Md Moynul Hasan

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Education

- **The University of Toledo** — Jan 2024 – Dec 2025
  M.S. in Mechanical Engineering — Toledo, OH, USA
  Focus: Thermal-Fluid Sciences
  •GPA: 3.76 / 4.00

- **Bangladesh University of Engineering and Technology** — Feb 2017 – Aug 2022
  B.Sc. in Naval Architecture and Marine Engineering — Dhaka, Bangladesh
  •GPA: 2.93 / 4.00

Publications

1. Keval Suthar, **Md Moynul Hasan**, Saketh Merugu, Michal Marszewski, Anju Gupta. Pool Boiling Enhancement With High Entropy Oxides (HEOs) . *In Preparation*, 2025.

2. Abishek Balsamy-Kamaraj, **Md Moynul Hasan**, Saketh Merugu, Anju Gupta. Comparison of 3D-Printed Copper Surfaces for Enhanced Pool Boiling Heat Transfer . *Manufacturing Letters*, 2025. To be presented at the 53rd SME North American Manufacturing Research Conference (NAMRC).

   •Performed comparative analysis of six 3D printed copper thermal enhancement surfaces (arced, chevron, horizontal wave, straight, square duct, vertical wave) to assess pool boiling performance using deionized (DI) water, ethanol, and water/ethanol mixtures (90/10 and 60/40 wt%).

   •Conducted pool boiling experiments on fused deposition modeling (FDM) fabricated copper surfaces, achieving a **260%** increase in critical heat flux (CHF) over plain copper with ethanol using the vertical wave surface, with an enhancement ratio for CHF (ER_{CHF}) of **3.53**.

   •Quantified surface roughness via electron microscopy, identifying the vertical wave surface with the highest arithmetical mean height (Sa = $6.7 \pm 0.14\ \mu m$) and maximum height (Sz = $21.4 \pm 0.3\ \mu m$), enhancing bubble dynamics and heat transfer efficiency.

   •Identified wicking assisted bubble dynamics and microscale roughness as key mechanisms for improved liquid replenishment, with the vertical wave surface achieving a low enhancement index (EI) of **1.54** for DI water, indicating efficient cooling.

   •Demonstrated the efficacy of FDM based copper surfaces for advanced thermal management, with applications in electronics cooling and energy storage systems.

3. Saketh Merugu, **Md Moynul Hasan**, Anupma Thakur, Jacob Patenaude, Babak Anasori, George Choueiri, Anju Gupta. $Ti_3C_2T_x$ MXene Additives for Enhanced Pool Boiling Regime . *ACS Omega*, 2025.
   DOI: https://doi.org/10.1021/acsomega.4c06988

   •Investigated the application of titanium carbide ($Ti_3C_2T_x$) MXene as an additive in DI water to enhance pool boiling performance, achieving a **70.1%** increase in CHF and a **213.5%** increase in heat transfer coefficient (HTC) with a low concentration of 0.1 wt% compared to plain copper with DI water.

   •Performed contact angle measurements using the sessile drop method, demonstrating a **33.7%** reduction in contact angle on copper after boiling with 0.1 wt% MXene dispersion compared to plain copper with DI water, enhancing surface wettability and nucleation site density due to MXene flake deposition.

   •Performed comparative analysis with existing literature, demonstrating an **11%** enhancement in CHF and **45%** in HTC compared to the highest reported Ag/ZnO enhanced fluids, establishing $Ti_3C_2T_x$ MXene dispersions as superior for advanced thermal management in heat exchangers, cooling systems, and energy storage devices.

4. **Md Moynul Hasan**, Md. Mashiur Rahaman, N. M. Golam Zakaria. Fast Aerodynamics Prediction of Wedge Tail Airfoils Using Multi-head Perceptron Network. *Arabian Journal for Science and Engineering (AJSE)*, 2024.
   DOI: https://doi.org/10.1007/s13369-023-08686-9

- Engineered a dataset of **220** RANS CFD simulation cases for NACA airfoils with wedge tails, enabling robust training of machine learning models to predict aerodynamic performance.
- Developed a multi head perceptron (MHP) network to predict flow fields and aerodynamic coefficients for wedge tail airfoils, achieving a **125 times** speedup over RANS CFD methods and high accuracy lift and drag predictions for aerospace and marine applications.
- Achieved high prediction accuracy (R^2 up to **0.9999**) for flow fields like pressure and velocity components using the MHP network, outperforming classical machine learning models such as decision tree, k nearest neighbors, and random forest in wedge tail airfoil aerodynamic analysis.
- Validated MHP predictions against RANS CFD results, reducing residual errors to near **zero** for velocity fields, ensuring reliable lift and drag estimates for aerospace control surfaces.
- Pioneered point by point flow field predictions for wedge tail airfoils, improving accuracy near airfoil boundaries and supporting efficient rudder design for marine vessels.

5. **Md Moynul Hasan**, Mohammad Fahim Faisal, N. M. Golam Zakaria, Md. Mashiur Rahaman. Predicting Aerodynamic Characteristics of Airfoils Using Artificial Neural Network. *Preprint*, 2024.
DOI: https://doi.org/10.21203/rs.3.rs-4156906/v1

   - Collected and digitized a dataset of 2,678 observations from wind turbine experiments of NACA 00 series airfoils, including airfoil coordinates, Reynolds numbers (Re) (10^4 to 10^7), and angles of attack (0 to 180 degrees), to train a robust ANN model for aerodynamic predictions.
   - Developed an artificial neural network (ANN) model to predict lift coefficient (C_L)and drag coefficient (C_D), achieving RMSE below **0.12** for C_L and **0.025** for C_D, surpassing RANS CFD in rapid aerodynamic analysis for wind turbines and marine rudders.
   - Optimized ANN architecture with 6 hidden layers and 128 nodes, outperforming RANS CFD turbulence models by accurately predicting stall shapes for angles of attack (11 to 30 degrees), enhancing airfoil design efficiency.
   - Conducted RANS CFD simulations using ANSYS Fluent, validating ANN predictions against experimental data for NACA 0012 to 0025 airfoils at Re = 1.6×10^5.
   - Demonstrated superiority of ANN model over k-ϵ, k-ω SST, and Spalart-Allmaras turbulence models, reducing computational time while achieving RMSE below **0.09** for C_L and **0.12** for C_D in test data for aerospace and marine applications.

6. **Md Moynul Hasan**, Md. Mashiur Rahaman, N. M. Golam Zakaria. The Effects of Wedge Tail Thickness on NACA 0021 Airfoil Performance. *Journal of Maritime Research (JMR)*, 2023.
DOI: https://doi.org/10.21203/rs.3.rs-4156906/v1

   - Designed wedge tail geometries for NACA 0021 airfoils with trailing edge thicknesses of **0.1**, **0.125**, and **0.15** times chord length, boosting lift coefficient (C_L) by up to **100%** at Re = **1×10^6** for enhanced rudder performance in marine navigation.
   - Conducted RANS CFD simulations using ANSYS Fluent to analyze aerodynamic performance across Mach numbers (0.05–0.25) and Reynolds numbers (0.25×10^6– 1×10^6), optimizing lift and drag for aerospace control surfaces.
   - Evaluated the impact of angle of attack (**1–9°**), identifying Wedge Tail 02 (**0.125c**) as the optimal design with the highest lift coefficient increase of **60–100%**, balancing drag penalties for ship maneuverability.

7. Md. Latifur Rahman, Nusrat Binta Nizam, Prasun Datta, **Md Moynul Hasan**, Taufiq Hasan, Mohammed Imamul Hassan Bhuiyan. A Wavelet-CNN Feature Fusion Approach for Detecting COVID-19 from Chest Radiographs. *11^{th} International Conference on Electrical and Computer Engineering (ICECE)*, 2020.
DOI: https://doi.org/10.1109/ICECE51571.2020.9393085

   - Contributed to curating a dataset of **2,940** X-ray images (**940** COVID 19, **1,000** pneumonia, **1,000** normal) from public repositories, enabling robust training and validation of a wavelet CNN model for COVID-19 detection.
   - Supported preprocessing of X-ray images using CLAHE and SOBEL edge detection, enhancing image quality for **224 × 224** inputs, improving feature extraction for COVID-19 detection.
   - Assisted in extracting Haar wavelet features from X-ray images, decomposing them into horizontal, vertical, and diagonal sub-bands, boosting three class classification accuracy by **2.04%** with MobileNetV2 and SVM for COVID-19 detection.

- Facilitated feature extraction using MobileNetV2 and DenseNet121, achieving a peak accuracy of **97.73%** for three class classification with an SVM classifier.
- Contributed to optimizing the wavelet-CNN model for telemedicine, reducing memory usage to **2468.66 MB** using MobileNetV2, supporting deployment on low power devices for COVID-19 detection.

Work Experience

- **Tnterfacial Thermal and Transport Lab (ITTL) [🌐]** Jan 2024 - Present
  Graduate Research Assistant Toledo, OH, USA
  - Conducted pool boiling experiments using DI water, ethanol, and water/ethanol binary mixtures on 3D printed copper surfaces to evaluate the performance of various thermal enhancement geometries. Also investigated the effects of $Ti_3C_2T_x$ MXene and high-entropy oxide (HEO) additives in DI water on heat transfer performance using plain copper substrates.
  - Automated the post processing of LabVIEW temperature acquisition data by developing a Python based pipeline to compute wall superheat, heat flux, and heat transfer coefficient (HTC).
  - Replaced previously manual Excel based methods, reducing data analysis time from hours or days to seconds, significantly increasing experimental throughput and enabling faster iteration.
  - Enabled the team to brainstorm and test a wider range of surface designs and fluid additive concentrations by reducing bottlenecks in the experimental workflow, resulting in richer datasets and improved research outcomes.
  - Collaborated on the interpretation of boiling regimes, bubble dynamics, and heat transfer trends, contributing to publications in top tier journals and conferences, with one work featured on the journal cover.

- **The University of Toledo [🌐]** Jan 2024 – Present
  Graduate Teaching Assistant Toledo, OH, USA
  - **MIME 2700: Applied Measurement and Instrumentation** – Supported a cohort of **39** students in Summer 2024 by conducting lab sessions on sensors, electrical circuits, data acquisition systems using LabVIEW, and instrumentation techniques. Guided hands on experiments involving strain gauges, thermocouples, RC filters, and rotary encoders. Provided technical mentorship for Arduino based final projects and evaluated lab reports with emphasis on analytical clarity and technical accuracy.
  - **MIME 3410: Thermodynamics II** – Appointed as a TA for four consecutive terms (Summer 2024, Fall 2024, Spring 2025, and Summer 2025) based on strong performance and subject mastery. Supported a total of **163** students by developing problem sets, preparing solutions, conducting office hours, and grading quizzes, homework, final exams and projects. Provided academic support on topics such as vapor power cycles, refrigeration systems, and combustion analysis, contributing to improved student comprehension and course outcomes.
  - **MIME 3420: Fluids Laboratory** – Led lab sessions for a cohort of **25** students during Spring 2025, covering experiments on surface tension, buoyancy, viscosity, Bernoulli's principle, pipe flow, and airfoil aerodynamics. Held TA office hours, guided students in data analysis and lab report writing, and evaluated final quizzes and reports with a focus on technical accuracy and conceptual understanding.

- **Bangladesh University of Engineering and Technology [🌐]** Oct 2022 – Jul 2023
  Research Assistant Dhaka, Bangladesh
  - Appointed as a RA based on strong undergraduate thesis performance and research aptitude.
  - Published one **Q1** journal article on neural network based aerodynamic prediction models and one **Q2** journal article on RANS-CFD based wedge tail airfoil performance analysis.
  - Conducted RANS-CFD simulations using ANSYS Fluent to evaluate lift and drag characteristics of wedge tail NACA 0021 airfoils under varying Mach and Reynolds numbers.
  - Developed machine learning models using multi-head perceptrons to predict lift and drag coefficients, demonstrating reliable performance across multiple tail geometries.
  - Interpreted simulation results, validated models against experimental benchmarks, and contributed to manuscript drafting and revision.

- **Animo.Ai [in]** Oct 2022 – Jul 2023
  Machine Learning Engineer Intern Dhaka, Bangladesh
  - Conducted Principal Component Analysis (PCA) and T-distributed Stochastic Neighbor Embedding (t-SNE) on datasets to extract relevant features and visualize data patterns.
  - Conducted time series analysis on datasets using machine learning algorithms.

- Applied techniques such as auto-regressive integrated moving average (ARIMA), long short-term memory (LSTM), and other models to make time series predictions.

- **Khulna Shipyard Ltd** [🌐] Jan 20 – Feb 20
  Industrial Trainee Khulna, Bangladesh
  - Gained comprehensive experience in industrial practices, including engineering project management, product fabrication, shipbuilding techniques, and ship repairing processes.

PROJECTS

- **Ship Scantling requirements prediction** Oct 22 – Dec 22
  Tools: [GitHub]
  - Developed an Artificial Neural Network (ANN) model to predict structural strength requirements for cargo and container vessels using ships' rule length, breadth, and draft.
  - Predicted scantling requirements for cargo and container ships across various classification societies using ANN, achieving an impressive R^2 value of **0.998**.
  - Improved the speed compared to the empirical formula used by classification societies.

- **Speaker Recognition System** Jun 22 – Jul 22
  Tools: [GitHub]
  - Created a voice record dataset to train a machine learning model.
  - Achieved almost **99%** accuracy in speaker recognition with the trained model.

- **Design of a General Cargo Ship Of 2500 Tonnes Cargo Capacity** Jul 19 – Dec 20
  Tools:
  - Designed a 2500 tonne general cargo ship for Dhaka-Chittagong-Dhaka route.
  - Carried out the structural calculations and constructed different structural plans for construction.
  - Performed Hydrostatic calculation, Scantling, Tank capacity calculation.
  - Submitted the project to the Department of Naval Architecture and Marine Engineering, BUET as a requirement for the Ship Design Project and Presentation course.

- **Obogoto: An app to inform about COVID-19** Mar 20 – Mar 20
  Tools: [GitHub]
  - Participated in the Obogoto app project promoting COVID-19 awareness in Bangladesh.
  - Contributed to data collection and data analysis tasks for the project.

TECHNICAL SKILLS

- **Engineering Software:** AutoCAD, SolidWorks, Rhinoceros 3D, ANSYS Fluent, OpenFoam
- **Programming Languages:** Python, R, MATLAB, C++, Fortran
- **ML Library:** TensorFlow, Keras, PyTorch, Scikit-learn, OpenCV
- **Data Analysis:** NumPy, Pandas, MS Excel
- **Data Visualization:** Matplotlib, Seaborn, OriginPro, Paraview, Tecplot
- **Experimental Tools:** Attension® Theta Lite, Keyence Optical Profilometer
- **Embedded Systems:** Arduino
- **Writing:** LaTeX, MS Word

LEADERSHIP EXPERIENCE

- **Member at Large** Aug 2024 - Apr 2025
  Association of MIME Graduate Students (AMGS), The University of Toledo [LinkedIn]
  - Contributed to Grad Sound Bites for **15+** graduate students from Civil, Chemical, and Mechanical Engineering, supporting 3-minute research presentations, and a MIME student-faculty lunch to foster interdisciplinary community.
  - Supported an industrial tour to First Solar and NorthStar BlueScope Steel plants and new graduate student orientation, enhancing industry exposure and integration for **20–30** MIME students.
  - Collaborated on a graduate seminar and fireside chat with Dr. Aranya Chauhan from Tesla Energy and Women's Equality Day 2024 volunteering, documenting **7** Economic Justice areas to advance gender equity advocacy.

VOLUNTEER EXPERIENCE

- **Volunteer and Notetaker, NWO 6th Women's Equality Day** Aug 2024
  Women of Toledo [🌐]
  - Documented insights from **6** women of diverse backgrounds in an Economic Justice discussion, capturing **7** key areas (e.g., housing, childcare, equal pay) to advance gender equity advocacy.
  - Synthesized discussions on financial literacy and workplace equality, highlighting needs like budgeting education and paid parental leave, fostering actionable gender equity solutions.
  - Enhanced analytical and communication skills through active listening and summarization, contributing to community driven strategies for systemic gender equity.

COURSES

- **Fluid and Thermal**
  - Experimental Fluid Mechanics, Fluid Mechanics, Marine Hydrodynamics, Basic Thermal Engineering, Intermediate Fluid Mechanics and Heat Transfer.

- **Mathematics**
  - Differential Calculus and Integral Calculus, Coordinate Geometry and Ordinary Differential Equation, Vector Analysis and Differential Equation (Special Types), Statistics, Partial Differential Equation and Matrices, Advanced Engineering Mathematics I.

- **Computational and Design Methods**
  - Computer Aided Design (CAD), Computer Programming in Ship Design, Optimization Methods in Ship Design, Advanced MATLAB for Engineers, Computational Fluid Dynamics I.

- **Materials and Mechanical Properties**
  - Mechanics of Structure, Shipbuilding Materials, Advanced Materials Science and Engineering.

- **Others**
  - Machine Learning, Deep Learning Specialization, TensorFlow Developer Professional Certificate, A Hands-on Introduction to Engineering Simulations, MATLAB and Octave for Beginners, AI in the Sciences and Engineering.