Kazi Tahsin Mahmood

Research Assistant – Department of Mechanical Engineering
Wayne State University

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SUMMARY

Ph.D. specialized in Nonlinear Dynamics, Topological Metamaterials and Quantum Analogous Computing.

- Specializing in Quantum & Topological Mechanics, Mechanics of Materials, Vibration and Acoustics. Experienced in Theoretical analysis, Numerical Modeling, and Experimental Research.
- Conducted analysis of dynamics of coupled granular network, mass spring model. Implemented quantum analogous analogy in classical elastic model.
- My research topics lie in Dynamics of Classical Nonlinear Network, Computational Mechanics, Quantum Inspired Information Processing and Topological Metamaterials.

ACADEMIC CREDENTIALS

Wayne State University — **Detroit, Michigan, USA**
Ph.D. *in Mechanical Engineering* — *Jan 2022 – Dec 2025*

GPA: 3.93/4.00
Dissertation Title: *Classical Realization of Quantum and Topological States through Nonlinear Elastic Networks*
Committee: Dr. M. Arif Hasan (Chair); Dr. Sean Wu; Dr. Chin-An Tan; Dr. Mohammad Bukhari; Dr. Pierre Deymier

Wayne State University — **Detroit, Michigan, USA**
M.Sc. *in Mechanical Engineering* — *Jan 2022 – May 2025*

GPA: 3.93/4.00
Thesis Title: *Nonlinear Dynamics Driven Quantum Analogous in Classical Granular Metamaterial*
Advisor: Dr. M. Arif Hasan

Bangladesh University of Engineering & Technology (BUET) — **Dhaka, Bangladesh**
B.Sc. *(Engg.) in Mechanical Engineering* — *Feb 2016 – Mar 2021*

GPA: 3.30/4.00
Thesis Title: *Electro-Thermo-Mechanical Response of a Thin Conductive Layer of Metal Matrix Composite Reinforced by Graphite Fibers*
Advisor: Dr. Shaikh Reaz Ahmed

RESEARCH INTERESTS

Topological Metamaterials	Quantum Analogous Computing	Nonlinear Dynamics
Acoustic Waveguides	Vibrational Mechanics	Solid Mechanics

PUBLICATIONS

1. Abrar N. E. Faiaz, Donte J. McMullen, **Kazi T. Mahmood**, and M. Arif Hasan, "Page-curve-like entropy dynamics in a classical elastic bit lattice," *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 36, no. 4, p. 043127, Apr. 2026.
2. **Kazi T. Mahmood**, M. Afridi Hasan, Abrar N-E Faiaz, M. Arif Hasan, Pierre A. Deymier, Keith Runge, and Joshua A. Levine, "Multi-Bit Quantum-Inspired Dynamics in Nonlinear Mechanical Oscillators," *Journal of Applied Mechanics*, pp. 1–15, Mar. 2026.
3. **Kazi T. Mahmood** and M. Arif Hasan, "Topological Vibration Analysis of Elastic Lattices Via Bloch-Sphere Mapping," *Journal of Vibration and Acoustics*, vol. 148, no. 4, p. 041004, Feb. 2026.
4. **Kazi T. Mahmood**, Abrar N. E. Faiaz, M. Arif Hasan, Pierre A. Deymier, Keith Runge, and Joshua A. Levine, "Experimental realization of logical elastic bits as qubit analogues in a nonlinear oscillator," *Scientific Reports*, vol. 16, no. 1, p. 3398, 2025.
5. **Kazi T. Mahmood** and M. Arif Hasan, "Topological insights from state manipulation in a classical elastic system," *AIP Advances*, vol. 15, no. 2, p. 025305, Feb. 2025.

6. **Kazi T. Mahmood** and M. Arif Hasan, "Experimental demonstration of classical analogous time-dependent superposition of states," *Scientific Reports*, vol. 12, no. 1, p. 22580, Dec. 2022.
7. **Kazi T. Mahmood** and M. Arif Hasan, "Harnessing Nonlinear Dynamics for Time-Driven Berry Phase in Classical Systems," Accepted: *Nonlinear Dynamics*.
8. Abrar N-E Faiaz, Akinsanmi S. Ige, **Kazi T. Mahmood**, Jake Balla, M. Arif Hasan, Pierre A. Deymier, Keith Runge, and Joshua A. Levine, "Modeling Phi-bits, Qubit Analogues, in Acoustic Waveguides," In Review: *Journal of Computational and Nonlinear Dynamics*.
9. Abrar N-E Faiaz, Donte J. McMullen, **Kazi T. Mahmood**, M. Arif Hasan, Pierre A. Deymier, Keith Runge, and Joshua A. Levine, "Experimental Geometric State Control on the Bloch Sphere Via Linear Mechanical Resonator," In Review: *Journal of Vibration and Acoustics*, 2026.

CONFERENCE PROCEEDING & PRESENTATIONS

- 184^{th} Meeting of the Acoustical Society of America, Chicago, Illinois, USA, 2023 (**Technical Talk**).
- International Conference on Smart Mobility and Vehicle Electrification, Hybrid, Lawrence Technological University, Detroit, Michigan, USA, 2023 (**Technical Talk**).
- Graduate Research Symposium, Wayne State University, USA, 2024 (**Poster Presentation**).
- APS Eastern Great Lakes Spring Meeting, Kettering University, Flint, Michigan, USA, 2024 (**Technical Talk & Poster Presentation**).
- APS March Meeting, Minneapolis, USA, 2024 (**Technical Talk, Online**).
- International Mechanical Engineering Congress & Exposition, Portland, Oregon, USA, 2024 (**Technical Talk & Poster Presentation**).
- 187^{th} Meeting of Acoustical Society of America, 2024, (**Technical Talk, Online**).
- APS Eastern Great Lakes Fall Meeting, Marietta College, Marietta, Ohio, USA, 2024, (**Technical Talk**).
- 188^{th} Meeting of the Acoustical Society of America, New Orleans, Louisiana, USA, 2025, (**Technical Talk**).
- APS March Meeting, Denver, Colorado, USA, 2026, (**Technical Talk**).
- 190^{th} Meeting of the Acoustical Society of America, Philadelphia, Pennsylvania, USA, 2026, (**Technical Talk**).
- APS Eastern Great Lakes Section (EGLS) & MIAAPT Joint Meeting, Wayne State University, Detroit, Michigan, USA, 2026, (**Technical Talk**).

RESEARCH EXPERIENCE

Graduate Research Assistant **Detroit, Michigan, USA**
Wayne State University *May 2024 – Present*

- **Project 1:** Development of the **Elastic Bit** (classical analog of quantum bit) in a classical elastic medium of granular beads using the linearized and nonlinear model. Constructed an analytical and experimental model of a nonlinear granular network using **asymptotic perturbation techniques**, formulating a higher-order system with time-dependent superposition. Designed an experimental setup to create an elastic bit in a nonlinear granular network, achieving a decoherence-free superposition of states for potential data transmission (NSF Grant 2204382).
- **Project 2:** Developed a theoretical framework for manipulating elastic bits' superposition of states and generating **Berry Phase** in a linearized and nonlinear elastic network, demonstrating quantum-classical correlations in both time-dependent and independent systems (NSF Grants 2242925).
- **Project 3:** Development of an algorithm to demonstrate the scalability of the **Logical Elastic Bit** in a mass-conical spring model. The harmonic response of the nonlinear system is modeled to show the time dependence of the elastic bit in the same model.
- **Project 4:** Investigated symmetry breaking in granular networks by a **2 order Molecular Dynamics** algorithm, revealing internal parameter variations that drive topological transitions across the **Brillouin Zone**. Multiple masses in the unit cells are considered for the exploration of the **Hilbert Space**.
- **Project 5:** Designed a topological phase-based **Mass Sensor**, leveraging sustained state superposition for enhanced sensitivity and precision. Using the property of the time-dependent superposition of states, a small change in mass creates a variation along the Berry phase formation in the Hilbert space.

New Frontiers of Sound (NewFoS) **Tucson, USA**
Research Collaborator, The University of Arizona *Sep 2023 – Present*

Project: *Topological Acoustic (TA) Quantum Analogies for Quantum Information Science (QIS)*

- **Primary Investigator:** Investigation of multi qubit analogue in classical nonlinear mass conical spring oscillator. Demonstration of scalable harmonic structures to form superposition of states and quantum-analogous gate operations like Hadamard and Phase gates. (NSF Grant Number 2204400).
- **Co-Investigator:** Development of the **Phi-Bit** (Phase Bit) by studying three coupled finite-length acoustic waveguides. This model effectively predicts the continuous phase behaviors of phi-bits across varying conditions (NSF Grant Number 2204400).

Undergraduate Research Assistant **Dhaka, Bangladesh**
Bangladesh University of Engineering & Technology *Nov 2019 – Feb 2021*

- Study of the strength of metal matrix composite (MMC) due to the passing of the electrical current in a thin composite material. The research explores the thermal stress generated in the MMC line due to the current and the effect of the geometry of the MMC mesh.
- Analyzed the stress-tolerant limit and failure characteristics due to the thermal and mechanical strength generated in the material using a **tensile** and **compression** strength machine.
- Development of a **heat pipe** exchanger model to increase heat transfer efficiency in a compact thermal management system for a high-performance induction motor.

TEACHING EXPERIENCE

Graduate Teaching Assistant **Detroit, Michigan, USA**
Wayne State University *Jan 2022 – May 2024*

- Served as **Course Instructor** for **ME 3400: Dynamics I** and **ME 5000: Engineering Analysis**, delivering lectures, designing problem sets, and evaluating student performance for both undergraduate and graduate cohorts.
- Provided instructional support for multiple laboratory and recitation sections, including grading, feedback, and individualized student mentoring.
- Assisted in exam administration and proctoring, ensuring academic integrity and smooth execution of assessments.

Research Experience Mentor **NSF Project**
New Frontiers of Sound (NewFoS) *Jan 2023 – May 2025*

- Mentored and supervised eight undergraduate researchers through the NSF New Frontiers of Sound (NewFoS) Research Experience and Mentoring (REM) program, guiding them in hypothesis formulation, experimental planning, data acquisition, and interpretation of results in nonlinear and topological acoustics.
- Trained students in the design and analysis of elastic waveguide systems, including mode identification, dispersion characterization, and phase–amplitude mapping, to investigate classical analogues of quantum information states.
- Facilitated literature review sessions and data presentation workshops to strengthen students' ability to connect experimental observations with theoretical models and communicate findings effectively.
- Oversaw independent research projects culminating in poster presentations at institutional and national conferences, fostering early-career engagement in interdisciplinary acoustics and quantum-inspired mechanics.

PROFESSIONAL EXPERIENCE

Engineer Trainee (Intern) **Chattogram, Bangladesh**
BSRM Steel Limited *Jan 2020 – Feb 2020*

- Gained hands-on experience in industrial steel-rod manufacturing processes, including billet reheating, rolling, and controlled cooling for construction-grade reinforcement bars.
- Assisted in the **Mechanical Maintenance** of re-rolling mill equipment, performing routine inspections, alignment, lubrication, and fault diagnostics to ensure continuous production efficiency and safety.

TECHNICAL SKILLS

- **Fabrication:** Granular Bead Network (Coupled Spherical Ball), Mass-Conical Spring Model, Coupled Linear Waveguides.
- **Programming language & Simulation:** C/C++, Python, Matlab, COMSOL, ANSYS.
- **Mathematical Modeling:** Finite Difference & Element Formulation, Multi-order Asymptotic Perturbation Modeling, Fourier Harmonics.
- **Drawing & Design Tool:** AutoCAD, SolidWorks.
- **Productivity:** Microsoft Office, Latex.
- **Machinery Efficiency:** Oscilloscope (Tektronix), Function Generator (B&K Precision), Power Amplifier (Piezodrive), Laser Doppler Vibrometer (Polytec), Transducers, Vibration Exciters.

ACADEMIC SERVICES

Reviewer

- Scientific Reports, Nature Portfolio — January 2024-Present
- Nonlinear Analysis, Elsevier — May 2023-Present
- Journal of Vibration & Acoustics — January 2025-Present
- IDETC-CIE 2026, ASME — 2026

AWARDS

- Graduate Student Professional Travel Grant, Wayne State University, 2024.

VOLUNTEERING ACTIVITIES

- Student Member, American Society of Mechanical Engineers (ASME) — Jun 2024 - Present
- Student Member, American Physics Society (APS) — Jul 2023 - Present
- Member, Acoustical Society of America (ASA) — Jan 2023 - Present
- Executive Member, BUET Robotics Society — Feb 2016 - Jul 2020

REFERENCES

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Department of Mechanical Engineering
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NSF CMMI Panel Fellow
Editorial Board Member at Scientific Reports (Nature)
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