

MUHAMMAD ARSLAN

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PROFESSIONAL PROFILE

Mechanical engineering PhD candidate specializing in AI-enabled robotic manufacturing and advanced additive manufacturing. Develops and experimentally validates learning-based control, sensor-guided process monitoring, and model-informed robotic repair. Research spans cementitious mortar development, photopolymer-composite formulation and characterization, computer vision, and data-driven process modeling, complemented by engineering research and university teaching experience.

EDUCATION

Ph.D., Mechanical Engineering

Jan 2022–Nov 2026 (expected)

University of Houston | Houston, TX | GPA: 3.697/4.000

Dissertation: Autonomous Adaptive Robotic Construction 3D Printing

M.Sc., Mechanical Design Engineering

Jan 2017–Nov 2019

University of Engineering and Technology Lahore, Pakistan | GPA: 3.313/4.000

Thesis: Modeling and Analysis of the Fused Deposition Modeling Process Using the Finite Element Method.

B.Sc., Mechanical Engineering

Oct 2011–Aug 2015

University of Engineering and Technology Lahore, Pakistan | GPA: 3.035/4.000

RESEARCH EXPERIENCE

Doctoral Researcher

Jan 2022–Present

University of Houston | Houston, TX

- Developed and physically validated an intelligent control framework combining reinforcement learning, incremental extreme learning machines (IELM), and model predictive control (MPC) for robotic construction 3D printing.
- Integrated laser-scanner-based geometric feedback and benchmarked adaptive against fixed-parameter multilayer printing; demonstrated stabilized mean absolute errors of approximately 1.5 mm (width) and 0.6 mm (height).
- Designed and characterized cementitious mortar mixes, assessing water-to-cement ratio, fresh density, material age effects, material flow, and deposited-bead geometry to support printability evaluation and process calibration.
- Developed laser-guided same-layer repair of material-loss gaps using spatial geometric measurements, semi-empirical grey-box deposition modeling, and constrained inverse repair planning.
- Implemented a spatial ridge-residual correction and physically repaired and laser-verified single and double gaps; evaluated gap repair improvement in construction 3D printing.

Research Associate

Oct 2020–Nov 2021

Department of Mechanical Engineering, University of Engineering and Technology Lahore, Pakistan

- Wrote the successful proposal securing Pakistan Science Foundation–TÜBİTAK funding for binder-assisted PEEK, ceramic, and metal-based bone implants; carried out sample preparation, testing, analysis.

SELECTED RESEARCH & ACADEMIC PROJECTS

Photopolymer Composite Additive Manufacturing

Collaborative Doctoral Research | University of Houston

- Co-developed and experimentally evaluated dual-curing photopolymer composites for extrusion-based additive manufacturing of civil infrastructure, focusing on material formulation, rheological properties, printability, and UV/thermal curing behavior.
- Integrated machine-learning-assisted formulation screening with UV-assisted 3D printing and experimental material characterization to investigate processing behavior, curing performance, and mechanical properties of printed specimens.

Concrete 3D Printing Layer Width Using Simulation Data

Research project | Robotic construction 3D printing

- Investigated concrete-printing layer-width prediction using Webots-generated simulation data and convolutional neural networks (CNNs).

Training a Legged Robot via Deep Reinforcement Learning

Academic project | University of Houston

- Trained simulated HalfCheetah-v3 locomotion policies using PPO and A2C in MuJoCo; evaluated 128×128 and 512×512 policy networks using episode rewards and simulation videos.

PUBLICATIONS & MANUSCRIPTS

- Muhammad Arslan, Abdul Wahid Mangi, and Vedhus Hoskere. “Real-Time Adaptive Control with Continual Learning for Robotic Construction 3D Printing.” *Journal of Computing in Civil Engineering* (ASCE), accepted for publication (2026). DOI: [10.1061/JCCEE5.CPENG-8585](https://doi.org/10.1061/JCCEE5.CPENG-8585)
- Muhammad Arslan, Abdul Wahid Mangi, and Vedhus Hoskere. “Sensor-Guided Same-Layer Repair of Material-Loss Gaps in Robotic Construction 3D Printing.” *Automation in Construction* (Elsevier), manuscript under review (2026).
- Abdul Wahid Mangi, Muhammad Arslan, and Vedhus Hoskere. “Instant-cure high-strength photopolymer composite for additive manufacturing of civil infrastructure.” *Advanced Composites and Hybrid Materials* (Springer Nature), manuscript under review (2026).
- Arslan, M., Aized, T., and Haq, M. A. “Investigating the Effects of Process Parameters of Fused Deposition Modeling Using Response Surface Methodology.” *Proceedings of the International Conference on Mechanical Engineering 2020*, UET Lahore, pp. 404–410.

TEACHING EXPERIENCE

Lecturer

Feb 2016–Sep 2020

Chenab College of Engineering and Technology (UET Lahore) | Gujranwala, Pakistan

- Taught courses on mechanics, machine design, manufacturing, engineering graphics/CAD, metrology, and quality assurance.
- Supervised final-year projects in fused deposition modeling, robotic handling, manufacturing-line simulation, and four-wheel steering.

Selected courses: Mechanics of Machines; Mechanics of Materials II; Theory of Machines II; Engineering Drawing and Graphics; Machine Design and CAD II; Advanced Mechanics of Materials; Manufacturing Processes; Metrology and Quality Assurance.

CONFERENCE PRESENTATIONS

Arslan, M. “Real-time Adaptive Control for Robotic Construction 3D Printing.” *Engineering Mechanics Institute (EMI) Conference 2026*, Boulder, CO, June 2026; *Experimental Analysis and Instrumentation Paper Competition* (second place).

HONORS & AWARDS

- Second Place, *Experimental Analysis and Instrumentation Paper Competition*, ASCE Engineering Mechanics Institute (EMI), Boulder, Colorado, USA 2026.
- US–Pakistan Knowledge Corridor Scholarship, Higher Education Commission of Pakistan, 2022–present.
- Graduate Tuition Fellowship and Out-of-State Tuition Waiver, University of Houston, 2022.

TECHNICAL EXPERTISE

AI & Machine Learning | Offline Reinforcement Learning (CQL, DQN); Online Reinforcement learning (PPO, A2C); incremental extreme learning machine (IELM); convolutional neural networks (CNNs); ridge-regression-based residual modeling ; data-driven predictive modeling.

Intelligent Control & Robotics | Model predictive control (MPC); adaptive control; URScript; ROS; RoboDK; NVIDIA Isaac Sim

Materials & Additive Manufacturing | Cementitious mortar/concrete formulation and mixture design for 3D printing; fresh-material characterization; extrusion-flow and printability evaluation; dual-curing photopolymer composites; extrusion-based additive manufacturing; fused deposition modeling.

Sensing & Computer Vision | 2D laser profile measurement; RGB camera calibration; OpenCV; deposited-bead geometry measurement; defect localization and characterization in 3D printing.

Programming & Simulation | **Python**; MATLAB; Raspberry Pi; d3rlpy; MQTT; Webots; MuJoCo; experimental and simulation-data analysis.

Engineering Design & Analysis | Finite element analysis (ANSYS); SolidWorks; AutoCAD; EDEM; Design-Expert; Tecnomatix Plant Simulation; Primavera P6.

CERTIFICATIONS

- Ultrasonic Testing Level II, in accordance with SNT-TC-1A recommended practice.
- Primavera P6 training in project planning, scheduling, monitoring, and control.

ACADEMIC ADVISORS / REFERENCES

University of Houston: Vedhus Hoskere (vhoskere@central.uh.edu) • Yashashree Kulkarni (ykulkarni@uh.edu)