Reachsak Ly

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RESEARCH INTERESTS

Leveraging emerging technologies such as Generative AI, Vision, Large language models, Blockchain, and Digital twins alongside Machine learning, Construction robotics, and Extended reality (XR) to develop innovative solutions for human building interaction, smart buildings and cities, and construction.

EDUCATION

2022 – Present
Ph.D. in Environmental Design and Planning
(Expected June 2025)
Myers Lawson School of Construction,
Virginia Polytechnic Institute and State University, Blacksburg, VA

2017 – 2021
Bachelor of Engineering in Civil Engineering
Specialization: Structural Engineering
Zhejiang University, China

ACADEMIC EXPERIENCE

2022 – Present
Research Assistant
Department of Building Construction,
Myers Lawson School of Construction,
Virginia Polytechnic Institute and State University, Blacksburg, VA

2022 – Present
Teaching Assistant
Department of Building Construction,
Myers Lawson School of Construction,
Virginia Polytechnic Institute and State University, Blacksburg, VA

2019 – 2021
Undergraduate Research Assistant
School of Civil Engineering and Architecture,
Zhejiang University, China

INDUSTRIAL EXPERIENCE

June 2020- June 2022
Project Engineer - China Railway Construction Corporation (CRCC)

- **Duties:** Coordinate with architects and construction team to ensure compliance with building codes and safety regulations. Conduct site inspections to monitor the quality and progress of construction. Provide technical advice and solutions during the construction phase.

May 2019- June 2020
Project Engineer Intern (Full-time) - China Railway Construction Corporation (CRCC)

- **Duties:** Conduct site safety inspection. Support senior engineers in reviewing and tracking construction schedules. Conduct site inspections to monitor the quality and progress of construction.

FELLOWSHIPS & AWARDS

2025 **Pratt Fellowship for Outstanding PhD Students** | *Virginia Tech, College of Engineering Office of Research and Innovation*

Award Amount: **$2,289.20** – Fellowship awarded in recognition of outstanding research contributions and academic excellence.

2023 **Student Award recipient for the IIBEC International Convention and Trade Show** | *RCI-IIBEC Foundation | USA*

2021 **Excellent Award** | *The International Project Competition in Structural Health Monitoring | 2021, University of Illinois Urbana-Champaign and Harbin Institute of Technology.*

2020 **Outstanding International Student Leader** | *Zhejiang University, China.*

2016 **Fully-funded government scholarship for the undergraduate program** | *Zhejiang University, China.*

2016 **1st Place in Microsoft Hackathon** | *Window App Studio Challenge. Microsoft*

REFEREED JOURNAL

2025 **Reachsak Ly**, Alireza Shojaei. Decentralized autonomous organizations in Built Environments: Applications, Potentials and Limitations. *Information Systems and e-Business Management Journal*. DOI:10.1007/s10257-025-00699-1

2023 Hossein Naderi, Alireza Shojaei, **Reachsak Ly**. Autonomous construction safety incentive mechanism using blockchain-enabled tokens and vision-based techniques. *Automation in Construction*. Vol. 153 DOI:10.1016/j.autcon.2023.104959

2023 Alireza Shojaei, **Reachsak Ly**, Saeed Rokooei, Amirsamman Mahdavian, Ahmed Al-Bayati Virtual site visits in Construction Management education: A practical alternative to physical site visits. *Journal of Information Technology in Construction (ITcon).* DOI:10.36680/j.itcon.2023.036

2023 Saeed Rokooei, Alireza Shojaei, **Reachsak Ly**. Faculty development program to enhance teaching quality in construction. *International Journal of Construction Management.* DOI: 10.1080/15623599.2024.2304475

REFEREED JOURNAL (Under Review/In-progress)

2025 **Reachsak Ly**; Alireza Shojaei; Xinghua Gao; Philip Agee; Abiola Akanmu. Autonomous Building Cyber-Physical Systems Using Decentralized Autonomous Organizations, Digital Twins, and Large Language Model. (*Submitted to Automation in Construction*) (Preprint: arXiv:2410.19262)

2025 **Reachsak Ly**; Alireza Shojaei. Public and private blockchain for decentralized digital building twins and building automation system. (*Under Review, Automation in Construction*) (PDF)

2025 **Reachsak Ly**, Mohammad Hossein Heydari, Hossein Naderi, Josh Iorio, Alireza Shojaei. Investigation of Gender and Racial Diversity in U.S. Construction Higher Education. Submitted to *International Journal of Construction Education and Research*. (*In revision for resubmission*) [PDF]

2024 MohammadHossein Heydari; Hossein Naderi; **Reachsak Ly**; Alireza Shojaei. An Industry-Centric Investigation of Educational Practices to Enhance Diversity in the Construction Workforce. Manuscript submitted to *Journal of Management in Engineering*. (Under review)

REFEREED CONFERENCE PROCEEDINGS

2025 **Reachsak Ly**, Alireza Shojaei, Xinghua Gao. Smart Building Operations and Virtual Assistants Using LLM. In *Companion Proceedings of the 33rd ACM Symposium on the Foundations of Software Engineering* , June 23-27, 2025, Trondheim, Norway (PDF)

2024 **Reachsak Ly**, Alireza Shojaei; Hossein Naderi. DT-DAO: Digital Twin and Blockchain-Based DAO Integration Framework for Smart Building Facility Management. In *Construction Research Congress 2024*, pp. 796-805. American Society of Civil Engineers. 2024-03-18, Des Moines, Iowa. DOI: 10.1061/9780784485262.081

2024 Hossein Naderi, **Reachsak Ly**, Alireza Shojaei. From Data to Value: Introducing an NFT-Powered Framework for Data Exchange of Digital Twins in the AEC Industry. In *Construction Research Congress 2024*, pp. 299-308. American Society of Civil Engineers. 2024-03-18, Des Moines, Iowa. DOI: 10.1061/9780784485262.031

2024 Hassan Azad, Alireza Shojaei, **Reachsak Ly**, Saleh Naseer, Laurie M. Heller. Assessment of annoyance from traffic noise in a school and a hospital. In *Inter-Noise 2024 Conference*, pp. 9000 - 9994, 2024-08-27, Nantes, France. DOI: 10.3397/IN_2024_4264

2021 Jiawei Zhang, Jiangpeng Shu , **Reachsak Ly**, Yiran Ji (2021). Continual-learning-based framework for structural damage recognition. In *The 10th International Conference on Structural Health Monitoring of Intelligent Infrastructure*, 2021-06-30-2021-07-02, Porto, Portugal. [PDF]

2020 Jiawei Zhang, **Reachsak Ly**, Weijian Zhao, Yunyi Liu. Image-Based Structural Damage Recognition using Deep Convolutional Neural Networks. In *Proceeding of the Fib Symposium 2020 Concrete Structure for Resilience Society*, 2020-22-11 to 2020-24-11, Shanghai, China. [PDF]

OTHER PUBLICATION

2021 Jiawei Zhang, Jun Li, **Reachsak Ly**, Yunyi Liu and Jiangpeng Shu. Deep Learning-Based Fatigue Cracks Detection in Bridge Girders using Feature Pyramid Networks. In *The 1st International Project Competition for Structural Health Monitoring*. 2020-15-06 to 2020-30-09, Harbin, China (arXiv:2410.21175)

2021 Jiangpeng Shu, Jiawei Zhang, **Reachsak Ly**, Fangzheng Lin, Yuanfeng Duan. Continual-learning-based framework for structural damage recognition. (arXiv:2408.15513)

2019 **Reachsak Ly**, Lou Tao Shen, Yu Yuansheng, Maosi Geng, Yinan Dong, Ce Wang. Renovation proposal of Santa Clara Street in San Jose. In *The 2019 ASCE Mid-Pacific Student Conference*, Transportation Challenge.2019-14-04-2019-19-04, San Jose, CA [PDF]

CONTRIBUTION TO PRIOR FUNDED RESEARCH

(NSF SCC-PG) Remote Sensing and Prediction of Environmental Noise to Facilitate Addressing the Social and Health Issues of Noise - Pilot Study: Schools and Hospitals

Award Amount: USD 149,437, Award Number: 2125427.

- Data analysis on noise datasets collected from hospitals and schools.
- Applied descriptive and inferential statistical techniques to assess noise levels and identify correlations with times of the day.
- Performed time series data visualization to illustrate patterns of environmental noise.

Diversity and Inclusion Seed Investments fund (Institute for Critical Technology and Applied Science (ICTAS)) Research on Diversity and Inclusion in the Construction industry and education.

- Conducted data collection for the development of a comprehensive DEI database. Assisted with the design and development of the project website.
- Submitted a journal paper on Gender and Racial Diversity in U.S. Construction Higher Education

GRANT PROPOSALS

Smart and Autonomous Building Cyber-Physical Systems; (NSF 24-581 Cyber-Physical Systems); **Submitted: 05/30/24**;

- My dissertation research and preliminary data related to Blockchain and LLM in smart building are the basis for this grant proposal.
- Contributed to the development and writing of the proposal, including the overall research design, project justification, theoretical underpinning, broader impacts, and intellectual merit.

AI-Driven Augmented Reality for Construction Education: Leveraging Vision and Large Language Models for Immersive and Interactive Learning; (NSF 23-624 Research on Innovative Technologies for Enhanced Learning (RITEL)); **Submitted: 11/05/24**;

- My preliminary works and data on Extended Reality and LLM serve as the basis for this proposal.
- Contributed to the development and writing of the proposal, including the overall research design, project justification, theoretical underpinning, broader impacts, and intellectual merit.

A Real-time and Automated Construction Safety Monitoring and Reporting system using Multimodal Generative AI (Charles Pankow Foundation); **Submitted: 12/01/24**;

- Contributed to the development of the prototypes of the Generative AI system for construction safety monitoring and the writing of the proposal, including the overall research design, project justification, broader impacts, and intellectual merit.

Virginia's Nexus Horizon - Synergizing Urban-Rural Resilience for Sustainable Growth. (NSF 24-533 Sustainable Regional Systems Research Networks); **Submitted: 05/15/24**

- Assisted with the introduction section and data management plan.

AI and Blockchain-Powered Mentorship and Gamification for Empowering Minority STEM Students: Nurturing a Sense of Belonging; (NSF 24-601 Advancing Informal STEM Learning); **Submitted: 01/07/24**

- Assisted with the introduction section and data visualization.

RELEVANT RESEARCH PROJECT

2024 – Present **Vision Language Model for Construction Site Progress and Safety Monitoring**
Developed a vision language model-based AI system to monitor construction site progress and safety conditions, integrating natural language processing, computer vision, and function calling for comprehensive site analysis and automated reporting. (Github) *(Manuscript in preparation)*

2024 – Present **Vision Language Model-based AI agents and (XR) Extended Reality applications**
Developed vision language model-based AI agents and extended reality (XR) applications. This project leverages open-sourced vision language model (LLaVA), Text-to-speech (TTS), and Speech-to-Text (STT) model with Unity 3D to develop a multimodal AI application on Microsoft HoloLens 2 with text, image, and video understanding. (Github) *(Manuscript in preparation)*

2024 – Present **Small language model-based smart home devices for Human-Building Interaction**
Deployed small language models (Phi-3 mini, LLaMA 3.2) onto Raspberry Pi 5 for human-building interaction applications, including smart building systems control. (Github) *(Manuscript in preparation)*

2024 – Present **Large Language Model for Human-Building Interaction**
Designed and implemented a large language model-based chatbot/AI agent to facilitate natural language interactions between building occupants and facility management systems such as smart facilities control. (Github) *(Manuscript in preparation)*

2024 – Present **Retrieval-Augmented Generation (RAG) Chatbot for Construction Safety**

Developed a retrieval-augmented generation (RAG) chatbot utilizing LLM to provide real-time safety information and guidance on construction sites to enhance workers' understanding of safety protocols and awareness. (Github) *(Manuscript in preparation)*

TEACHING EXPERIENCE

Undergraduate level

BC 4434 - Construction Practice I

This course delves into advanced business and management practices related to vertical construction projects. It covers a wide range of topics, including Work Breakdown Structure (WBS), planning and scheduling, cash flow forecasting and analysis, assemblies estimating, as well as estimating general conditions and overhead costs. Additionally, students will explore site logistics planning, construction contracts and insurance, and the review and management of Building Information Models (BIM). The course also introduces the Design-Build project delivery method.

- **Duties**: Conducted lab sessions and graded students' labs, homework, and exams. Instructed students on key topics such as Work Breakdown Structure (WBS), planning and scheduling, cash flow forecasting and analysis, and assembly estimating. Supervised and mentored students on these topics, held regular office hours for additional support, and provided personalized guidance to help students understand course material and industry practices.

BC 4444 - Construction Practice II (Capstone Project)

This course explores and applies business and construction management practices related to the development and preparation of a response to an RFP to an actual Design-Build capstone project. Topics are reinforced through working on a real-life D/B project. This course is designed to prepare students to understand concepts and principles of the D/B contracting method through working on preparing and delivering responses to an RFP for a real-life D/B project.

- **Duties**: Guided students through the development and execution of their capstone projects, providing supervision on the use of design and project management software, including Revit, MS Project, and RSMeans for cost estimation. Assisted students in preparing responses to project RFPs, offering continuous feedback on design quality and project milestones. Graded student submissions and provided detailed feedback.

BC 4164 - Process Planning and Production Design for Construction

Course topics include production systems, behavior of construction systems and workers, relationships between subsystems in the construction process, queueing systems, process modeling, and simulation. This course gives students an understanding of the production process from both a theoretical and practical perspective. It also equips them with tools and techniques to design, analyze, and improve construction processes.

- **Duties**: Instructed students on the use of Primavera Cloud for project management, including scheduling, process planning, and production analysis. Provided hands-on guidance in utilizing the software to model and improve construction processes. Graded student assignments and projects, offering detailed feedback to enhance their understanding of production systems and process modeling.

Graduate level

BC 5984 - Decision-Making and Risk Management

This course explores the theories, methodologies, and tools used in decision-making and risk management from a beginner to an advanced level. Students will gain insights into the complexities of making decisions in uncertain environments and learn strategies to manage and mitigate risks effectively. This course is designed to prepare students to think critically and become better decision-makers. It will also equip them with risk management knowledge to apply in various contexts.

- **Duties**: Supervised students in performing calculations related to planned and expected values for decision-making in project management. Guided them through the application of risk

management strategies and techniques. Facilitated hands-on experience with project simulation using the Monte Carlo method to analyze and manage uncertainties in project outcomes.

GUEST LECTURE

BC4164 –Process Planning and Production Design for Construction ***Virginia Tech***

- Supervised and coordinated students in BC4164 class on the use of **Generative AI,** such as ChatGPT and Claude, and open-sourced LLM, such as Llama 3.2, for construction scheduling applications.

SKILLS

Application used

Autodesk Platform Service, Autodesk Tandem, Primavera P6, Autodesk Revit, Autodesk Naviswork, AutoCAD, Autodesk Recap, Faro Scene, Trimble Realworks, SPSS, Microsoft Projects, and Unity 3D.

Programming language

Python, R, Python, C#, Javascript, Java, HTML/CSS, ROS, Solidity and MATLAB

Data Science & Machine Learning: TensorFlow, PyTorch, Scikit-Learn, Pandas, NumPy, Matplotlib, MLX, CUDA, Llama.cpp, Llamaindex, Huggingface, Langchain, Unsloth AI and CrewAI

PROFESSIONAL AFFILIATION/ CERTIFICATION

- Future Professoriate Certificate, *Graduate Certificate Program, Virginia Tech,* 2024
- CIRTL Certificate, *Center for the Integration of Research, Teaching & Learning, Virginia Tech, 2024*
- Student member, *Center for Human-Computer-Interaction (CHCI), Virginia Tech.*
- Student member*, International Institute of Building Enclosure Consultants (IIBEC).*

UNIVERSITY SERVICE

2024 – Present Research collaboration with the Diversity, Equity, and Inclusion (DEI) Committee at the Myers-Lawson School of Construction.

- **Duties:** Conduct research on the investigation of the relationship between racial and gender diversity among student graduates and their retention rates within the construction industry. Collaborate with multiple institutions to collect and analyze data on construction student graduates, focusing on diversity metrics. Assist with data collection, data visualization, and the development of the department's DEI website.

PROFESSIONAL SERVICE

Journal paper Reviewer

2024 – Present Journal of Information Technology in Construction

2024 – Present Journal of Construction Engineering and Management

Conference paper Reviewer

2025 ASCE International Conference on Computing in Civil Engineering (i3CE 2025)

OUTREACH / COMMUNITY SERVICE

2024 ***Building Leaders for Advancing Science and Technology (BLAST) program,*** Myers Lawson School of Construction, Virginia Tech, VA| July 09, 2024

- **Duties:** Conducted a research demonstration on the integration of LLM-based AI agents and Augmented Reality (AR) for smart building control. Presented the application of AR and LLM technologies, showcasing their potential future impact on the construction industry to high school students.

2024 ***Virginia 4-H Youth Development Program***, Myers Lawson School of Construction, Virginia Tech, VA| July 09, 2024

- **Duties:** Organized and conducted a workshop demonstrating the application of quadruped robots in the construction industry. Engaged high school students in hands-on activities and discussions about robotics technology and its potential impact on construction practices.

MENTORSHIP SERVICE

2024 Student mentoring for the U.S. Department of Energy Solar Decathlon competition.

- Guiding students on the development of digital twins for the Zero Energy Buildings.

2022 – Present Student mentoring.

- Conducting one-on-one meetings with students to resolve challenges encountered in the taught courses.