

# Maruf Md. Ikram

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## ACADEMIC CREDENTIALS

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### Doctor of Philosophy (Dual Ph.D.)

Aug 2022 – Present

Mechanical Engineering (ME) and Communicative Sciences and Disorders (CSD)

Michigan State University (MSU)

Lansing, Michigan

### Master of Science (M. Sc.)

Spring 2026

Mechanical Engineering (ME)

CGPA: 3.88/4.00

Michigan State University (MSU)

Lansing, Michigan

### Bachelor of Science (B. Sc.)

Feb 2016 – Feb 2021

Mechanical Engineering (ME)

Bangladesh University of Engineering and Technology (BUET)

Dhaka, Bangladesh

CGPA: 3.93/4.00 (Merit position 5/192)

## RESEARCH INTERESTS

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- Direct Ink Writing
- Thermo-fluid Modeling
- Thermodynamics
- Uncertainty Quantification
- Turbulence Modeling
- Machine Learning
- Voice Disorders
- Air Conditioning & HVAC
- Image Processing
- Thermal Energy Storage
- Exergy Analysis
- Finite & Spectral Element Modeling

## RESEARCH EXPERIENCE

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### Graduate Research Assistant

Jan 2023 – Present

Fractional Mathematics for Anomalous Transport and Hydromechanics (FMATH) group and Analysis of Voice and Hearing (AVAH) Lab.

**Ph.D. Thesis (ongoing):** Data-Driven, AI-Assisted High-Fidelity Thermo-Fluid Biosystem Modeling of Human Voice Production Incorporating Respiratory, Phonatory, and Articulatory Subsystems.

- Developed physics-based and data-driven computational models for complex biosystems, integrating respiratory, phonatory, and articulatory subsystems to simulate human voice production mechanics.

- Applied thermo-fluid and CFD modeling principles to analyze airflow transport, pressure evolution, flow resistance, vortex formation, and glottal jet behavior in biological airway systems.
- Built AI-driven image-processing and deep learning pipelines to extract biomechanical features from high-speed videoendoscopy data for subject-specific voice modeling.
- Conducted biomechanics-based modeling of vocal fold motion, lung dynamics, airway compliance, and pressure-flow interactions using lumped-element mass-spring-damper systems.
- Integrated patient-specific medical imaging, physiological signals, and computational simulations to predict clinically relevant variables such as glottal flow, subglottal pressure, and intrapleural pressure.
- Applied optimization techniques, including Particle Swarm Optimization, to calibrate biomechanical and flow-system parameters for personalized prediction of respiratory and phonatory function.
- Investigated biomaterial and tissue-mechanics behavior of vocal folds, lung tissues, and compliant airways by modeling elasticity, damping, resistance, deformation, and flow-induced motion.
- Developed computational frameworks linking thermo-fluid dynamics, biosystem modeling, biomechanics, and machine learning to support noninvasive assessment of normal and disordered voice production.

#### **Undergraduate Research Assistant**

Apr 2019 – Feb 2021

Micro-to-Macro scale Fluids Engineering Lab, BUET.

**Supervisor:** Dr. A. B. M. Toufique Hasan, Professor, Department of Mechanical Engineering, BUET

**B. Sc. Thesis:** Direct Simulation Monte Carlo Analysis on Thrust Vectoring of a Supersonic Micro Nozzle Using Bypass Mass Injection.

- Conducted DSMC-based numerical simulations of rarefied nitrogen flow through a planar converging-diverging supersonic micro-nozzle for micro-propulsion and thrust-vectoring applications.
- Designed and analyzed baseline and bypass-injection micro-nozzle configurations by varying bypass channel width and outlet pressure to investigate thermo-fluid flow behavior, including Mach number, pressure, temperature, density, and Knudsen number distributions.
- Evaluated propulsion performance by calculating total mass flow rate, secondary flow percentage, thrust force, thrust coefficient, thrust vectoring angle, and specific impulse to assess maneuverability and efficiency of fluidic thrust vectoring systems.

## PROJECTS

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### **Shell-and-Tube Heat Exchanger** | Oct 2017 – Feb 2018

- Designed and modeled the heat exchanger in SolidWorks, including shell geometry, tube bundle layout, and baffle configuration for optimized fluid flow distribution and heat transfer performance.
- Fabricated the prototype and conducted pressure integrity and thermal performance tests and optimized the shell-side baffle arrangement and evaluated nanofluid-based coolants, improving overall cooling capacity by 13% compared to the baseline design.

### **Forced Draft Cooling Tower** | Feb 2018 – Aug 2018

- Designed a sheet-metal forced-draft cooling tower assembly, including fan housing, airflow ducts, and structural frame using SolidWorks, applying GD&T and Design for Manufacturing (DFM) principles.
- Simulated conjugate heat transfer using ANSYS Fluent to optimize fan-driven forced convection cooling performance, validated through prototype testing and improving cooling efficiency by 18%.

### **Multipurpose Remotely Controlled Military Vehicle** | Sep 2018 – Feb 2019

- Led cross-functional development of a remote-controlled electro-mechanical vehicle prototype, integrating mechanical design, electronics, and control systems across multiple prototypes.
- Implemented embedded motor control and modular mechanical assemblies for rapid component replacement and conducted prototype testing with sensor instrumentation and data acquisition to evaluate vehicle mobility, drivetrain efficiency, and system reliability.

## MENTORSHIPS & COLLABORATIONS

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### **Thesis Mentorship** | May 2021 – Dec 2021

- Mentored an undergraduate thesis group on the numerical analysis of supersonic micro-jet/micro-nozzle flow using DSMC-based simulation methods.

### **Research Mentorship** | May 2024 – May 2025

- Mentored two students in my graduate research lab, including one graduate student and one undergraduate student on computational modeling, data analysis, and research workflow development.
- Provided technical guidance on literature review, simulation setup, result interpretation, and research presentation.
- Collaborating with Dr. Suvash Saha from the University of Technology Sydney. Mar 2018 – Present
- Collaborating with Dr. Muhammad Rahman and Dr. Pulickel Ajayan from Rice University. Mar 2021 – Present
- Collaborating with Dr. John Hart from Massachusetts Institute of Technology. Mar 2021 – Present

## PUBLICATIONS

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### Book Chapters

- Arka AM, Ikram MM, Dey K, Ehsan MT, Zafar S, Shahriar S, Rahman MZ. A review on additively manufactured materials in biomedical applications.
- Dey K, Islam M, Chowdhury O, Arka AM, Ikram MM, Rahman MZ. Green synthesis of nanoparticles and their applications in dental tissue engineering. In Applications of Nanomaterials in Dentistry 2026 Jan 1 (pp. 459-483). Elsevier.

### Journal Publications

- Saadi MA, Maguire A, Pottackal NT, Thakur MS, Ikram MM, Hart AJ, Ajayan PM, Rahman MM. Direct ink writing: a 3D printing technology for diverse materials. Advanced Materials. 2022 Jul;34(28):2108855.
- Ikram MM, Saha G, Saha SC. Conjugate forced convection transient flow and heat transfer analysis in a hexagonal, partitioned, air filled cavity with dynamic modulator. International Journal of Heat and Mass Transfer. 2021 Mar 1;167:120786.
- Saha G, Al-Waaly AA, Ikram MM, Bihani R, Saha SC. Unveiling the dynamics of entropy generation in enclosures: a systematic review. International Journal of Thermofluids. 2024 Feb 1;21:100568.
- Priam SS, Ikram MM, Saha S, Saha SC. Conjugate natural convection in a vertically divided square enclosure by a corrugated solid partition into air and water regions. Thermal Science and Engineering Progress. 2021 Oct 1;25:101036.
- Ikram MM, Saha G, Saha SC. Unsteady conjugate heat transfer characteristics in hexagonal cavity equipped with a multi-blade dynamic modulator. International Journal of Heat and Mass Transfer. 2023 Jan 1;200:123527.
- Sourov MA, Emu SI, Thakur MS, Ikram MM, Morshed AK, Rahman MM. A general simulation-based study on printability of inks in direct ink writing. Scientific Reports. 2025 Mar 21;15(1):9842.
- Ikram MM, Saha G, Saha SC. Second law analysis of a transient hexagonal cavity with a rotating modulator. International Journal of Heat and Mass Transfer. 2024 Apr 1;221:125039.
- Shuvo MS, Ikram MM, Hasan MN, Saha S. Thermal resistance analysis on conjugate free convective flow in a thick-walled square chamber. Case Studies in Thermal Engineering. 2023 Nov 1;51:103644.
- Saha S, Ikram MM. Comment on “Effects of inclination angle on conduction-natural convection in divided enclosures filled with different fluids”[International Communications in Heat and Mass Transfer, 37 (2010) 182–191]. International Communications in Heat and Mass Transfer. 2021 Dec 1;129:105751.

- Ikram MM, Priam SS, Saha S. Thermo-fluid characteristics and second law analysis of an inclined two-fluid system with variable surface roughness. *Case Studies in Thermal Engineering*. 2022 Sep 1;37:102270.
- Durjoy MS, Zaman MA, Ikram MM, Siddique IJ. Conjugate heat transfer in a hexagonal cavity with aerodynamic modulators. *Results in Engineering*. 2025 Jul 25:106417.
- Jayanthi Harikrishnan VV, Ikram MM, Herkel S, Meng W, Khater A, Johnson K, Boul P, Lou M, Nagarajaiah S, Rahman MM, Ajayan PM. Hexagonal boron nitride reinforced quick-setting multifunctional cement. *Oxford Open Materials Science*. 2025;5(1):itaf002.

### Peer-Reviewed Conference Proceedings

- Ikram MM, Saha S. Conjugate natural convection and entropy generation under uniform magnetic field in a partitioned square cavity filled with two different nanofluids. In *AIP Conference Proceedings* 2021 Feb 25 (Vol. 2324, No. 1, p. 050028). AIP Publishing LLC.
- Ikram MM, Zayernouri M, Naghibolhosseini M. Vortical Features in the Aerodynamics of Larynx and Mouth Cavity in Sustained Vowel Production. In *2023 4th International Conference on Computation, Automation and Knowledge Management (ICCAKM)* 2023 Dec 12 (pp. 1-6). IEEE.
- Ikram MM, Tahsin AT, Hasan AT. Effect of Bypass Mass Injection on Thrust Vectoring of a Supersonic Micro-Nozzle: A DSMC Investigation. In *International Symposium on Aviation Technology, MRO, and Operations* 2021 Jun 28 (pp. 349-356). Cham: Springer International Publishing.

### Under Review

- Ikram MM, Naghibolhosseini M, Zayernouri M. AI-Driven Lumped-Element Modeling of Human Respiratory System for Studying Voice Mechanics. *arXiv preprint arXiv:2606.18296*. 2026 Jun 15.

### TECHNICAL SKILLS

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- **Mechanical Design & CAD:** SolidWorks, CATIA V5/V6, AutoCAD, GD&T (ASME Y14.5), tolerance stack-up analysis, design for manufacturing (DFM), design for assembly (DFA), thermal component design, heat exchanger design, and fluid system layout.
- **Engineering Simulation & Analysis:** COMSOL Multiphysics, ANSYS Fluent, ANSYS Icepak, Abaqus, Star-CCM+, Nektar++, and OpenFOAM for CFD, single- and multiphase flow, heat transfer, turbulent flow modeling, structural finite element analysis (FEA), and thermo-fluid system analysis.
- **Thermal-Fluids & Energy Systems:** Experienced in HVAC and refrigeration systems, heat exchangers, heat sinks, electronic cooling systems, pump- and fan-driven cooling systems, fluid distribution systems, thermal power cycles, and thermal system modeling.
- **Rarefied & Multiscale Flow Modeling:** Skilled in OpenFOAM-based laminar and turbulent simulations, with expertise in micro- to nanoscale molecular flow analysis using DSMCFoam+ and Direct Simulation Monte Carlo methods.

- **Programming, Optimization & Data Analysis:** Highly proficient in MATLAB and Python for numerical modeling, optimization, reduced-order modeling, data processing, and simulation post-processing; basic programming familiarity with C, C++, FORTRAN, and Octave.
- **Post-Processing & Visualization:** Experienced in Tecplot, ParaView, MATLAB, and Python-based visualization for analyzing CFD, thermal, structural, and experimental datasets.
- **Hardware Development & Experimental Validation:** Experienced in rapid prototyping, prototype fabrication and testing, engineering test plans, thermal and environmental testing, instrumentation, data acquisition, hardware validation, and experimental characterization of thermal and fluid systems.
- **Lab Tools & Instrumentation:** Oscilloscope, multimeter, thermocouples, thermal sensors, pressure sensors, flow sensors, and data acquisition systems.

## LEADERSHIP & OUTREACH

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- Engineering College Advisory Council Member, Michigan State University Apr 2025 – Present
- Treasurer, Mechanical Engineering Graduate Student Association, MSU Aug 2024 – Present
- Council of Graduate Students Representative, Department of Communicative Sciences and Disorders, MSU Aug 2024 – Present
- Member of COGS Fellowship Review Committee, MSU Aug 2024 – Present
- Mentor at Multiscale Mechanical Modeling and Research Network (MMMRN). Jan 2020 – Jan 2021
- Vice President at Buetians' Organization of Narayanganj District (BOND). Apr 2019 – Jul 2020
- Volunteer at "Kaan Pete Roi," a mental health support helpline. May 2016 – Dec 2020

## PEER REVIEW SERVICE

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- Reviewer for Aerospace Science and Technology Dec 2021 – Present
- Reviewer for Case Studies in Thermal Engineering Dec 2021 – Present
- Reviewer for International Journal of Heat and Mass Transfer May 2025 – Present
- Reviewer for Powder Technology May 2025 – Present
- Reviewer for Measurement. May 2025 – Present
- Reviewer for Numerical Heat Transfer Part A: Applications Jan 2024 – Present
- Reviewer for Results in Engineering Jan 2026 – Present

## TEACHING EXPERIENCE

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**Lecturer** Dec 2021 – Aug 2022

Department of Mechanical and Production Engineering (MPE)

Ahsanullah University of Science and Technology, Dhaka, Bangladesh

**Course Instructor** Aug 2024 – Dec 2024

Department of Communicative Sciences and Disorders

CSD 313: Speech Science

**Graduate Teaching Assistant**

Department of Mechanical Engineering.

ME 333: Laboratory for Fluid Mechanics May 2026 – Present

ME 391: Mechanical Engineering Analysis Jan 2026 – May 2026

ME 425: Experimental Mechanics Aug 2025 – Dec 2025

ME 332: Laboratory for Fluid Mechanics Jan 2025 – May 2025

ME 332: Laboratory for Fluid Mechanics Jan 2024 – May 2024

ME 332: Laboratory for Fluid Mechanics Aug 2022 – Dec 2022

## COMPETITIONS & ACTIVITIES

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- 1<sup>st</sup> Position in the Mechanics Olympiad (Senior Group) at BUET Mechanical Festival. Feb 2016
- 2<sup>nd</sup> Position in the Mechanics Olympiad (Senior Group) at BUET Mechanical Festival. Feb 2017
- 2<sup>nd</sup> Position in the Astro-Physics Olympiad (Senior Group) at Cosmo Carnival. Mar 2017
- Participant, Hult Prize Business Case Competition 2017
- Participant, Pioneros Business Case Competition 2017
- Participant, Robo Fiesta, EEE Day 2018, Department of Electrical and Electronic Engineering, BUET Jul 2018
- Participant, Robo Carnival 2019, BUET Robotics Society Jan 2019
- Participant, EEE Day 2019, Department of Electrical and Electronic Engineering, KUET Jun 2019

## **HONOURS & AWARDS**

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- Leadership Fellowship, Michigan State University May 2026
- Graduate Office Fellowship, Michigan State University Apr 2026
- Circle Graduate Fellow, Michigan State University Jan 2026
- ASHFoundation Graduate Student Scholarship Oct 2025
- Best Paper Award – 54th Annual Symposium: Care of the Professional Voice May 2025
- Scholarship of Undergraduate Teaching and Learning (SUTL) Fellowship, Michigan State University Apr 2025
- Graduate Office Fellowship, Michigan State University Apr 2025
- Open Scholarship Fellowship, Michigan State University Sep 2025
- Centennial Research Grant (CRG) for transient analysis of external rotation induced flow system analysis. Jun 2021 – Aug 2022
- Graduate School Travel Fellowship May 2024
- Graduate School Travel Fellowship May 2025
- University Merit Scholarship & Dean's List Award 2016 - 2020
- Government Scholarship (Talentpool) in Higher Secondary School Certificate Examination of Bangladesh. 2015
- Government Scholarship (Talentpool) in Junior School Certificate Examination of Bangladesh. 2010
- Government Scholarship (General) in Primary School Certificate Examination of Bangladesh. 2007

## **INTERNSHIP**

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- Thermal Systems Intern at Haripur 360 MW Power Plant. Jan 2020 – Feb 2020
- Designed and instrumented airflow experiments using 12 thermocouples, pressure sensors, and NI DAQ systems to validate HVAC and thermal management system performance and supported recommendations to improve ventilation in turbine halls.
  - Evaluated airflow distribution, heat rejection, and cooling system efficiency to support turbine generator thermal management.