SAMARJITH BISWAS

Research Scientist III

AI & Acoustic Systems Innovation Leader

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Tucson, Arizona, US

Executive Summary

Mechanical & Aerospace Engineer and Research Scientist with over 7 years of experience specializing in **AI-driven acoustic metamaterial design**, **topological acoustics**, **thermoacoustic metamaterials**, **quantum analogies in acoustics**, **RF device engineering**, **energy harvesting systems**, and **neural network-optimized acoustic metastructures**. Currently leading advanced research at University of Arizona's prestigious New Frontiers of Sound Science & Technology Center with proven track record of successful NASA collaborations on Thermoacoustic Metastructures (TAMS). Expert in advanced computational modeling using COMSOL Multiphysics, ANSYS, DeltaEC, and AI frameworks including TensorFlow, PyTorch, and physics-informed neural networks (PINNs). Demonstrated ability to translate complex AI-acoustic research into practical aerospace, semiconductor, telecommunications, and energy applications. Recognized leader in mentoring next-generation engineers and fostering innovation through cross-disciplinary collaborations.

Core Competencies

Acoustic Engineering:
- Topological Acoustics & Phononic Crystals
- Thermoacoustic Systems & Heat Engines
- Quantum Analogies in Acoustic Systems
- RF Device Design & Electromagnetic Acoustics
- Acoustic Metamaterials & Metasurfaces
- Sound Absorption & Noise Control
- Vibration Analysis & Modal Testing
- Non-Destructive Evaluation Techniques
- Anechoic Chamber Testing

Advanced Technologies:
- Energy Harvesting & Transduction
- MEMS Design & Microfabrication
- Structural Supercapacitors
- Phase-Change Materials
- Additive Manufacturing for Acoustics
- Thermoelectric Energy Conversion
- Piezoelectric Transducers
- Smart Materials & Adaptive Structures
- Composite Materials Design

Education

Doctor of Philosophy (Ph.D.) in Mechanical & Aerospace Engineering — 2019 – 2024
Oklahoma State University — *Stillwater, OK*
- **Dissertation:** Development and Optimization of Thermoacoustic Metastructures for Energy Harvesting and Noise Mitigation
- **Research Focus:** Thermoacoustic systems, acoustic metamaterials, energy harvesting, computational acoustics, multiphysics modeling

Master of Science (M.S.) in Mechanical Engineering — 2017 – 2019
Northern Arizona University — *Flagstaff, AZ*
- **Thesis:** Development of Structural Supercapacitors for Electric Vehicle Applications
- **Research Focus:** Energy storage systems, composite materials, electrochemical characterization

Bachelor of Science (B.S.) in Mechanical Engineering — 2011 – 2016
Rajshahi University of Engineering & Technology (RUET) — *Bangladesh*
- **Senior Project:** Design and Development of Micro-Displacement Sensor using LVDT Technology

Professional Experience

Research Scientist III – Acoustic Engineering — September 2024 – Present
University of Arizona, New Frontiers of Sound Science & Technology Center — *Tucson, AZ*
- Lead cutting-edge experimental and computational acoustics research specializing in topological acoustics, quantum analogies, RF device engineering, and non-destructive evaluation modalities for aerospace and telecommunications applications
- Drive AI-based design optimization of 2D topological phononic crystals using phase-change materials (PCM), achieving ∼200 MHz functional behavior via machine-learning algorithms
- Develop deep learning models for automated parameter prediction of Borofloat-based metamaterials, reducing design iteration time by 75% and enabling real-time optimization
- Implement neural network frameworks for waveguide geometry prediction and edge-state validation, integrating physics-informed neural networks (PINNs) with COMSOL simulations
- Design and implement sophisticated acoustic metamaterials and metasurfaces with phase-change capabilities for quantum computing applications
- Collaborate with esteemed institutions including City University of New York, Wayne State University, Caltech, UCLA, Georgia Tech, Spelman College, University of Alaska-Fairbanks, and University of Colorado-Boulder on multidisciplinary breakthrough innovations

Graduate Research Associate – Thermoacoustic Systems August 2019 – August 2024
Oklahoma State University, Mechanical & Aerospace Engineering *Stillwater, OK*

- Pioneered development of Thermoacoustic Metastructures (TAMS) for simultaneous energy harvesting and noise mitigation achieving substantial decibel reduction (15-25 dB) across broad frequency ranges (100-2000 Hz)
- Engineered innovative acoustic-thermoelectric transduction schemes producing millivolt-level voltage outputs with microwatt-scale power generation capabilities suitable for wireless sensor networks and IoT applications
- Led comprehensive multiphysics simulation studies using COMSOL Multiphysics, ANSYS Fluent, and DeltaEC thermoacoustic modeling software to predict TAMS performance and optimize design parameters
- Managed state-of-the-art acoustic testing facilities including anechoic chambers, reverberation rooms, and advanced instrumentation systems using National Instruments Data Acquisition (NI-DAQ) hardware
- Developed novel thermoacoustic heat engines and refrigeration systems for aerospace thermal management applications with focus on high-efficiency energy conversion and waste heat recovery
- Designed and fabricated modular TAMS configurations for scalable noise barriers with integrated energy capture functionality tailored for aerospace applications including aircraft engine noise reduction
- Optimized critical design parameters including acoustic absorption coefficients vs. thermal gradient relationships, achieving 25% improvement in multifunctional metamaterial performance
- Conducted extensive evaluation of additive manufacturing techniques vs. traditional ceramic stack fabrication methods, identifying cost-effective strategies reducing manufacturing costs by 40%
- Collaborated directly with NASA Langley Research Center scientists and engineers on thermoacoustic liner optimization projects for next-generation aircraft propulsion systems
- Developed advanced measurement techniques for characterizing thermoacoustic phenomena including temperature field mapping, acoustic intensity measurements, and power output quantification
- Mentored 5+ undergraduate students and 2 graduate students in thermoacoustic research methodologies, experimental techniques, and computational modeling approaches
- Secured research funding through competitive grant applications and maintained detailed project documentation for technology transfer and commercialization activities

Instructor of Record – Mechanical Engineering Technology January 2023 – August 2023
Oklahoma State University, MET Department *Stillwater, OK*

- Served as primary instructor for advanced 4000-level Machine Elements course covering gear design, bearing analysis, shaft design, clutches, brakes, and mechanical system integration for 60-80 students across multiple sections
- Developed comprehensive curriculum materials including lecture presentations, laboratory exercises, design projects, and assessment strategies resulting in 30% improvement in student comprehension and retention rates
- Implemented innovative teaching methodologies incorporating MATLAB simulations, SolidWorks modeling exercises, and hands-on laboratory experiences to bridge theoretical concepts with practical applications
- Led intensive Summer Bridge Program instruction for 30-40 incoming students per section, facilitating successful university transition and improving first-year retention by 20%

Graduate Teaching Associate – Engineering Mechanics August 2019 – December 2022
Oklahoma State University, Mechanical & Aerospace Engineering *Stillwater, OK*

- Taught Elementary Dynamics courses in two discussion sections with 25-30 students each, employing interactive problem-solving methodologies and collaborative learning approaches
- Independently led Honors program discussions focusing on advanced dynamics problems, critical thinking development, and advanced mathematical modeling techniques
- Developed supplementary learning materials including solved example problems, practice examinations, and tutorial videos to support diverse learning preferences

Graduate Research Assistant – Energy Storage Systems August 2017 – July 2019
Northern Arizona University, Mechanical Engineering Department *Flagstaff, AZ*

- Led innovative development and optimization of structural supercapacitors (SSCs) for electric vehicle applications integrating electrical energy storage functionality with load-bearing structural capabilities
- Achieved exceptional power density of 32.06 W/kg and energy density of 53.58 mWh/kg at 2V operating voltage through advanced electrode functionalization techniques and nanomaterial integration
- Optimized SSC component materials and configurations yielding specific capacitance of 57.82 mF/g with enhanced operating voltage capability of 2.4V suitable for automotive and aerospace applications
- Developed advanced carbon fiber electrode functionalization processes using chemical vapor deposition (CVD) and plasma treatment techniques
- Conducted comprehensive electrochemical characterization including cyclic voltammetry, electrochemical impedance spectroscopy, and galvanostatic charge-discharge testing protocols
- Performed mechanical testing of composite structures including tensile testing, flexural testing, and fatigue analysis to validate structural integrity under combined electrical and mechanical loading

Graduate Teaching Assistant – Thermodynamics & Heat Transfer August 2017 – July 2019
Northern Arizona University, Mechanical Engineering Department *Flagstaff, AZ*

- Assisted in design and implementation of advanced laboratory experiments bridging theoretical thermodynamics concepts with practical engineering applications
- Collaborated with faculty members on comprehensive thermodynamics curriculum updates ensuring alignment with ABET accreditation requirements
- Supervised student laboratory sessions covering calorimetry, heat conduction experiments, convection heat transfer measurements, and thermal radiation characterization

Research & Development Engineer April 2017 – August 2017
B-Trac Engineering Ltd *Dhaka, Bangladesh*

- Led critical infrastructure projects including design and development of mobile surveillance watch tower systems for Bangladesh Police enhancing field visibility and tactical deployment capabilities
- Supervised and mentored multidisciplinary teams of 8+ technicians, engineers, and project professionals ensuring adherence to project timelines, quality standards, and safety protocols
- Determined optimal and economical electrical installation layouts while ensuring maximum productivity and cost-effectiveness in assigned engineering projects
- Championed data-driven decision-making methodologies by analyzing performance metrics and customer feedback resulting in 15% improvement in overall project efficiency

Technical Skills

Simulation & Modeling: COMSOL Multiphysics, ANSYS Workbench/Mechanical/Fluent, DeltaEC, Fluid-Structure Interaction (FSI), Thermal-Structural Coupling, Modal Analysis, Nonlinear Material Modeling

Programming & AI: Python (TensorFlow, PyTorch), MATLAB, C/C++, LabVIEW, R, FORTRAN, Physics-Informed Neural Networks (PINNs), Machine Learning, Deep Learning

CAD/CAM: SolidWorks, AutoCAD, G-code Programming, CNC Machining

Instrumentation: NI-DAQ Systems, Anechoic/Reverberation Rooms, UTM/DMA, DSC/TGA/IR, Electrochemical Impedance Spectroscopy (EIS), Potentiostats, FDM/SLA 3D Printers

Specialized Analysis: Acoustic Signal Processing, Thermoacoustic Flow Modeling, Heat Transfer Analysis, Materials Characterization, Statistical Analysis

Selected Research Projects

NASA Collaborative Research: Thermoacoustic Liner Optimization for Aircraft 2023

- Collaborated directly with NASA Langley Research Center scientists on advanced thermoacoustic liner design optimization for next-generation aircraft propulsion systems
- Utilized specialized Normal Incidence Tube (NIT) testing protocols and advanced DeltaEC thermoacoustic simulation software to characterize acoustic absorption and thermal performance
- Successfully achieved 9.5°C thermal gradient at optimized frequency of 790 Hz while maintaining superior acoustic absorption coefficients exceeding 0.8 across broad frequency ranges

TAMS Component Optimization for Enhanced Energy Harvesting Performance 2022

- Led comprehensive parametric optimization studies investigating stack length variations, pore size distributions, and resonator geometry configurations to maximize thermoacoustic metastructure efficiency
- Demonstrated simultaneous noise reduction capabilities (15-25 dB) and energy generation performance (microwatt-scale power output) suitable for autonomous sensor networks and IoT applications
- Validated theoretical predictions through extensive experimental characterization including acoustic intensity measurements, temperature field mapping, and electrical power output quantification

Additive Manufacturing for Advanced Thermoacoustic Devices 2021

- Conducted comprehensive benchmarking studies comparing 3D-printed thermoacoustic stacks with traditional ceramic honeycomb structures using DeltaEC simulation and experimental validation
- Identified cost-effective additive manufacturing approaches reducing production costs by 40% while maintaining comparable or superior thermoacoustic performance
- Developed design guidelines for additively manufactured thermoacoustic components including material selection criteria, geometric optimization parameters, and post-processing requirements

Structural Supercapacitors for Electric Vehicle Applications 2019

- Designed and developed innovative energy-storing composite materials achieving energy density of 53.58 mWh/kg and exceptional mechanical modulus of 6.9 GPa for dual-function EV structural applications
- Implemented advanced electrode functionalization techniques using carbon nanotube integration and conductive polymer coatings to enhance electrochemical performance
- Developed scalable manufacturing processes suitable for automotive production including automated fiber placement, resin transfer molding, and integrated electrode fabrication techniques

Mobile Surveillance Watchtower for Law Enforcement Applications 2017

- Engineered complete mobile surveillance system including structural design, electrical systems integration, and tactical deployment mechanisms for Bangladesh Police field operations
- Performed comprehensive structural analysis including wind load calculations, seismic considerations, and stability analysis ensuring safe operation under adverse environmental conditions
- Led project from conceptual design through prototype development and field testing resulting in successful technology transfer to law enforcement agencies

Precision Micro-Displacement Sensor Development using LVDT Technology 2017

- Developed cost-effective surface roughness analyzer integrating Linear Variable Differential Transformer (LVDT) technology with advanced microelectronics and signal processing capabilities
- Achieved measurement precision of ±0.1 micrometers suitable for industrial quality control applications in manufacturing and precision machining operations
- Designed custom signal conditioning circuitry, data acquisition systems, and user interface software enabling real-time surface characterization and automated analysis

Publications & Intellectual Property

Patent:

• J. Manimala, **S. Biswas**. *Thermoacoustic Meta-Structure*. US Patent 2025/128,348 (2025)

Selected Journal Publications:

• **Biswas, S.**, Krawczyk, Z., & Manimala, J.M. Multifunctional Characterization of a Thermoacoustic Meta-Structure. *Progress in Engineering Science* (2025)

• **Biswas, S.**, Kresl, W., & Manimala, J.M. On the relationship between acoustic absorption and temperature gradient in a thermoacoustic liner. *International Journal of Aeroacoustics*, 24(1-2), 42-67 (2025)

Selected Conference Publications:

• **Biswas, S.**, & Santana, R. Investigation of Meta-Stacks for Thermoacoustic Applications. *188th Meeting of the Acoustical Society of America*, New Orleans, LA (2025)

• **Biswas, S.**, & Manimala, J.M. Quiet power: Exploring the feasibility of a noise-mitigating, thermoacoustic energy harvester. *Journal of the Acoustical Society of America*, 151(4) (2022)

• **Biswas, S.**, Krawczyk, Z., & Manimala, J.M. Evaluation of additively manufactured stacks for thermo-acoustic devices. *INTER-NOISE Congress*, 263(2), 4376-4387 (2021)

Presentations & Conference Participation

• 4th Annual MAE Graduate Research Symposium, Oklahoma State University, Stillwater, OK, 2022 (**Best Oral Presentation Award**)

• 182nd Meeting of the Acoustical Society of America, Denver, CO, May 2022

• 50th International Congress and Exposition on Noise Control Engineering (INTER-NOISE 2021), Washington, D.C., August 2021

• 40th ASME/AIAA Regional Student Symposium, Stillwater, OK, April 2021

Awards & Honors

• Best Oral Presentation Award – OSU MAE Graduate Research Symposium (2022)

• International Excellence Award – Northern Arizona University (2018-2019)

• Graduate Research Assistantship – Oklahoma State University (2019-2024)

• Graduate Teaching Assistantship – Northern Arizona University (2017-2019)

• Finalist – 3 Minute Teach Competition (2023)

• Finalist – Riata Center Business Plan Competition (2022)

• Dean's List – Rajshahi University of Engineering & Technology (2014-2016)

Professional Certifications

• **Six Sigma Green Belt Certification** – Coursera-Kennesaw State University (June 2023)

• **Engineering Project Management Specialization** – Coursera-Rice University (June 2023)

• **Professional Development Certificates (edX):** Underactuated Robotics (MIT), Solar Energy Engineering (TU Delft), Autonomous Navigation for Flying Robots (TUM), Robot Mechanics and Control (SNU), Cyber-Physical Systems (UC Berkeley), Future Cities (ETH), Learning from Data (CIT)

Leadership & Professional Service

• Judge – OSU MAE Graduate Research Symposium (2024), Oklahoma State Science and Engineering Fair (2023), 27th Annual OK-LSAMP Research Symposium (2023)

• Peer Reviewer – *International Journal of Mechanical Sciences* (2023–Present), *Journal of Sound and Vibration* (2022–Present)

• Laboratory Manager – Solid & Structural Dynamics Lab, Oklahoma State University (2021–2024)

• OK Catalyst Roadmap Spring Cohort (2023)

• Student A/V Room Monitor – ASA 182nd Meeting (2022)

Professional Memberships

Acoustical Society of America (ASA) – Student Member (August 2021 – Present)

Active leadership in Engineering Acoustics and Structural Acoustics committees. Regular contributor to biannual meetings with research presentations and technical discussions. Volunteer coordinator for student professional development initiatives.

Languages

English (Fluent), Bengali (Native), Hindi (Conversational)

Technical writing | Grant proposals | Conference presentations | Patents | Cross-cultural collaboration | Team leadership