Md Moynul Hasan

✉ mdmoynul.hasan@rockets.utoledo.edu | 🌐 mmh38.github.io | 🔗 Md Moynul Hasan

Toledo, Ohio 43607, United States

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).

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

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

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

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

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. *11th International Conference on Electrical and Computer Engineering (ICECE)*, 2020.
DOI: https://doi.org/10.1109/ICECE51571.2020.9393085

RESEARCH PROJECTS

Enhanced Pool Boiling using HEO — Jan 25 – Present

- Conducted pool boiling experiments of the following high entropy oxides as additives in deionized (DI) water, such as spinel $[(Al_{1/6}Co_{1/6}Cr_{1/6}Fe_{1/6}Mn_{1/6}Ni_{1/6})_3O_4]$, perovskite $[La(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})O_3$, $Y(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})O_3]$, and rock salt $[(Mg_{0.2}Co_{0.2}Ni_{0.2}Li_{0.2}Zn_{0.2})O]$.

- Enhanced critical heat flux (CHF) by **66.1%** using 0.05 wt% $La(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})O_3$ and **62.5%** with 0.05 wt% $Y(Co_{0.2}Cr_{0.2}Fe_{0.2}Mn_{0.2}Ni_{0.2})O_3$ perovskite additives, and increased heat transfer coefficient (HTC) by **136.5%** with the latter over plain copper surfaces using DI water in pool boiling experiments.

- Conducted a **15** day dispersion test of samples in DI water using ultrasonication to break apart particle aggregates, capturing images for analysis, and identified key mechanisms including particle de-agglomeration, hydroxyl group formation, and electrostatic repulsion for effective dispersion.

Enhanced Pool Boiling on 3D Printed Copper Surfaces

Apr 24 – Aug 24

- 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 and identified wicking assisted bubble dynamics as key to improved liquid replenishment, with the vertical wave surface (Sa = $6.7\pm0.14\,\mu$m, Sz = $21.4\pm0.3\,\mu$m) achieving a low enhancement index (EI = **1.54**) in DI water, indicating efficient cooling.

MXene Enhanced Pool Boiling Performance

Jan 24 – Apr 24

- 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.

Neural Network Modeling of Wedge Tail Airfoils

Mar 23 – Jul 23

- 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 for marine applications.
- Developed a multi head perception (MHP) network to predict flow fields such as pressure and velocity components and aerodynamic coefficients such as lift coefficient and drag coefficient for wedge tail airfoils, achieving a **125 times** speedup over RANS-CFD methods with high prediction accuracy with R^2 up to **0.9999**, outperforming classical models like decision trees, k-nearest neighbors, and random forests.
- Validated MHP predictions against RANS-CFD results, achieving near **zero** residual errors for velocity fields and reliable lift and drag estimates, while pioneering **point by point** flow field predictions to improve accuracy near airfoil boundaries, supporting efficient rudder design for marine vessels.

Wedge Tail Thickness Effects on NACA 0021 Airfoil

Oct 22 – Mar 23

- Designed wedge tail geometries for NACA 0021 airfoil with trailing edge thicknesses of **0.1**, **0.125**, and **0.15** times chord length (c), 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 over Mach (0.05–0.25) and Reynolds numbers (0.25×10^6–1×10^6), optimizing lift and drag for marine rudders.
- Evaluated the impact of angle of attack (**1–9°**), identifying wedge tail with **0.125c** as the optimal design with the highest lift coefficient increase of **60–100%**, balancing drag penalties for ship maneuverability.

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, evaluating thermal enhancement geometries and the effects of $Ti_3C_2T_x$ MXene and high entropy oxide (HEO) additives on heat transfer performance, contributing to publications in top tier journals, with one work featured on the **journal cover**.
- Developed a Python based pipeline to automate post processing of LabVIEW temperature acquisition data, computing wall superheat, heat flux, and heat transfer coefficient (HTC), replacing manual Excel based methods and reducing data analysis time from hours or days to **seconds**.

- Enhanced experimental throughput by streamlining data analysis, enabling **faster** iteration and testing of diverse surface designs and fluid additive concentrations, resulting in **richer** datasets and improved research outcomes.

Bangladesh University of Engineering and Technology [🌐]   Oct 2022 – Jul 2023
Research Assistant   Dhaka, Bangladesh

- Conducted RANS-CFD simulations using ANSYS Fluent to evaluate the effects of wedge tail on NACA 0021 airfoil lift and drag characteristics under varying Mach and Reynolds numbers.
- Developed machine learning models using multi head perceptrons to predict flow fields, such as pressure and velocity, along with lift and drag coefficients for various wedge tail airfoils, validated against RANS-CFD simulations.
- Authored a **Q1** journal article on multi head perception based wedge tail airfoils aerodynamis predictions and a **Q2** journal article on RANS-CFD based NACA 0021 wedge tail airfoil performance analysis, contributing to manuscript drafting and revision.

ACADEMIC PROJECTS

Design of a General Cargo Ship Of 2500 Tonnes Cargo Capacity   Jul 19 – Dec 20
Tools: AutoCAD, Rhinoceros 3D, Maxsurf, Microsoft Excel.

- Designed a 2500 tonne general cargo ship for the Dhaka-Chittagong-Dhaka route (304 km), achieving a service speed of 10 knots with optimized principal particulars **(L=73.8 m, B=13.7 m, T=4.2 m)** using empirical and Posdunine/Benford approaches for efficient grain transport.
- Conducted comprehensive structural and hydrostatic analyses, including scantling, lines plan, and stability calculations, ensuring compliance with ABS/GL rules and achieving a maximum GZ at **40°**.
- Developed detailed construction plans (midship section, shell expansion, rudder arrangement) and performed resistance and power calculations, enabling a trimmed stern draft of **4.26** m, and submitted as a capstone project to BUET's Naval Architecture Department.

TEACHING AND VOLUNTEER EXPERIENCE

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.

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.

LEADERSHIP EXPERIENCE

Member at Large   Aug 2024 - Apr 2025
Association of MIME Graduate Students (AMGS), The University of Toledo   [in]

- Contributed to Grad Sound Bites for **15+** graduate students from Civil, Chemical, and Mechanical Engineering, supporting 3 minutes 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.

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
- **Presentation and Graphics:** MS PowerPoint, Inkscape, GIMP

RELEVANT COURSEWORK

Fluid and Thermal Sciences

- Hydrostatics and Stability[1] • Fluid Mechanics[1] • Marine Hydrodynamics[1] • Resistance and Propulsion of Ships[1] • Experimental Fluid Mechanics[2] • Marine Engineering[1] • Basic Thermal Engineering[1] • Heat Transfer[1] • Intermediate Fluid Mechanics and Heat Transfer[2]

Mathematics and Physics

- Differential Calculus and Integral Calculus[1] • Coordinate Geometry and Ordinary Differential Equation[1] • Vector Analysis and Differential Equation (Special Types)[1] • Statistics, Partial Differential Equation and Matrices[1] • Fourier Analysis, Harmonic Function, Complex Variable and Laplace Transforms[1] • Advanced Engineering Mathematics I[2] • Reliability[2] • Structure of Matter, Electricity & Magnetism and Modern Physics[1] • Waves & Oscillations, Geometrical Optics and Wave Mechanics[1]

Computational and Design Methods

- Numerical Computations[1] • Control Engineering[1] • Advanced MATLAB for Engineers[2] • Computational Fluid Dynamics I[2] • Ship Design and Drawing[1] • Computer Aided Design (CAD)[1] • Computer Programming in Ship Design[1] • Optimization Methods in Ship Design[1]

Materials and Mechanical Properties

- Shipbuilding Materials[1] • Advanced Materials Science and Engineering[2] • Mechanics of Structure[1] • Ship Structure[1] • Ship Construction[1]

Online Courses

- Machine Learning[3] • Deep Learning Specialization[3] • TensorFlow Developer Professional Certificate[3] • A Hands-on Introduction to Engineering Simulations[4] • MATLAB and Octave for Beginners[4] • AI in the Sciences and Engineering[5]

[1] Undergraduate   [2] Graduate   [3] Coursera   [4] edX   [5] ETH Zürich