Althaf Shajihan

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RESEARCH AREAS

- Autonomous Structural Health Monitoring
- Smart Sensing and Internet of Things (IoT)
- Computer Vision and Generative AI
- Smart-Cities and Digital-Twins for Disaster Resilience
- Scientific Machine Learning and Physics-Informed Neural Networks (PINN)

EDUCATION

Ph.D. in Civil and Environmental Engineering (Focus: Structural Engineering) 2025
University of Illinois Urbana-Champaign (UIUC), Urbana, IL
Research area: AI and Smart Sensing Framework for Infrastructure Assessment | **GPA: 4.00/4.00**
Advisor: Prof. Billie F. Spencer, Jr.

M.S. in Computer Science 2024
University of Illinois Urbana-Champaign (UIUC), Urbana, IL
Research area: Physics-informed Neural Networks for Structural Systems | **GPA: 3.95/4.00**
Advisor: Prof. Girish Chowdhary

M.S. in Structural Engineering 2018
Indian Institute of Technology Bombay (IIT-B), Bombay, India
Research Area: Structural Health Monitoring of Masonry Arch Bridges | **GPA: 9.92/10.00**
Departmental 1st Rank | Institute Silver Medal | Advisor: Prof. Pradipta Banerji

B.S. in Civil Engineering 2016
National Institute of Technology Calicut (NIT-C), Calicut, India
Departmental 3rd Rank | **GPA: 9.21/10.00**

AWARDS AND HONORS

- **First Runner-up**, 7th–Midwest Smart Structures Colloquium, University of Illinois Urbana-Champaign 2025
- **Graduate College Conference Presentation Award**, University of Illinois Urbana-Champaign 2024
- **First Runner-up**, 6th–Midwest Smart Structures Colloquium, Purdue University 2024
- **Outstanding Student Contributor**, Academy for Excellence in Engineering Education, UIUC 2023
- **Mavis Future Faculty Fellowship**, University of Illinois Urbana-Champaign 2022-23
- **Insight Leadership program**, Illinois Leadership Center, University of Illinois Urbana-Champaign 2023
- **International Liu Huixian Earthquake Engineering Scholarship**, U.S – China E.E. Foundation 2022
- **Editor's Choice Journal Article**, MDPI Sensors journal 2021
- **Excellence Award**, 1st Intl. SHM competition – Data Anomaly Detection Challenge (*out of 330 students*) 2020
- **Bronze Award**, 1st Intl. SHM competition – Image based crack identification in bridges (*out of 112 teams*) 2020
- **Ravindar K. and Kavita Kinra Fellowship**, University of Illinois Urbana-Champaign 2018-19
- **Institute Silver Medal**, felicitated by Prime Minister of India for Dept. 1st Rank, IIT Bombay, India 2018
- **First Place**, Research Poster Competition, National Civil Engineering Research Expo, IIT Madras, India 2016
- **99.4th Percentile (Top 0.6%)** among 120,000 candidates, Graduate Aptitude Test in Engg. (GATE), India 2016

RESEARCH EXPERIENCE

San Diego State University – San Diego, CA

- **Assistant Professor** 2025 – Present
  - Research on advancing Physics-informed AI and Generative models for resilient civil infrastructure.

StructureIQ, Inc – Champaign, IL

- **Hardware Research Intern** Summer 2025
  - Prototyped and tested next-generation IoT sensor nodes for SHM of civil infrastructure, including PCB design modifications, sensor integration, and LoRa communication.
  - Led hardware–software co-design, debugging, and performance validation to bridge academic research with deployable SHM technologies.

Smart Structures Technology Lab – University of Illinois Urbana-Champaign, IL

- **Graduate Research Assistant**
- *Bridge Monitoring using Smart Sensors and Physics-informed Neural Networks* 2022 – 2025
  - Developed a novel unsupervised PINN-based damage detection framework for railroad truss bridges, achieving over 95% accuracy and validated on full-scale Calumet Bridge scenarios.
  - Integrated multi-modal data (site inspections, drone surveys, FEM models, IoT sensors) into deep learning pipelines for holistic and context-aware condition assessment.
- *Autonomous Infrastructure Assessment with Edge Computing and UAVs* 2020 – 2025
  - Developed a low-cost, deployable wireless machine-vision system for autonomous long-term displacement monitoring of railroad bridges with up to 25 days of battery operation; achieved state-of-the-art synchronization accuracy across multiple wireless camera nodes.
  - Developed a pipeline for 3D damage localization in bridges from drone inspection videos in GPS-denied environments using sparse point-clouds; validated on a 100-year-old bridge in Mahomet, Illinois.
- *Synchronized Wireless Sensing & Anomaly Detection with Deep Learning* 2018 – 2020
  - Developed hardware and software for synchronized sensing with external sensors in Wireless Smart Sensors, achieving state-of-the-art data-sync precision of up to 8 µsec and reducing false-positives in SHM.
  - Automated anomaly identification in sensor data with deep learning, achieving 96% classification accuracy even using a small training dataset.

Indian Institute of Technology Bombay, India

- **Graduate Research Assistant**
- *Structural Health Monitoring of Masonry Arch Bridge using Multi-Model Updating* 2017 – 2018
  - Performed condition assessment of a 90-year-old masonry arch railroad bridge for increased train axle loads using a multi-model updating technique. Developed a new computationally efficient 1D formulation for abutment soil-structure interaction considering the influence of moving train loads.
- *Seismic Base Isolation using Periodic Foundation* 2016 – 2017
  - Designed and validated a novel periodic foundation system with 1D composite meta-materials achieving wider low-frequency band gaps for seismic wave attenuation, offering a cost-effective solution to be used in bridge piers for earthquake force mitigation.

National Institute of Technology Calicut, India

- **Undergraduate Researcher**
- *Experimental and Numerical Study on Composite RC Deep Beams* 2015 – 2016
  - Optimized RC deep beam performance via experimental testing and FE analysis, using steel fibers and rubber additives to improve capacity, ductility, and crack distribution for better failure warning.

GRANTS & RESEARCH FUNDING

◦ **Full-Scale Seismic Testing of LifeArk Building Units** 2025 – 2026
LifeArk, Principal Investigator, Co-PI: Dr. Robert K. Dowell, *Grant Amount: $38,846*

◦ **Full-Scale Laboratory Testing of Welded, Debonded Miter Gate Anchorages for Fatigue Life Assessment** 2026 – 2027
U.S. Army Corps of Engineers (USACE), PI: B.F. Spencer, Jr., Co-authored on behalf of Prof. B.F. Spencer, Jr. *Grant Amount: $232,500*

◦ **Innovative Technologies in Structural Health Monitoring for Condition Assessment and Future Reliability Prediction** 2025 – 2026
U.S. Army Corps of Engineers (USACE), PI: B.F. Spencer, Jr., Co-authored on behalf of Prof. B.F. Spencer, Jr. *Grant Amount: $423,335*

◦ **Condition Assessment of Railroad Bridges using Wireless Smart Sensors** 2018 – 2020
U.S. Department of Transportation, Federal Railroad Administration (FRA), PI: B.F. Spencer, Jr., Co-author of closure report. *Grant Amount: $355,388*

JOURNAL PUBLICATIONS

[J1] Lawal, O., **Shajihan, A.**, Mechitov, K., & Spencer Jr, B. F. (2024). Edge Integration of Artificial Intelligence into Wireless Smart Sensor Platforms for Railroad Bridge Impact Detection. Sensors, 24(17), 5633. https://doi.org/10.3390/s24175633

[J2] Wang, S., Rodgers, C., Fillmore, T., Welsh, B., Golecki, T., **Shajihan, A.**, & Spencer, B. F. (2023). Vision-based model updating and evaluation of miter gates on inland waterways. Engineering Structures, 280, 115674. https://doi.org/10.1016/j.engstruct.2023.115674

[J3] Lawal, O., **Shajihan, A.**, Mechitov, K., & Spencer Jr, B. F. (2023). An event-classification neural network approach for rapid railroad bridge impact detection. Sensors, 23(6), 3330. https://doi.org/10.3390/s23063330

[J4] **Shajihan, A.**, Hoang, T., Mechitov, K., & Spencer Jr, B. F. (2022). Wireless SmartVision system for synchronized displacement monitoring of railroad bridges. Computer-Aided Civil and Infrastructure Engineering, 37(9), 1070-1088. https://doi.org/10.1111/mice.12846

[J5] Lawal, O., Najafi, A., Hoang, T., **Shajihan, A.**, Mechitov, K., & Spencer Jr, B. F. (2022). Development and validation of a framework for smart wireless strain and acceleration sensing. Sensors, 22(5), 1998. https://doi.org/10.3390/s22051998

[J6] **Shajihan, A.**, Wang, S., Zhai, G., & Spencer Jr, B. F. (2022). CNN based data anomaly detection using multi-channel imagery for structural health monitoring. Smart Structures Systems, 29(1), 181-193. https://doi.org/10.12989/sss.2022.29.1.181

[J7] Zhai, G., Narazaki, Y., Wang, S., **Shajihan, A.**, & Spencer, B. F. (2022). Synthetic data augmentation for pixel-wise steel fatigue crack identification using fully convolutional networks. Smart Structures Systems, 29(1), 237-250. https://doi.org/10.12989/sss.2022.29.1.237

[J8] **Shajihan, A.**, Chow, R., Mechitov, K., Fu, Y., Hoang, T., & Spencer Jr, B. F. (2020). Development of synchronized high-sensitivity wireless accelerometer for structural health monitoring. Sensors, 20(15), 4169. https://doi.org/10.3390/s20154169

[J9] Jain, S., **Shajihan, A.**, Laskar, A., & Alam, A. (2020). Application of innovative one-dimensional periodic isolation systems for seismic response reduction of bridges. Advances in Structural Engineering, 23(7), 1397-1412. https://doi.org/10.1177/1369433219895918

[J10] **Shajihan, A.**, Mechitov, K., Chowdhary, G., & Spencer Jr, B. F., Physics-informed neural network based model updating and damage identification in railroad truss bridges. arXiv preprint arXiv:2502.00194. (*in press*)

[J11] **Shajihan, A.**, Lawal, O., Golecki, T., Mechitov, K., & Spencer Jr, B. F., Deep learning-based prediction and localization of damage severity in steel truss bridges from drone surveys. (*under review*)

CONFERENCE PAPERS & TECHNICAL PRESENTATIONS

[1] **Shajihan, A.**, "Automated deep-learning based damage mapping in steel truss bridges from drone surveys", 7th Midwest Smart Structures Colloquium (MSSC), Univ. of Illinois Urbana-Champaign, IL, May 20-22, (2025).

[2] **Shajihan, A.**, "Physics-Informed Neural Network for Damage Identification in Railroad bridges", 6th Midwest Smart Structures Colloquium 4MSSC), Purdue University, IN, April 26-28, (2024).

[3] Rodgers, C., Wang, S., Welsh, B., **Shajihan, A.**, Golecki, T., Eick, B., & Spencer, B. F., "Vision-Based Displacement Estimation of Large-Scale Infrastructure — A Case Study." in the 14th International Workshop on Structural Health Monitoring (IWSHM), Stanford University, CA, September 12-14, (2023).

[4] Lawal, Omobolaji, **Shajihan, A.**, Mechitov, K., and Spencer Jr, B. F., "A Decision Tree-based Neural Network Approach for Railroad Bridge Event Classification": ASCE Engineering Mechanics Institute (EMI) 2023 Conference, Georgia Tech, Atlanta, June 6 - 9, (2023).

[5] **Shajihan, A.**, "Synchronized Displacement Monitoring with Multiple Wireless Smart Cameras", 5th Midwest Smart Structures Colloquium, Univ. of Illinois Urbana-Champaign, IL, April 15-16, (2023).

[6] **Shajihan, A.**, and Hoang, T. Mechitov, K., and Spencer, B. F., "Cyber-Physical Framework for Efficient Evaluation of Vision-based Displacement Tracking Systems", 8th World Conference on Structural Control and Monitoring (8WCSCM), Orlando, FL, June 5-8, (2022).

[7] **Shajihan, A.**, and Hoang, T., "Wireless Vision-based Synchronized Displacement Monitoring", The 2nd ZHITU Symposium on Advances in Civil Engg., UNIST, South Korea, Sep 28-29, (2021).

[8] **Shajihan, A.**, and Banerji, P., "Structural Health Monitoring of Masonry Arch Bridge using Multi-Model Updating", 4th Midwest Smart Structures Colloq. (4MSSC), Purdue Univ., IN, April 12, (2019).

[9] **Shajihan, A.**, Aishwarya, T., Shruthi, V., E. Mathew, S., Manoj, A., "Study on Concrete Deep Beams", Poster presentation in Civil Engineering Research Expo, IIT Madras, India, March 12-13, (2016).

TECHNICAL PUBLICATIONS

[1] Dowell, R. K., & **Shajihan, A.**,"AI Versus Hand Calculations for Statically Indeterminate Structural Engineering Examples", Feature article, STRUCTURE Magazine, (2025) *(in-press).*

INVITED TALKS & SEMINARS

[1] **Shajihan, A.**,"Bridging Smart Sensing and Physics-informed AI for Resilient Railroad Bridges", Seminar, Department of Computer Science, San Diego State University, Sep 29, (2025).

[2] **Shajihan, A.**,"Physics-Informed Neural Networks for Damage Identification and Structural Condition Assessment", Seminar, Department of Aerospace Engineering, San Diego State University, Sep 26, (2025).

[3] **Shajihan, A.**,"AI applications for Civil Infrastructure Assessment", Invited Talk, SDSU AI Club, San Diego State University, Sep 19, (2025).

TEACHING EXPERIENCE

Assistant Professor 2025 – Present

CIVE 421: Reinforced Concrete Design, San Diego State University

- Teaching a class of 32 students the fundamentals of RC design for structural elements.

Lead Teaching Assistant (TA) 2022 – 2023

CEE Strategic Instructional Innovations Program, University of Illinois

- Led curriculum enhancement initiative with 12 faculty and a team of 4 TAs, integrating advanced computational elements and Python-based coding across CEE courses.
- Developed Jupyter Notebook lab modules for CEE300, replacing inefficient workflows; facilitated cross-department collaboration, presented at AE3's Celebration of Teaching, and recognized as *Outstanding Student Contributor* in 2023.

Interim Lecturer Fall 2023

CEE 472: Structural Dynamics, Dept. of Civil Engineering, University of Illinois

- Delivered substitute lectures to the class of 60+ students, covering topics in structural dynamics of single and multi degree-of-freedom systems.

Head Teaching Assistant Spring 2020

CEE 598: Structural Damping, Dept. of Civil Engineering, University of Illinois

- Supervised group presentations, held office hours, graded assignments, and managed the course website.
- Designed Matlab homework problems on optimal damper design for seismic resilience of buildings.

Teaching Assistant Fall 2019

CEE 472: Structural Dynamics, Dept. of Civil Engineering, University of Illinois

- Led in-person and Zoom office hours for 50+ students, offering clarification on conceptual topics and assisting with debugging Matlab-based assignments and projects.

Teaching Assistant 2017 – 2018

Structures Mechanics II, Indian Institute of Technology Bombay, India

- Provided one-on-one assistance during office hours; graded assignments and exams for the course of 100+ students.

Lab Teaching Assistant 2016 – 2017

Heavy Structures Lab, Indian Institute of Technology Bombay, India

- Guided 120+ students in conducting experimental tests on an indeterminate beam setup, overseeing measurement collection and structural analysis.

Student Coordinator 2015 – 2016

Student Guidance Cell, National Institute of Technology Calicut, India

- Tutored freshmen in an Introductory Computer Science course on C/C++ and held one-on-one office hours.

PROFESSIONAL EXPERIENCE

Project Team Lead Summer 2022

UIUC Bahl Smart Bridge, University of Illinois

- Designed and implemented a real-time computer vision and AI-based pedestrian traffic monitoring system, integrating live 3D pose rendering within a simulated Digital Twin of the Smart Bridge.
- Collaborated with the National Center for Supercomputing Applications (NCSA), Urbana, IL, to develop this system into an open to public interactive smartphone application. By fusing camera and accelerometer data, and utilizing both edge and cloud computing, the system provides a real-time experience for users.

Team Leader Summer 2019

12th Asia-Pacific-Euro Summer School on Smart Structures Technology, Italy

- Led a team of 9 international graduate students in deploying accelerometers on the Annibaldi bridge in Sapienza University, Rome to conduct system identification and finite element (FE) based model updating.

Graduate Structural Designer 2017 – 2018

Team Shunya – Solar Decathlon China, U.S Dept. of Energy, IIT Bombay, India

- Led structural design for IIT-B's entry representing India in Solar Decathlon China'18, an international competition to build solar-powered, net-zero energy modular houses in 15 days.
- Designed I.S. code compliant steel superstructure and foundation, conducted FE analysis for floor-vibration comfort levels, and developed a rapid assembly process for modular shipment in a container.

Site Engineering Intern Summer 2014

Delhi Metro Rail Corporation Ltd. (DMRC), India

- Monitored RC bridge girder pre and post-tensioning; reviewed structural design drawings for the Kochi Metro Rail project, India.

MENTORING & UNIVERSITY SERVICE

Mentoring

Graduate Student Mentor – University of Illinois 2020 – 2025

- Mentored Mr. Bolaji Lawal (Ph.D. Student) in microprocessor programming and soldering techniques for printed circuit boards, leading to the development of a wireless strain sensor for monitoring applications.
- Supervised experimental setup for shake table vibration tests with a real-time controller, guiding Ms. Casey Rodgers, Mr. Ray Ausan, Ms. Mengxiao Zhong, and Mr. Bolaji Lawal (Ph.D. Students).
- Led development of a custom autonomous drone for structural defect inspection, overseeing integration of machine-vision camera, gimbal control, vision-based path planning, and edge-computing with Mr. Thomas Ngare Matiki, Mr. Ray Ausan (Ph.D. Students), and Xinyang Li (B.S. Student).

Graduate Student Mentor – Indian Institute of Technology Bombay, India 2017

- Mentored Mr. Shubham Agarwal (B.S. Student) in nonlinear finite element modeling of a masonry arch bridge and automated Abaqus processes using Python scripting.

University Service

Vibration Monitoring Advisor – University of Illinois Spring 2022

- Diagnosed vibration noise in Environmental Engineering Lab using multi-accelerometer setup, tracing the source to a lamp and enabling new device installation.
- Performed vibration analysis for a sensitive Physics Lab experiment with high-sensitivity wireless accelerometers.

TECHNICAL REVIEWER

- Measurement, Elsevier
- Engineering Structures, Elsevier
- Structure and Infrastructure Engineering, Taylor & Francis
- IEEE Transactions on Mobile Computing, IEEE Computer Society
- Remote Sensing, MDPI
- Sensing and Imaging, Springer Nature
- Journal of Civil Structural Health Monitoring, Springer Nature
- International Journal of Rail Transportation, Taylor & Francis

COMPETENCIES

Programming Languages:	Python, C/C++, Embedded C, Matlab, and R
Softwares and Tools:	Abaqus, Comsol, SAP2000, and Blender | Raspberry Pi, and Nvidia Jetson
Languages:	English, Hindi, and Malayalam

OTHER POSITIONS

Community Service Positions

- Coordinator – Shakes and Quakes program for children at Mahomet Elementary School, IL 2019 – 2024
- Organizer – Community-building activities and interfaith initiatives at CIMIC, Urbana, IL 2018 – 2023
- Student member – National Service Scheme, NIT-C, surveyed for high school construction, India. 2015

Professional Memberships

- American Society for Civil Engineers (ASCE) 2022 – Present
- Structural Engineering Institute (SEI) 2022 – Present
- American Railway Engineering and Maintenance-of-Way Association (AREMA) 2021 – Present