

## Shichao Liu, Assistant Professor

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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 2023)

## BACKGROUND

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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, Environmental, and Architectural 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

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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 (2019-2023)*

Promoting Architectural Design Skills through Collaborative Learning Enabled by Augmented Reality

*Implemented in AREN 3020: Architectural Design IV - Building Energy Simulation (2021)*

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: Develop a smart individualized environmental system for building energy efficiency and indoor environmental justice

2022-2023

MQP: Design a Tiny House on Wheels for Wildfire and Indoor Air Quality Research and Teaching

2022-2023

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 (2019, 2021)

HONORS, AWARDS & RECOGNITION FOR TEACHING WPI Teaching Innovation Grant 2021

## SCHOLARSHIP

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PEER REVIEWED JOURNAL PUBLICATIONS 1. Zhang, Y., **Liu, S.**, Hu, W., and Yadav, M. (2022). Editorial: Effects of Indoor Environmental Quality on Human Performance and Productivity. *Frontiers in Built Environment*: 161, p.112357. doi: 10.3389/fbuil.2022.1095443  
2. 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  
3. 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

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†co-advised PhD student

4. Guo, X.<sup>†</sup>, 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
5. Wang, H. <sup>‡</sup>, 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, p.102860  
doi:10.1016/j.jobe.2021.102860
6. Wang, C. <sup>†</sup>, 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
7. 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
8. **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
9. John, D., **Liu, S.** (2020) Air diffusion performance index method update *ASHRAE Journal*, 62(1), pp.20-26.
10. 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
11. 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
12. 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 CO<sub>2</sub> cloud: laboratory measurements of metabolic CO<sub>2</sub> 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

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<sup>†</sup>PhD student

<sup>‡</sup>PhD student

13. **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
14. 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
15. 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.jobbe.2018.11.015
16. 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

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**Publication before joining WPI in 2018**

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17. 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
18. 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
19. 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
20. 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
21. **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.
22. **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
23. **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

24. 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
25. **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
26. **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
27. **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
28. **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. Alrefaei, D., Sankar, G., Nia, J., Djamasbi, S., **Liu, S.**, Strauss, S., and Somasse, G. (2022) Anxiety and Information Processing: An Eye Tracking Study. *AMCIS TREOS 2022*, Minneapolis, USA
2. Li, Y.<sup>†</sup>, Farzin, S., **Liu, S.** (2022) Promoting collaborative learning in architectural engineering design through multi-user augmented reality. *ASEE Annual Conference-Excellence Through Diversity 2022*, Minneapolis, USA
3. Wang, C.<sup>†</sup>, Liang, Y., Yao, W., Bergendahl, J., Hurley, R.<sup>¶</sup>, and **Liu, S.** (2022) Indoor fabric as an adsorptive reservoir for volatile organic compounds in wildfire smoke: a preliminary study. *The 5th International Conference on Building Energy and Environment 2022*, Montreal, Canada
4. Guo, X.<sup>†</sup>, Yan, S., Wang, C., Wang, L., and **Liu, S.** (2022) The impact of window-opening behaviors on indoor air quality and human exposure during wildfires. *The 5th International Conference on Building Energy and Environment 2022*, Montreal, Canada
5. Belyamani, M.<sup>†</sup>, Hurley, R.<sup>¶</sup>, 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

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<sup>†</sup>PhD student

<sup>¶</sup>Undergraduate student

6. Hurley, R.<sup>†</sup>, 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
7. Guo, X.<sup>†</sup>, 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.
8. Wang, C.<sup>†</sup>, Lin, Y., **Liu, S.** (2022) Effects of air quality in the vehicle cabin on driving performance. *Proceedings of Healthy Buildings 2022*, Hawaii, USA.
9. Wang, C.<sup>†</sup>, 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.
10. Patel, D.<sup>§</sup>, Guo, X.<sup>†</sup>, Lee, K., **Liu, S.** (2020) Are LEED-certified apartments more satisfying? What do tenants say? *Proceedings of Indoor Air 2020*, Seoul, Korea.
11. 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.
12. Jiang, H., Iandoli, M., **Liu, S.**, Whitehill, J. (2019) Measuring students' thermal comfort and its impact on learning. *Educational Data Mining 2019*, Montreal, Canada.
13. **Liu, S.**, Novoselac, A. (2018) Fate of particles released by a puff dispersion with different ventilation systems. *IBPC 2018*, Syracuse, USA
14. **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.
15. **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.
16. 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.

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**Publication before joining WPI in 2018**

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

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<sup>§</sup>Master student

18. 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.
19. **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

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**Externally funded**

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1. Interactive effects of thermal and interior ambient light environment on comfort, emotion, and driving performance  
*\$50,000; PI; Ford URP* 2021
2. RAPID: Measuring the impact of SARS-CoV-2 on stress, engagement, and academic performance of online learning  
*\$199,943 PI; NSF* 2020
3. Designing Responsive Physical Learning Environments to Promote Student Engagement and Learning  
*\$299,991; PI; NSF* 2019

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**Internally funded**

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4. Environmental stressors and decision-making performance in the context of climate change  
*\$60,000 (Liu: \$20,000); PI; TRIAD - Worcester Polytechnic Institute*  
2019
5. 4D data collection framework for the built environment  
*\$10,000; 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*



- *ASHRAE Guideline 10: Interactions Affecting the Achievement of Acceptable Indoor Environments*

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

Guest Editor

- *Special issue: Effects of indoor environmental quality on human performance and productivity* - Journal of Frontiers in Built Environment 2022
- *Special issue: Thermal comfort of buildings in a changing world* - Journal of Building Engineering 2022

Ad hoc Journal Reviewer

- *Building and Environment, Indoor and Built Environment, Energy and Buildings, Indoor Air, Sustainability, Journal of Ventilation, PLOS ONE, Aerosol Science and Technology, Measurement, 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
- *Department of Energy (DOE) - State and Community Energy Program* 2022

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:* 1055 March 2023  
 H index: 20

## SERVICE TO

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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 & WPI Touchtomorrow: How does COVID transmit in your classroom? 2021  
 UNIVERSITY  
 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)	<i>Think your thermostat is lying? Science explains why</i> , The Washington Post	2022
	<i>Not Too Hot, Not Too Cold: WPI Researchers Awarded Grant to Find Just the Right Classroom Environment for Learning</i> , WPI	2020
	<i>Too Hot, Too Cold? Scientists Search For The Optimal Temperature For Learning</i> , Forbes	2020
	<i>WPI receives \$200K grant to study college student pandemic stress</i> , Worcester Business Journal	2020
	<i>WPI Researchers Awarded National Science Foundation Grant to Measure Stress in College Students and Impact on Learning During Pandemic</i> , WPI	2020
	<i>WPI Researchers Awarded Grant To Find Just the Right Classroom Environment for Learning</i> , Trillions	2020
	<i>WPI researchers will study how stress related to coronavirus affects students' learning by using facial recognition software, heart rate monitors</i> , Mass Live	2020
	<i>Worcester Polytechnic Institute Researchers Awarded National Science Foundation Grant to Measure Stress in College Students and Impact on Learning During Pandemic</i> , Yahoo! News	2020
	<i>Students' stress during COVID</i> , Local NPR	2020
	<i>In Cold Offices, It's All About Your Feet</i> , The Atlantic	2016