering
Worcester Polytechnic Institute

Postdoctoral Researcher Feb. 2015 to Dec. 2017
Center for the Built Environment (CBE)
University of California, Berkeley

Graduate Research Assistant Jul. 2010 to Dec. 2014
Civil, Architectural, and Environmental Engineering
The University of Texas at Austin

Research Assistant Sep. 2009 to May 2010
Building Service Engineering
The Hong Kong Polytechnic University

TEACHING

EXPERIENCE

Instructor (Since 2018)

Worcester Polytechnic Institute, MA

- *AREN 3020: Architectural Design Studio IV: Building Energy Simulation, Undergraduate level*
- *AREN 3024: Building Physics, Undergraduate level*

Adjunct instructor (2017)

Laney College, Oakland

- *ETC 213: Indoor Air Quality, Undergraduate level*

Guest instructor (2016)

University of California, Berkeley

- *ARCH 298: Research Skills, Graduate level*
- *ARCH 241P: Research methods in Building Sciences, Graduate level*

Guest instructor (2013)

The University of Texas at Austin

- *CE 397: Modeling of Air and Pollutant Flows in Buildings, Undergraduate & Graduate levels*

INNOVATIONS	Embrace AI: Bring coding skills to the curriculum *Implemented in AREN 3025: Building Energy Simulation in 2019* Learning by Peer Teaching & Learning by Collaborative Exploring *Implemented in AREN 3024: Building Physics since 2019* Promoting Architectural Design Skills through Collaborative Learning Enabled by Augmented Reality *Plan to be implemented in AREN 3020: Architectural Design IV - Building Energy Simulation* Course redesign *Convert AREN 3025: Building Energy Simulation course to AREN 3020 (starting in 2020): Design Studio IV - Building Energy Simulation; Class meeting time increases from 6 hours to 12 hours per week*
COURSES TAUGHT	AREN 3024: Building Physics, Undergraduate level Since 2018 AREN 3025 or 3020: Design Studio IV: Building Energy Simulation, Undergraduate level Since 2018 *AREN 3020 is a design studio course with 12 hours class time each week that is double of a regular course* CE 1030: Civil Engineering and Computer Fundamentals 2018, 2019 *Two lectures and a lab session for the topics of Architectural Engineering*
UNDER-GRADUATE PROJECTS	MQP: Design a net-zero and resilient building for heatwaves 2022-2023 MQP: Design robot-enabling architectural elements for roof and facade retrofits 2021-2022 MQP: Develop a LEED lab at WPI 2021-2022 MQP: HoloARCH-Design a Commercial Building by Incorporating Collaborative Augmented Reality 2021-2022 MQP: Design of a quarantine hospital/center for mildly sick COVID-19 patients in New York City 2020-2021

Graduate theses and dissertations advised	X. Guo (PhD student), *Wellbeing of Occupants During Converging Crises*, Primary advisor 2021 to present
	M. Belyamani (PhD student), *Advanced Architectural Design Using Augmented Reality*, Primary advisor 2021 to present
	C. Wang (PhD student), *The Effect of Physical Environment on Cognitive Performance*, Primary advisor 2018 to present
Independent studies	DR SL6 Directed Research/Graduate AREN3999-DR SL6 Building Energy Simulation 2019
Academic advising	Three Ph.D. students in Civil Engineering since 2018 Approximately thirty undergraduate students in Architectural Engineering every year Two NSF REU visiting students from 2019
Honors, awards & recognition for Teaching	WPI Teaching Innovation Grant 2021

Scholarship

Peer Reviewed Journal Publications	1. Feng, Y., **Liu, S.**, Wang, J., Yang, J., Jao, Y.L. and Wang, N. (2022). Data-driven personal thermal comfort prediction: A literature review. *Renewable and Sustainable Energy Reviews*: 161, p.112357. doi:10.1016/j.rser.2022.112357
	2. Wang, H. [‡], Dembsey, N.A., Meacham, B.J.,**Liu, S.** and Simeoni, A. (2022). A sensitivity matrix method to understand the building fire egress performance gap. *Fire Safety Journal*: 127, p.103516. doi:10.1016/j.firesaf.2021.103516
	3. Guo, X.[†], Lee, K., Wang, Z. and **Liu, S.** (2021). Occupants' satisfaction with LEED-and non-LEED-certified apartments using social media data. *Building and Environment*: 206, p.108288 doi: 10.1016/j.buildenv.2021.108288
	4. Wang, H. [‡], Dembsey, N.A., Meacham, B.J., **Liu, S.** and Simeoni, A. (2021) Comparison of sensitivity matrix method, power function-based response surface method, and artificial neural network in the analysis of building fire egress performance. *Journal of Building Engineering*: 43,

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[‡]co-advised PhD student
[†]PhD student

p.102860
doi:10.1016/j.jobe.2021.102860

5. Wang, C. [†], Zhang, F., Wang, J., Doyle,J., Hancock, P., Mak, C., **Liu,S.** (2021) How indoor environmental quality affects occupants' cognitive functions: A systematic review. *Building and Environment*: 193, p.107647
doi:10.1016/j.buildenv.2021.107647

6. Yang, L., Wang, X., Li, M., Zhou, X., **Liu, S.**, Zhang, H., Arens, E., Zhai, Y. (2020) Carbon dioxide generation rates of different age and gender under various activity levels. *Building and Environment*:186, p.107317
doi:10.1016/j.buildenv.2020.107317

7. **Liu, S.**, Wang, Z., Schiavon, S., He, Y., Luo, M., Zhang, H., Arens, E. (2020). Predicted percentage dissatisfied with vertical thermal stratification. *Energy and Buildings*: 220, p. 110085
doi:0.1016/j.enbuild.2020.110085

8. John, D., **Liu, S.** (2020) Air diffusion performance index method update *ASHRAE Journal*, 62(1), pp.20-26.

9. Wang, Z., Warren, K., Luo, M., He, X., Zhang, H., Arens, E., Chen, W., He, Y., Hu, Y., Jin, L. and **Liu, S.** (2020). Evaluating the comfort of thermally dynamic wearable devices. *Building and Environment*: 167, p.106443.
doi:10.1016/j.buildenv.2019.106443

10. Yang, Y., Zhang, B., Feng, Q., Cai, H., Jiang, M., Zhou, K., Li, F., **Liu, S.** and Li, X. (2019). Towards locating time-varying indoor particle sources: Development of two multi-robot olfaction methods based on whale optimization algorithm. *Building and Environment*: 166, p.106413.
doi:10.1016/j.buildenv.2019.106413

11. Pantelic, J., **Liu, S.** ., Pistore, L., Licina, D., Vannucci, M., Sadrizadeh, S., Ghahramani, A., Gilligan, B., Sternberg, E., Kampschroer, K. and Schiavon, S. (2019). Personal CO2 cloud: laboratory measurements of metabolic CO_2 inhalation zone concentration and dispersion in a typical office desk setting. *Journal of exposure science & environmental epidemiology*, pp.1-10.
doi:10.1038/s41370-019-0179-5

12. **Liu, S.**, Schiavon, S., Prasanna Das, H., Jin, M., Spanos, C.(2019). Personal thermal comfort models with wearable sensors. *Building and Environment*:162, p.106281.
doi:10.1016/j.buildenv.2019.106281

13. Feng, Q., Cai, H., Li, F., Liu, X., **Liu, S.**, Xu, J. (2019). An improved particle swarm optimization method for locating time-varying indoor particle sources. *Building and Environment*: 146-157.
doi:10.1016/j.buildenv.2018.10.008

[†]PhD student

14. Ghahramani, A., Pantelic, J., Vannucci, M., Pistore, L., **Liu, S.**, Gilligan, B., Alyasin, S. and Arens, E. (2019). Personal CO2 Bubble: Context-dependent Variations and Wearable Sensors Usability. *Journal of Building Engineering* 22: 295-304. doi:10.1016/j.jobe.2018.11.015

15. Chen, W., **Liu, S.**, Gao, Y., Zhang, H., Arens, E., Zhao, L., Liu, J. (2018). Experimental and numerical investigations of indoor air movement distribution with an office ceiling fan. *Building and Environment* 130: 14-26. doi:10.1016/j.buildenv.2017.12.016

Publication before joining WPI in 2018

16. Jin, M., **Liu, S.**, Schiavon, S., Spanos C. (2018). Automated mobile sensing: Towards high-granularity agile indoor environmental quality monitoring. *Building and Environment* 127: 268-276. **(Best paper award)** doi:10.1016/j.buildenv.2017.11.003

17. Amai, H., **Liu, S.**, Novoselac, A. (2017). Experimental study on air change effectiveness: Improving air distribution with all-air heating systems. *Building and Environment* 125: 515-527. doi:10.1016/j.buildenv.2017.09.017

18. Gao, Y., Zhang, H., Arens, E., Present, E., Ning, B., Zhai, Y., Pantelic, J., Luo, M., Zhao, L., Raftery, P., **Liu, S.** (2017). Ceiling fan air speeds around desks and office partitions. *Building and Environment* 124: 412-440. doi:10.1016/j.buildenv.2017.08.029

19. Cao, G., **Liu, S.**, Boor, B.E. and Novoselac, A. (2017). Dynamic interaction of a downward plane jet and a cough jet regarding particle transmission: an analytical and experimental study. *Journal of Occupational & Environmental Hygiene* 14(8) 618-631. doi: 10.1080/15459624.2017.1316383

20. **Liu, S.**, Schiavon, S., Kabanshi, A. and Nazaroff, W. (2017). Predicted percentage dissatisfied with ankle draft. *Indoor Air.* 27(4):852-862. doi:10.1111/ina.12364.

21. **Liu, S.**, Clark, J., and Novoselac, A. (2017). Air diffusion performance index (ADPI) of overhead-air-distribution at low cooling loads. *Energy and Buildings* 134:271-284 doi: 10.1016/j.enbuild.2016.10.055

22. **Liu, S.**, and Novoselac, A. (2016). The Effect of Deflectors on Air Diffusion Performance Index (ADPI) of Adjustable Diffusers: Cooling Condition (RP-1546). *Science and Technology for the Built Environment* 22(1): 67-74. doi: 10.1080/23744731.2015.1078700

23. Cao, G., **Liu, S.**, Boor, B.E. and Novoselac, A. (2015). Characterizing the Dynamic Interactions and Exposure Implications of a Particle-Laden Cough Jet with Different Room Airflow Regimes Produced by Low and High Momentum Jets. *Aerosol and Air Quality Research* 15: 1955-1966. doi: 10.4209/aaqr.2015.03.0146

24. **Liu, S.**, and Novoselac, A. (2015). Air Diffusion Performance Index (ADPI) of diffusers for Heating. *Building and Environment* 87: 215-223. doi: 10.1016/j.buildenv.2015.01.021

25. **Liu, S.**, and Novoselac, A. (2014). Transport of airborne particles from an unobstructed cough jet. *Aerosol Science & Technology* 48(11): 1183-1194. doi: 10.1080/02786826.2014.968655

26. **Liu, S.**, and Novoselac, A. (2014). Lagrangian particle modeling in the indoor environment: A comparison of RANS and LES turbulence methods (RP-1512). *HVAC&R* 20(4): 480-495.doi: 10.1080/10789669.2014.884380

27. **Liu, S.**, Mak, C.M. and Niu, J. (2011). Numerical evaluation of louver configuration and ventilation strategies for the windcatcher system. *Building and Environment* 46(8): 1600-1616. doi: 10.1016/j.buildenv.2011.01.025

CONFERENCE PROCEEDINGS

1. Belyamani, M.[†], Hurley, R.[¶], Djamasbi,S., Somasse,G., Strauss, S., and **Liu, S.** (2022) Low-Energy Wearable Cooling Strategy for Thermal Comfort at a Warm Environment. *The 5th International Conference on Building Energy and Environment 2022*, Montreal, Canada

2. Hurley, R.[†], Belyamani, M., Djamasbi,S., Somasse,G., Strauss, S., and **Liu, S.** (2022) Do We Overestimate the Impact of Carbon Dioxide on Cognition and Decision-Making?: Preliminary Evidence. *The 5th International Conference on Building Energy and Environment 2022*, Montreal, Canada

3. Guo, X.[†], Incollingo Rodriguez, A., Farzin, S., Whitehill, J., Van Dessel, S., and **Liu, S.** (2022) How indoor environment quality affected college students' mental health and learning performance during COVID-19: a long-term study. *Proceedings of Healthy Buildings 2022*, Hawaii, USA.

4. Wang, C.[†], Lin, Y., **Liu, S.** (2022) Effects of air quality in the vehicle cabin on driving performance. *Proceedings of Healthy Buildings 2022*, Hawaii, USA.

5. Wang, C.[†], Zhang, F., **Liu, S.** (2020) A Review on the Relationship Between Indoor Environmental Quality and Cognitive Functions Using a Visual Text-Mining Approach. *Proceedings of Indoor Air 2020*, Seoul, Korea.

6. Patel, D.[§], Guo, X.[†], Lee, K., **Liu, S.** (2020) Are LEED-certified apartments more satisfying? What do tenants say? *Proceedings of Indoor Air 2020*, Seoul, Korea.

7. Aren, E., Heinzerling, D., **Liu, S.**, Paliaga, G., Pande, P., Schiavon, S., Zhang, H. (2020) Advances to ASHRAE Standard 55 to encourage more effective building practice. *Windsor Conference'20*, Windsor, U.K.

[†]PhD student
[¶]Undergraduate student
[§]Master student

8. Jiang, H., Iandoli, M., **Liu, S.**,Whitehill, J. (2019) Measuring students' thermal comfort and its impact on learning. *Educational Data Mining 2019*, Montreal, Canada.

9. **Liu, S.**, Novoselac, A. (2018) Fate of particles released by a puffdispersion with different ventilation systems. *IBPC 2018*, Syracuse, USA

10. **Liu, S.**, Jin, M., Das, H.P., Spanos, C.J., Schiavon, S.(2018) Personal thermal comfort models based on physiological parameters measured by wearable sensors. *Windsor Conference'18*, Windsor, U.K.

11. **Liu, S.**, Wang, Z., He, Y., Luo, M., Zhang, H., Schiavon,S.(2018) Local thermal discomfort caused by temperature stratification at whole-body thermal neutrality. *Indoor Air'18*, Philadelphia, USA.

12. Wang, Z., Luo, M., Zhang, H.,He, Y., Jin, L., Arens, E., **Liu, S.**(2018) The Effect of a Low-Energy Wearable Thermal Device on Human Comfort. *Indoor Air'18*, Philadelphia, USA.

Publication before joining WPI in 2018

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13. Jin, M., **Liu, S.**, Schiavon, S., Spanos, C. (2017) Indoor Environmental Quality Monitoring by Autonomous Mobile Sensing. *BuildSys'17*, Delft, The Netherlands.

14. Kabanshi, A., **Liu, S.**, and Schiavon, S. (2016). Potential adaptive behavior to counteract thermal discomfort in spaces with displacement ventilation or underfloor air distribution systems. *The 14th international conference of Indoor Air Quality and Climate*, Belgium.

15. **Liu, S.**, Cao, G., Boor, B.E., and Novoselac, A. (2014). A protected occupied zone ventilation system to prevent the transmission of coughed particles. *The 13th international conference of Indoor Air Quality and Climate*, Hong Kong, China.

FELLOWSHIPS & GRANTS

1. Interactive effects of thermal and interior ambient light environment on comfort, emotion, and driving performance
PI; Ford URP 2021

2. RAPID: Measuring the impact of SARS-CoV-2 on stress, engagement, and academic performance of online learning
PI; NSF 2020

3. Environmental stressors and decision-making performance in the context of climate change
PI; TRIAD - Worcester Polytechnic Institute 2019

4. Designing Responsive Physical Learning Environments to Promote Student Engagement and Learning
PI; NSF 2019

	5. 4D data collection framework for the built environment	
	Co-PI;Smart World - Worcester Polytechnic Institute	2018

PATENTS   Control program for scanning-detect of HPEA filter leakages
(2010SR008056)   2010

PROFESSIONAL
SOCIETY
MEMBERSHIPS
AND OFFICES

Secretary (2019), Vice Chair (2020), Chair (2021-)
- *ASHRAE TC 2.1 Physiology and Human Environment*

Voting member
- *ASHRAE Standard 55:Standard 55 Thermal Environmental Conditions For Human Occupancy*
- *ASHRAE Standard 62.2: Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*
- *ASHRAE Standard 70: Method of Testing the Performance of Air Outlets and Air Inlets*
- *ASHRAE Standard 113: Method of Testing for Room Air Diffusion*

Scientific committee
- *The 2nd International Workshop on Applied Machine Learning for Intelligent Energy Systems (AMLIES), Melbourne, Australia, 2020*
- *The 7th International Building Physics Conference-Healthy, Intelligent, and Resilient Buildings and Urban Environments, Syracuse, NY, 2018*
- *The 15th International Conference on Indoor Air Quality and Climate, Philadelphia, PA, USA, 2018*
- *The 14th International Conference on Indoor Air Quality and Climate, Ghent, Belgium, 2016*

EDITORIAL &
REFEREE
ACTIVITIES

Ad hoc Journal Reviewer
- *Building and Environment, Indoor and Built Environment, Energy and Buildings, Indoor Air, Sustainability, Journal of Ventilation, PLOSONE, Aerosol Science and Technology, Measurment, ASHRAE Journal*

NSF panelist
- *IUSE*   2020,2021
- *S-STEM*   2020

Ad hoc Proposal Reviewer
- *National Science Centre of Poland*   2020
- *National Science and Engineering Research Council of Canada*   2020

HONORS,
AWARDS &
RECOGNITION
FOR
SCHOLARSHIP

Ralph G. Nevins Physiology & Human Environment Award   2020
- *This award recognizes a promising investigator, preferably less than 40 years of age, for significant accomplishment in the general area of man's response to the environment, which may include thermal, moisture, visual, acoustical, toxic, allergic, olfactory, vibrational and microbiological effects on man's health, comfort and well-being.*

Best Paper Award

	- *Journal of Building and Environment*	2018
Professional Development Award		
	- *University of California, Berkeley*	2017
Postdoctoral fellowship		
	- *Singapore-Berkeley Building Efficiency and Sustainability in the Tropics*	2015
Chapter Scholarship *(Golden Gate ASHRAE Chapter)*		2015
Graduate Student Grant-In-Aid *(ASHRAE)*		2011
Sangde Fellowship *(Tianjin University)*		2008
Xingke Fellowship *(Tianjin University)*		2007
Travel Grant		
	- *Golden Gate Travel Grant* (Golden Gate ASHRAE Chapter)	2016
	- *Kolodzey Travel Grants* (The University of Texas at Austin)	2014

| CITATIONS | [*Google Scholar Citation*](): 719 | March 2022 |
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SERVICE TO

PROFESSION	Professional Membership	
	- *American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE)*	
	- *International Society of Indoor Air Quality and Climate*	
	Industry standard development	
	- *ASHRAE Standard 55, 62.1, 70, 113*	
	Conference seminar and workshop organization	
	- *ASHRAE summer conference*	2022
	- *ASHRAE summer conference*	2021
	- *2nd International Workshop on Applied Machine Learning for Intelligent Energy Systems (AMLIES)*	2020
	- *Indoor Air conference*	2020
	- *ASHRAE summer conference*	2020
	- *ASHRAE summer conference*	2019

DEPARTMENT & UNIVERSITY	WPI Touchtomorrow: How does COVID transmit in your classroom?	2021
	Department Award Committee	Since 2021
	Smart world initiative	Since 2019

	Woosox consulting	2019
	Open house for accepted students to Architectural Engineering	Since 2018

STUDENTS	Co-supervision

- *Patel D., Robotics Engineering and Computer Science* — Master
- *Wang, H., Close the Building Fire Performance Gap by Sensitivity Matrix Method and Substitute Algebraic Mode* — PhD

COMMUNITY	Inspection of ventilation systems of Saint Paul Diocesan Jr. Sr. High School during COVID — 2020

OTHER (MEDIA)	*Not Too Hot, Not Too Cold: WPI Researchers Awarded Grant to Find Just the Right Classroom Environment for Learning*, WPI — 2020

Too Hot, Too Cold? Scientists Search For The Optimal Temperature For Learning, Forbes — 2020

WPI receives $200K grant to study college student pandemic stress, Worcester Business Journal — 2020

WPI Researchers Awarded National Science Foundation Grant to Measure Stress in College Students and Impact on Learning During Pandemic, WPI — 2020

WPI Researchers Awarded Grant To Find Just the Right Classroom Environment for Learning, Trillions — 2020

WPI researchers will study how stress related to coronavirus affects students' learning by using facial recognition software, heart rate monitors, Mass Live 2020

Worcester Polytechnic Institute Researchers Awarded National Science Foundation Grant to Measure Stress in College Students and Impact on Learning During Pandemic, Yahoo! News — 2020

Students' stress during COVID, Local NPR — 2020

In Cold Offices, It's All About Your Feet, The Atlantic — 2016