

XI WANG

Ph.D. Candidate
Department of Civil and Environmental Engineering
University of Michigan
1006 G. G. Brown Laboratory, 2350 Hayward Street
Ann Arbor, MI, 48109-2125, USA
Email: wangix@umich.edu
Website: <https://www.xiwang.page/>

EDUCATION

Ph.D. in Civil Engineering, January 2019 – Expected April 2022

University of Michigan, Ann Arbor, MI, U.S.

Dissertation: Towards Construction Workforce 4.0: Teaching and Supervising Construction Robots through Immersive Process-Level Digital Twins

Advisors: Prof. Carol C. Menassa and Prof. Vineet R. Kamat

M.S. in Robotics, January 2019 – Expected April 2022

University of Michigan, Ann Arbor, MI, U.S.

Research Focus: Human-Robot Collaboration

Advisors: Prof. Carol C. Menassa and Prof. Vineet R. Kamat

Selected Courses: Robotics System Laboratory, Computer Vision, Natural Language Processing, Machine Learning, Embedded Control System (GPA: 4.0/4.0)

M.S.E. in Construction Engineering and Management, September 2017 – December 2018

University of Michigan, Ann Arbor, MI, U.S.

Research Focus: Interdependencies in Community Resilience, Building Environment, and Human Comfort

Advisors: Prof. Carol C. Menassa and Prof. Vineet R. Kamat

Selected Courses: Construction Cost Engineering, Critical Path Method, Building Information Modeling, Construction Equipment, Construction Contracting (GPA: 4.0/4.0)

B.E. in Construction Management, September 2013 – June 2017

Dongbei University of Finance and Economics, Dalian, Liaoning, China

Thesis: Energy Consumption Analysis and Cost Estimation Based on Building Information Modeling Technology

Advisors: Prof. Xiaobo Chen and Prof. Jianxin Zhang

Selected Courses: Project Financing, Urban Economics, Engineering Economics, Cost Accounting, Feasibility Study, Construction Technology and Organization (GPA: 4.12/5.0)

PROFESSIONAL APPOINTMENTS

Graduate Student Research Assistant, University of Michigan, January 2019 – Present

Graduate Student Instructor, University of Michigan, January 2021 – April 2021

Research Assistant, University of Michigan, September 2017 – December 2018

PUBLICATIONS

Refereed Journal Articles:

Wang, X., Liang, C. J., Menassa, C. C., & Kamat, V. R. (2021). Interactive and Immersive Process-Level Digital Twin for Collaborative Human-Robot Construction Work. *Journal of Computing in Civil Engineering*, 35(6), 04021023.

Liang, C. J., **Wang, X.,** Kamat, V. R., & Menassa, C. C. (2021). Human-Robot Collaboration in Construction: Classification and Research Trends. *Journal of Construction Engineering and Management*, 147(10), 03121006.

Deng, M., **Wang, X.,** & Menassa, C. C. (2021). Measurement and prediction of work engagement under different indoor lighting conditions using physiological sensing. *Building and Environment*, 203, 108098.

Wang, X., Li, D., Menassa, C. C., & Kamat, V. R. (2019). Investigating the effect of indoor thermal environment on occupants' mental workload and task performance using electroencephalogram. *Building and Environment*, 158, 120-132.

Journal Manuscripts in Progress:

Wang, X., McGee, W., Menassa, C. C., & Kamat, V.R. Closed-Loop Human-Robot Collaborative Construction and Building Information Modeling System.

Wang, X., Wang, S., McGee, W., Menassa, C. C., & Kamat, V.R. Teaching Robot Construction Tasks through Demonstration in Immersive Process-Level Digital Twin.

Deng, M., **Wang, X.,** & Menassa, C. C. Investigating the Effect of Wearing Masks on Office Work During the Pandemic Period.

Deng, M., **Wang, X.,** Li, D., Menassa, C. C., & Kamat, V.R. Digital ID for Real-Time Human-Centric Indoor Monitoring and Control.

Refereed Conference Articles:

Wang, X., Liang, C. J., Menassa, C. C., & Kamat, V. R. (2020). Real-Time Process-Level Digital Twin for Collaborative Human-Robot Construction Work. In *ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction* (Vol. 37, pp. 1528-1535). IAARC Publications.

Wang, X., Li, D., Menassa, C. C., & Kamat, V. R. (2019, November). Can infrared facial thermography disclose mental workload in indoor thermal environments?. In *Proceedings of the 1st ACM International Workshop on Urban Building Energy Sensing, Controls, Big Data Analysis, and Visualization* (pp. 87-96).

Wang, X., Li, D., Menassa, C. C., & Kamat, V. R. (2019). Investigating the neurophysiological effect of thermal environment on individuals' performance using electroencephalogram. In *Computing in Civil Engineering 2019: Data, Sensing, and Analytics* (pp. 598-605). Reston, VA: American Society of Civil Engineers.

Book Chapter:

Li, D., Wang, X., Menassa, C. C., & Kamat, V. R. (2020). Understanding the impact of building thermal environments on occupants' comfort and mental workload demand through human physiological sensing. In *Start-Up Creation* (pp. 291-341). Woodhead Publishing.

HONORS AND AWARDS

Barbour Scholar, University of Michigan, 2021

- A 104-year-old community of exceptional female scholars selected out of Rackham Predoctoral Fellowship recipients

Rackham Graduate Student Research Grant, University of Michigan, 2021

John L. Tishman Predoctoral Fellowship, University of Michigan, 2019

Rackham Conference Travel Grant, University of Michigan, 2019

Tishman Master's Fellowship, University of Michigan, 2017

Outstanding Graduate Class of 2017, Dongbei University of Finance and Economics (DUFE), 2017

Featured Student of Academic Records (Rank 1/104), DUFE, 2017

Second Place Award, "TH Sware" National Undergraduates BIM Application Skills Competition, 2016

CASC Scholarship, DUFE, 2016

First-class Academic Scholarship, DUFE, 2014, 2015, 2016

Second Place Award, "Challenge Cup" National Undergraduate Curricular Academic Science and Technology Competition, 2015

Liaoning Undergraduate Innovation and Entrepreneurship Program Grant, 2015

Xiangzhou Scholarship, DUFE, 2014

GRANT WRITING EXPERIENCE

Closed-Loop Building Information Modeling Digital Twin for Collaborative Human-Robot Construction Work, 2021 (Funded: \$2,993)

- Rackham Graduate Student Research Grant, University of Michigan,
- Role: Led Proposal Writing and Budgeting, 2021
- Project Lead: Xi Wang

Collaborative Research: Partnering Workers with Interactive Robot Assistants to Usher Transformation in Future Construction Work, 2021 (Funded: \$1,580,000)

- National Science Foundation Future of Work at the Human-Technology Frontier (FW-HTF-R)
- Role: Assisted PI with framework design, technical details, and proposal writing
- PI: Dr. Carol C. Menassa

Overcoming Workspace Uncertainties for Enabling Adaptive Co-Robotized Construction Work, 2021

- National Science Foundation National Robotics Initiative (NRI)
- Role: Assisted PI with technical details and proposal writing
- PI: Dr. Vineet R. Kamat

Redesigning the Future of Construction Work by Replicating the Master-Apprentice Learning Model in Human-Robot Worker Teams, 2020 (Funded: \$250, 000)

- National Science Foundation Future of Work at the Human-Technology Frontier (FW-HTF-P)
- Role: Assisted PI with framework design, technical details, and proposal writing
- PI: Dr. Carol C. Menassa

Enabling Independent Mobility in People with Physical Disabilities by Advancing Human-Centered Social and Technological Research, 2019

- National Science Foundation Smart and Connected Communities (SCC-IRG)
- Role: Assisted PI with technical details and proposal writing
- PI: Dr. Carol C. Menassa

Leveraging Big Data and Immersive Virtual Environments for Robust Interpretation of Caregiver Thermal Comfort in Ambulatory Oncology Settings, 2018

- University of Michigan Engineering Research Accelerator Initiative
- Role: Assisted PI with related literature reviews and experiment design
- PI: Dr. Carol C. Menassa

Systematic Leaflets Collective System on Campus and Corresponding Innovation Mechanism, 2015 (Funded: ¥6,000)

- Liaoning Undergraduate Innovation and Entrepreneurship Program
- Role: Led Proposal Writing, 2015
- Project Lead: Xi Wang

RESEARCH EXPERIENCE

Projects related to Human-Robot Collaboration in Construction:**Leading:****Closed-loop Building Information Modeling and Human-Robot Collaborative Construction System, University of Michigan, March 2021 – Present**

- Creating building information modeling workflow to provide information to and to update with robotized construction
- Developing communication framework between human, robot, construction site, and building information model based on Robot Operating System and immersive digital twin

Robot Construction Task Learning through Worker Demonstration, University of Michigan, December 2020 – Present

- Developing a knowledge-based system for robots to learn new construction tasks from worker demonstrations in an immersive digital twin
- Enhancing human-robot interaction process using situated dialogues

Immersive Process-Level Digital Twin for Human-Robot Collaborative Construction, University of Michigan, January 2020 – December 2020

- Developed an immersive virtual reality (VR) interface for workers to perform high-level task planning and interact with construction robots
- Proposed an interactive and immersive process-level digital twin system (I2PL-DT) for human-robot collaborative construction work

In Collaboration:

Taxonomy of Interaction Mechanisms between Human and Construction Robots, September 2019 – November 2020

- Collaboratively conducted a comprehensive literature review for human-robot interaction in construction and classify them with our proposed taxonomy
- Collaboratively proposed several challenges and future research directions in the field of construction robotics

Projects related to Human Interaction with Built Environments:

Leading:

Exploring the relationship between Infrared Facial Thermograph on Mental Workload, University of Michigan, April 2019 – August 2019

- Studied the relationships between facial thermography and EEG-measured mental workload
- Used random forest classifier to disclose mental workload from infrared facial thermograph under different thermal environment

Analyzing the Neurophysiological Effect of Indoor Thermal Environment on Occupants' Performance with Electroencephalogram (EEG)

- Developed a computerized cognitive task system to study cognitive performance and a mental workload model from EEG signals
- Explored personalized effects of thermal environment on occupants' mental workload and cognitive performance, and further explored their relationships

In Collaboration:

Real-Time Human-Centric Indoor Monitoring and Control with Digital ID, June 2020 - Present

- Contributed ideas to a real-time human-centric building control system based on Digital ID
- Assisted in machine learning prediction model design and implementation

The Effects of Wearing Masks on Office Worker's Performance during Pandemic, September 2020 – August 2021

- Contributed ideas to framework and experimental design to compare office workers' performance without masks, wearing disposable masks, and wearing cloth masks during Covid
- Assisted with data analysis and paper writing

Investigating Occupants' Engagement with EEG and Physiological Data under Different Lighting Conditions, University of Michigan, January 2020 – March 2021

- Integrated the computerized cognitive task system I developed to design the experiment
- Contributed ideas to propose a prediction framework to disclose EEG-measured engagement level from less intrusive physiological measurements

Other Projects:

Investigating the Environmental Impact on Community Resiliency, University of Michigan, 09/2017 – 04/2020

- Developed a life cycle assessment (LCA) simulator and coupled with natural hazards simulators through Run-Time Infrastructure to assess the environmental impact at the community scale
- Analyzed the interdependent effect of community resiliency on environmental impact as part of the NSF Interdependencies in Community Resilience Project

Advancing Caregiver Skills and Comfort Level in Ambulatory Ontology Settings, University of Michigan, 02/2018 – 05/2019

- Developed a portable physiological sensory system to measure caregivers' comfort level while wearing PPE and conducted experiments in School of Nursing Multi-professional Oncology Safety Simulation and Training Workshop
- Assisted in developing an immersive VR system for nursing training

Investigating the Crowdsourcing Mechanisms to Promote Independent Mobility for People with Physical Disabilities (PPD), *University of Michigan*, 03/2019 – 04/2019

- Explored crowdsourcing mechanisms to collect accessibility information for PPD to promote their independent mobility
- Investigated existing indoor and outdoor navigation techniques and accessible public transportation systems and their limitations

TEACHING AND MENTORSHIP EXPERIENCE

CEE 331: Construction Management (Online), University of Michigan, Winter 2021

- Delivered lectures in weekly online lab sessions, instructed course projects, held office hours, and led grading
- Developed and administered lab projects and weekly quizzes materials

General Motors Project Cost Estimation Workshop, University of Michigan, 2021

- Delivered a lecture introducing a cost estimation project based on a real building in Ann Arbor
- Developed tutorial videos, detailed instruction materials, and related documents for self-paced learning

Graduate Student Mentor, University of Michigan, 2018 - Present

- Master's Students: Yijian Zhao, Daisuke Tokumaru, Nagappan Palaniappan, Nayanika Bora
- Master Student (Robotics): Shuoqi Wang
- Ph.D. Students: Min Deng, Hongrui Yu

PRESENTATIONS

Talks:

Enhancing Construction Industry Workforce with Human-Robot Collaboration, Barbour Scholars Celebration, University of Michigan, 2021

Human-Robot Collaborative Construction with Interactive and Immersive Digital Twin, CEE 830: Construction Engineering Seminar, University of Michigan, 2021

Enhancing Construction Industry Workforce with Human-Robot Collaboration. GRADtitude in Extraordinary Times: A Virtual Celebration of Rackham Donors & Scholars, University of Michigan, 2021

Conference Presentations:

Real-Time Process-Level Digital Twin for Collaborative Human-Robot Construction Work, International Symposium on Automation and Robotics in Construction (ISARC), Kitakyushu, Japan (Online), 2020

Can Infrared Facial Thermography Disclose Mental Workload in Indoor Thermal Environments?, The 1st ACM International Workshop on Urban Building Energy Sensing, Controls, Big Data Analysis, and Visualization, New York, 2019

Feasibility of Low-Cost Infrared Thermal Imaging to Assess Occupants' Thermal Comfort, On Behalf of Colleague Da Li, ASCE International Conference on Computing in Civil Engineering (i3CE), Atlanta, GA, 2019

Investigating the Neurophysiological Effect of Thermal Environment on Individuals' Performance Using Electroencephalogram, ASCE International Conference on Computing in Civil Engineering (i3CE), Atlanta, GA, 2019

Poster Session:

Investigating the effect of thermal environment on occupants' mental workload and task performance, Construction Research Symposium, University of Michigan, MI, 2019

LEADERSHIP AND SERVICE

Contributing Member, CEE Diversity, Equity, and Inclusion (DEI) Committee, University of Michigan, October 2021 – Present

Volunteer, Transportation Diversity Recruitment Program University Visit Day, Michigan Department of Transportation and University of Michigan, July 2021

Voting Member, CEE Diversity, Equity, and Inclusion (DEI) Committee, University of Michigan, October 2020 – September 2021

Committee Member, CEE Graduate Student Advisory Council, University of Michigan, August 2019 – September 2021

Committee Member, CEE DEI Collaborative, University of Michigan, July 2020 – July 2021

Planet Blue Ambassador, University of Michigan, 2018 - Present

Learning and Research Section Chair, Student Union of School of Investment and Construction Management, October 2015 – September 2016

PROFESSIONAL AFFILIATIONS

Reviewer, International Symposium on Automation and Robotics in Construction (ISARC), 2021

Reviewer, Journal of Integrative Neuroscience, IMR, 2021 - Present

Reviewer, Journal of Computing in Civil Engineering, ASCE, 2020 – Present

Reviewer, ASCE Construction Research Congress (CRC), 2020

Student Member, ASCE Technical Council on Computing and Information Technology, Visualization, Information Modeling, and Simulation (VIMS) Committee

Student Member, ASCE Technical Council on Computing and Information Technology, Data Sensing and Analysis (DSA) Committee

INDUSTRY EXPERIENCE

Project Cost Engineering Intern, Dalian Investment Verification Center, Dalian, China, July 2017 – October 2017

- Audited the tender document and budgeting of infrastructure construction projects
- Tracked utilization of government funds in infrastructure construction projects

SKILLS

Language Proficiency: Native Chinese, Professional English

Programming/OS: ROS, C++/C, Python, C#, Bash, LCM, Matlab, Simulink

Software/Tools: Unity, Rhino/Grasshopper, Revit, Naviswork, Solidworks, Bluebeam Revu

Hardware: Kuka, Raspberry Pi, Beagle Bone, Lidar, Kinect, Turtlebot, VR, EEG, GSR