Xiayu Zhao

PhD Student — Robotic, Automation, and Intelligent Sensing (RAISe) Lab
University of Illinois Urbana-Champaign (UIUC)
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Research Interests

AI and machine learning algorithms for seamless human-robot collaboration; Computer vision techniques for automated inspection tasks; Construction robotics; Robotic control and navigation.

Education

Ph.D. Student, *Civil and Environmental Engineering, The Grainger College of Engineering, University of Illinois Urbana-Champaign* Spring 2024 – present

- Advisor: Dr. Houtan Jebelli
- GPA: 3.91/4.00 (Spring 2024 – present)
- Dissertation Title:

Master of Computer Science, *Siebel School of Computing and Data Science, University of Illinois Urbana-Champaign* 2025 – 2027

- Research fields: Vision, Graphics, Interaction, and Robotics.
- GPA: 4.00/4.00 (Fall 2025 – present)
- Courses taken: CS598 (Deep Learning for Robotic Manipulation) A, CS547/IE534 (Deep Learning) A+, ECE470 (Introduction to Robotics) A, CS598 (Advanced Computational Topics in Robotics) A-, CS443 (Reinforcement Learning) B+, Ordered Data Structures (Coursera, provided by UIUC), Object-Oriented Data Structures in C++ (Coursera, provided by UIUC).

Master of Architecture, *Tsinghua University, Beijing, China* 2019 – 2021

- Research fields: Robotic Construction, 3D Printing, Computational Design, GPA: 3.97/4.00

Bachelor of Architecture, *Tianjin University, Tianjin, China* 2014 – 2019

- Research fields: Computational Design, GPA: 3.85/4.00

Academic Appointments

Graduate Student Research Assistant, *University of Illinois Urbana-Champaign, Urbana, IL, U.S.*
Spring 2024 – present
Supervisor: Professor Houtan Jebelli

Graduate Student, *Icon Lab, Penn State University* Fall 2023
Robotic Construction Safety Training Prototype with Immersive Technology (VR)
Role: **Team Leader** — Supervisor: Professor John Messner — TA: Saleh Alghamdi
Team: Tessa Beauchat, Islam Gharaibeh, Fangxiao Li

- Connected ROS (Robot Operating System) with Unity 3D to control robot arm mounted UGV (Unmanned Ground Vehicle) in immersive simulation environments.
- Developed an interactive, game-based prototype specifically for collision-avoidance safety training, targeted at workers involved in human-robot collaborative construction scenarios.

Research Assistant, *DAIC (Digital Architecture and Robotic Construction) Lab, Tsinghua University*
Jul. 2021 – Apr. 2023
Supervisor: Professor Weiguo Xu

- Extracted design information to program and control robot arms for large-scale 3D printing.

- Developed software plug-ins for robotic construction, including 3D printing, metal cutting, wood cutting, wall painting, etc.

Master's Thesis and Graduation Design Spring 2021
Large-Scale Multi-Robots 3D Printing Construction Planning — Instructor: Professor Weiguo Xu

Student Assistant, *Built Environmental Virtual Reality Lab, Tianjin University* 2016 – 2017
Instructor: Professor Sinan Yuan
Sponsor: *National Natural Science Foundation*

- Related Methods: Field research, Data Collection, 3D Modeling, Data Input, Data Visualization using a Game Engine, VR Experience for Volunteers, Analysis of Statistical Results, Spatial morphology, and Human Spatial Cognition Mechanisms.

Teaching and Mentoring

Teaching Assistant, *Robotic Construction Research Series, Robotic Construction Group, Tsinghua University* Sep. 2022 – Apr. 2023
Supervisor: Professor Weiguo Xu

- Advising master students with their graduation projects related to robotic construction.
- Research topics involved plastic 3D printing, wood cutting, and foam cutting with KUKA robot arm.

Teaching Assistant, *Tsinghua University Parametric Design Workshop 2019* Jul. 2019
Tutor: Casey Rehm
Project Title: *Artificial Intelligence Architectural Design – 2D and 3D Generative Neural Network Techniques for Design Biomorphism.*

Teaching Assistant, *Computer-Aided Architectural Design Research in Asia (CAADRIA) Workshop 2018* May 2018
Tutors: Shajay Bhooshan, Vishu Bhooshan, Henry Louth, Leo Claudius
Project Title: *Developable Funicular Skeletons with Tensioning Membranes*

Professional Experiences

Research Engineer, *Institute of Future Human Habitats* 2021 – 2023
Tsinghua University Shenzhen International Graduate School (SIGS)

- Developed large-scale robotic construction technology based on composite consumables and practical building materials with an interdisciplinary team.
- Developed software interface to streamline input and control.

3D Concrete Printing Specialist, *Heqing Digital Building Technology Co.* 2020 – Apr. 2023

- Participated in several on-site robotic construction projects in China and the US, including designing the shape, designing the print path, writing the print program, operating the robot arm on-site, post-maintenance, etc.

Intern Architect, *Zaha Hadid Architects* Jun. – Sept. 2020
Project Director: Satoshi Ohashi

- Participated in the design stage of the final winning bid – competition – design of *Tower C of Shenzhen Bay Super Headquarters.*
- Participated in the Preliminary design of the Unicorn Island project in Sichuan.

Intern Architect, *China Architecture Design & Research Institute* Jun. – Sept. 2018
Project Director: Professor Xinggang Li

- Participated in the design of the *National Sliding Center* in the Beijing 2022 Winter Olympic Games in the Yanqing District.

Co-designer, *Model Slicing and Toolpath Plug-in Development for Robotic Construction* Mar. – Apr. 2023
Project Leaders: Chenwei Sun, Weiguo Xu

Principal Designer, *Rotatable Fine Extrusion Print Head Design for 3DCP Decorative Panels* Oct. 2021 – Feb. 2022
Partners: Zilu Guo, Qi Liu, Chenwei Sun

Associate Project Manager, *Wooden House Renovation with Multi-Robots 3D Printed Walls* Jul. – Aug. 2022
Project Leaders: Weiguo Xu, Chenwei Sun
Sponsor and Co-designer: University of Hong Kong, Prof. Lin John C.H.

Principal Designer, *Factory Façade Design Based on Style Transfer Machine Learning* 2022
Zhangjiakou, Hebei, China

Lead Designer, *Robot 3D Concrete Printed Model House for Low-income People in Africa* 2020
Project Leader: Weiguo Xu — Wuxi, Zhejiang, China

Designer and Engineer, *Wujiazhuang Multi-Robots 3D Concrete Printed Farmhouse* 2020
Project Leaders: Weiguo Xu, Yuan Gao, Chenwei Sun — Wujiazhuang, Hebei, China

Awards & Honors

Academic Awards

- **Olympiad Medalist** – All Engineering Field, 2025 Olympiad in Engineering Science 2025
  Held at the University of Stavanger, Norway
  Submission: *Autonomous Drone-based System for Precision, Non-contact Surface Finishing in Construction*
  Team: Tianyu Ren, Xiayu Zhao, Houtan Jebelli
- **First Place** – ASCE 2025 Global Robotics and Automation Competition 2025
  2025 ASCE Computing Conference, New Orleans, hosted by the ASCE Computing Division
  Submission: *Module-enhanced Slope-Adaptive and Hazard-Aware Hexapod Robotic System for Safe Roof Inspection*
  Team: Xiayu Zhao, Houtan Jebelli
- **Journal Cover Feature** – *Computer-Aided Civil and Infrastructure Engineering* 2025
  Paper: *A Computational Method for Real-time Roof Defect Segmentation in Robotic Inspection*
- **Outstanding Graduate Award** 2019
- **Outstanding Graduation Design Award** 2019
- **Tianjin University's Outstanding Student Award** (1/1000) 2019
- **Outstanding Project Assignment in National Higher Education Institutions** 2017
- **Honorable Mention** – Skyscraper Competition (eVolo) 2018
  Team: Jiangchen Hu, Yining Bei, Mingwen Zhang
- **China Architecture Newcomers Competition – Top 100 Award** 2017
- **4$^{\text{th}}$ National Tournament of Green Building Innovation (2015) – First Prize** 2015
  Team: Adela Wei, Mark Wang, Mason Yang, Yu Zhao
  Sponsor: *The Chartered Institute of Building (CIOB)*

Academic Scholarship

- **University Graduate Fellowship** (Sponsor: *Pennsylvania State University*) 2023
- **College of Engineering Scholarship** (Sponsor: *College of Engineering, PSU*) 2023
- **China National Scholarship** (1/101) 2018
- **China National Scholarship** (1/97) 2016
- **China National Scholarship** (1/94) 2015
  (Sponsor: *Ministry of Education of the People's Republic of China*)

Publications

Refereed Journal Papers

1. **Zhao, X.** and Jebelli, H. (2025). "A Computational Method for Real-time Roof Defect Segmentation in Robotic Inspection." *Computer-Aided Civil and Infrastructure Engineering*, 1–28. (Featured as the cover image of the journal.)
2. **Zhao, X.**, Liu, Y., and Jebelli, H. (2025). "Module-Enhanced Slope-Adaptive and Hazard-Aware Hexapod Robotic System for Safe Roof Inspection." *ASCE OPEN: Multidisciplinary Journal of Civil Engineering*, 3(1), 04025011.
3. Ye, W., Chen, S., **Zhao, X.**, Xu, W. (2022). "Porous Space — Biomimetic of Tafoni in Computational Design." *Architectural Intelligence*. 18 (2022).
4. **Zhao, X.**, Xu, W. (2021). "Research Progress and Application Status of 3D Printing Construction Technology." *Chinese & Overseas Architecture*. 10(2021):7–13.

Journal Manuscripts in Progress *To be updated.*

Refereed Conference Papers

5. Ren, T., **Zhao, X.**, and Jebelli, H. (2026). "Dynamic Robotic Control Strategies for UAV Stability with Rotatory Payload." (Accepted).
6. **Zhao, X.**, Ren, T., and Jebelli, H. (2026). "LLM-Driven Safe Robotic Navigation in Construction Sites: A Prompt Engineering Framework with Terrain-Adaptive Path Planning." (Accepted).
7. **Zhao, X.**, Liu, Y., and Jebelli, H. (2026). "Hybrid UAV-UGV System with Interchangeable Ground Modules for Multi-Terrain Construction Site Inspection." (Accepted).
8. Guo, X., Li, Y., Kong, X., Jiang, Y., **Zhao, X.**, Gong, Z., Zhang, Y., et al. (2025). "Toward Engineering AGI: Benchmarking the Engineering Design Capabilities of LLMs." *NeurIPS 2025 Datasets and Benchmarks Track*. arXiv:2509.16204.
9. **Zhao, X.** and Jebelli, H. (2025). "Adaptive Kinematic and Dynamic Control for Hexapod Robots in Complex Construction Environments." *Proceedings of the 42nd International Symposium on Automation and Robotics in Construction (ISARC 2025)*, Montreal, Canada, pp. 210–217. https://doi.org/10.2226
10. **Zhao, X.**, Ren, T., Liu, Y., and Jebelli, H. (2025). "Sensor Fusion and Hierarchical Inspection Strategy for Aerial-Ground Multi-Robot System." *Proceedings of the 42nd International Symposium on Automation and Robotics in Construction (ISARC 2025)*, Montreal, Canada, pp. 163–170.
11. Ren, T., **Zhao, X.**, and Jebelli, H. (2025). "Advanced Sensor Integration for Enhanced Flight Control in UAV-Based Construction Automation." *Proceedings of the 42nd International Symposium on Automation and Robotics in Construction (ISARC 2025)*, Montreal, Canada, pp. 122–129.
12. Liu, J., Ping, Y., Wang, Y., and **Zhao, X.** (2025). "Machine Learning-Based Optimization for Modular Robotic Systems in Construction: A Review." *2025 International Conference on Computing in Civil Engineering (i3CE)*. (Accepted).
13. **Zhao, X.**, Ren, T., and Jebelli, H. (2024). "Adaptive Intelligence for Robot Navigation Efficiency with a Deep-Reinforcement-Learning-Based Cyber-Physical System." *2024 International Conference on Computing in Civil Engineering (i3CE)*, Pittsburgh, Pennsylvania, U.S. (Accepted).
14. **Zhao, X.**, and Jebelli, H. (2024). "Grounding Large Language Models in Robot Control: Facilitating Human-Robot Collaboration in Construction." *2024 International Conference on Computing in Civil Engineering (i3CE)*, Pittsburgh, Pennsylvania, U.S. (Accepted).
15. Ojha, A., **Zhao, X.**, Zhang, Y., Liu, Y., and Jebelli, H. (2024). "Improving Heat Strain Prediction in Construction Workers: A Transfer Learning Approach to Overcome Variability Challenges." *2024*

International Conference on Computing in Civil Engineering (i3CE), Pittsburgh, Pennsylvania, U.S. (Accepted).

16. Ojha, A., Gautam, Y., **Zhao, X.**, Sharifironizi, A., Jebelli, H., and Martin, A. (2024). "Understanding the Impact of an Exoskeleton System On Metabolic Cost of Workers During Common Repetitive Construction Tasks." *2024 International Conference on Computing in Civil Engineering (i3CE)*, Pittsburgh, Pennsylvania, U.S. (Accepted).
17. **Zhao, X.**, Xu, Z., Xu, W. (2023). "Reusable Assembled Lightweight 3D Concrete Printed Components Based on Tessellation Patterns." *IASS Symposium 2023.* (Abstract Accepted).
18. Ye, W., **Zhao, X.**, Xu, W. (2022). "Simulation Algorithm Based on Weathered Rock Morphology and Optimization Algorithm for Design Applications." in *Hybrid Intelligence: Proceedings of the 4th International Conference on Computational Design and Robotic Fabrication (CDRF 2022).* Online and Global, 2022.

Poster Presentations *To be updated.*

Invited Interviews, Exhibitions and Speeches

Exhibitions and Invited Speeches **Bi-City Biennale of Urbanism/Architecture 2022** Apr. 2022 – Jan. 2023
Title: *Assembled 3D Printed Concrete Urban Miniature Garden*
Role: **Lead Exhibit Designer** — *Kingway Brewery*, Shenzhen, Guangdong, China

Design as Solution: Shenzhen Design Week 2021 Dec. 2021
Title: *Robotic 3D Printed Concrete Construction Works*
Role: **Keynote Speaker & Lead Exhibit Designer** — *UpperHills*, Shenzhen, Guangdong, China

Future-Home: Beijing Urban Architecture Biennale 2021 Oct. 2021
Role: **Exhibit Designer** — *Zhangjiawan Design Town*, Beijing Urban Vice Center

Invited Interviews *To be updated.*

Professional Leadership & Service Activities

Professional Committees *To be updated.*

Journal & Conference Reviewer (Selected) *Journal Reviewer*

- Developments in the Built Environment
- ASCE Open Journal

Conference Reviewer

- ASCE International Conference on Computing in Civil Engineering (i3CE 2024)
- ASCE International Conference on Computing in Civil Engineering (i3CE 2025)
- ASCE International Conference on Computing in Civil Engineering (i3CE 2026)
- 42nd International Symposium on Automation and Robotics in Construction (ISARC 2025)
- 43rd International Symposium on Automation and Robotics in Construction (ISARC 2026)
- 12th International Conference on Industrial Ecology (ISIE 2025)
- CI & CRC 2026 Joint Conference

Student Member, American Society of Civil Engineers (ASCE) Fall 2023 – present

Cat Foster Volunteer, Vermilion County Animal Shelter 2025 – present

Team Leader, Data Forum Center, Tsinghua University Student Union Fall 2020
Job Contents: Campus Applet Development; Data Visualization.

Activity Manager, Sports Department of Graduate Student Union, Tsinghua University Fall 2019

Event Organizer, Purple (LGBTQ+ Community), Tsinghua University Fall 2019 – Spring 2021

Team Member, Women's Soccer Team, School of Architecture, Tsinghua University 2019 – 2020

Computer Skills

Robot Programming/OS: ROS, Industrial Robot Language (URScript), C#
Programming: Matlab, Python, R, C++
Simulation Software: Unity, Unreal Engine
Statistical Analysis Software: IBM-SPSS
Drawing and Building Information Modeling: AutoCAD, Revit, Rhino, Grasshopper, SketchUp, SolidWorks, Adobe Photoshop, Adobe Illustrator
General Software/Platform: MS-Office, LaTeX, Google Colab, Jupyter Notebook

References

Available upon request.