

Muhammad Abdun Nafi

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EDUCATION

Doctor of Philosophy (PhD) in Mechanical Engineering (ME) [Aug. 2023 – Present]
Purdue University

Master of Science (MS) in Mechanical Engineering (ME) [Aug. 2021 – May 2023]
Miami University

Relevant Coursework: Finite Element Analysis, Advanced Mechanics of Materials, Fracture Mechanics, Scanning Electron Microscopy, Control of Dynamic Systems, Engineering Analysis, Biomaterials.

Bachelor of Science (BS) in Mechanical Engineering (ME) [Aug. 2014 – Oct. 2018]
Bangladesh University of Engineering and Technology (BUET)

Relevant Coursework: Mechanics of Solids, Machine Design, Mechanics of Machinery, Machine Tools, Production Processes, Heat and Mass Transfer, Fluid Mechanics, Mechatronics, Thermodynamics.

SKILLS

- **Programming Languages:** Matlab, C, C++, Python
- **Simulation and Modeling:** Abaqus, ANSYS Fluent
- **Design Tools:** SolidWorks, Inventor, AutoCAD, CHEMCAD
- **Battery Fabrication:** Li-ion batteries (LIBs), Li-metal batteries (LMBs), All solid-state batteries (ASSBs), Anode free batteries
- **Manufacturing and Machining:** Wire-EDM, Die-Sinking EDM, Micro-EDM, Conventional manufacturing machines
- **Material Characterization:** Optical microscope, SEM, Gamry Instrument (For Corrosion Testing), ramèhart Contact Angle Goniometers (For Wettability Testing)
- **Visualization and Post Processing Tools:** Tecplot 360, Paraview
- **Documentation and Presentation:** Office Suite, Latex

RESEARCH EXPERIENCE & ACTIVITIES

• **Graduate Research Assistant, [Laboratory for Advanced Manufacturing Processes \(LAMP\)](#)** [Aug. 2022 – May 2023]
Department of Mechanical & Manufacturing Engineering, Miami University.

Work overview:

Machining of Ti-6Al-4V by wire-EDM:

- Experimental study of surface textures (i.e., micro-channels, micro-pillars) on Ti-6Al-4V machined by Wire-EDM with different parameter settings.
- Investigation of surface and tribological properties, wettability, biocompatibility due to the change in parameter settings and surface features.

Machining of Aluminum:

- Machining of aluminum metal matrix composite sample at millimeter level by wire-EDM for tensile testing.

Nanosecond Laser Machining of Silicon and 3D printed CFRP:

- Measurement of surface roughness and dimensions of holes and slots produced on 3D printed CFRP and silicon samples using nanosecond laser machining process.
- Analyzing the variations of surface roughness, dimensions and heat-affect zones due to the change in number of pulses.

- **Undergraduate Research Assistant, [Macro-to-Micro scale Fluids Engineering Lab \(MuFEL\)](#)**, Department of Mechanical Engineering, BUET. [Sep. 2017 – Oct. 2018]

Work overview:

- Study of thrust vectoring in a supersonic propulsion nozzle at different NPRs.
- Computational investigation of change in pressure, thrust and thrust vector angle using ANSYS-Fluent and Tecplot 360.

- **Mentor**, Multiscale Mechanical Modeling and Research Network (MMMRN), BUET. [Dec. 2017 – Nov. 2018]

Work overview:

- Guided junior year students with their projects.
- Organized workshops on the basics and applications of fluid mechanics, research paper writing, simulations using ANSYS-Fluent.

TEACHING EXPERIENCE

- **Graduate Teaching Assistant**, Department of Mechanical & Manufacturing Engineering, Miami University. [Aug. 2021 – May. 2022]

Courses instructed:

- **Numerical Methods:** An undergraduate level course that focuses on non-linear equations, system of equations, numerical integration, initial-value problems for ordinary differential equations (ODEs), regression.
 - Graded homework, quizzes and assignments
 - Helped students in lab to solve numerical problems by using MATLAB
- **System Modeling, Analysis, and Control:** An undergraduate level course which provides an in-depth study of mechanical, electrical, hydraulic, and electrical system modeling, linearization, Laplace transform, block diagram reduction, system response, time domain specifications, system stability analysis, controller performance matrices, root locus, root locus-based controller design (PD, PI, Lag, Lead), Bode diagram.
 - Evaluated homework, quizzes and assignments
 - Assisted students to apply theoretical knowledge in lab
- **Mechanical Vibrations:** An undergraduate level course that is offered to cover the basics of formulation and response of single degree of freedom (SDoF) and multiple degree of freedom (MDoF) systems, energy methods, numerical solution of SDof system, response of SDof system with harmonic excitation, damping and forced vibration, isolation, and dynamic vibration absorber
 - Graded homework and exams
 - Mentored students in their group case studies and projects

- **Graduate Teaching Assistant**, Department of Chemical, Paper & Biomedical Engineering, Miami University. [Jun. 2022 – Jul. 2022]

Course instructed:

- **Engineering Economics:** An undergraduate level course that focuses on future and present worth of investments, rate of return, net present value, payback period, inflation, and deprivation.
 - Evaluated homework, quizzes and assignments

INDUSTRY EXPERIENCE

- **Industrial Trainee**, NestleBD, Gazipur, Bangladesh. [Mar. 2018 – Apr. 2018]

Work overview:

- Worked on a project named “Factor Analysis of Breakdown for Noodle Line#01 and #03 for the year 2017”.

PUBLICATIONS

- **Muhammad Abdun Nafi**, Mahmud Anjir Karim, Shashi Lalvani, Paul F. James, Andrew Sommers, Muhammad P. Jahan, "Investigating Wettability and Corrosion Resistance of the Titanium Alloy Surface Engineered by the WEDM Process", *Manufacturing Letters* 35, 2023: 450-459. <https://doi.org/10.1016/j.mfglet.2023.08.100>
- **Muhammad Abdun Nafi**, Muhammad P. Jahan, "Functional Surface Generation by EDM- A Review", *Micromachines*, 2022. <https://doi.org/10.3390/mi14010115>
- **Muhammad Abdun Nafi**, Muhammad P. Jahan, "Functional EDMed surfaces for Bio-Applications", *Comprehensive Materials Processing (Second Edition)*, vol. 10, 2024, 103-123. <https://doi.org/10.1016/B978-0-323-96020-5.00237-5>
- Mahmud Anjir Karim, **Muhammad Abdun Nafi**, Muhammad P. Jahan, "Investigating Electrode Design Methodologies for Improving Productivity in Silicon Using Die Sinking EDM", *International Manufacturing Science and Engineering Conference*, vol. 87240. American Society of Mechanical Engineers, 2023. <https://doi.org/10.1115/MSEC2023-105143>
- Muhammad P. Jahan, Aakash Niraula, **Muhammad Abdun Nafi**, Asma Perveen, "Multi-Scale Traditional and Non-Traditional Machining of Bulk Metallic Glasses (BMGs)-Review of Challenges, Recent Advances, and Future Directions", *Micromachines*, 2024. <https://doi.org/10.3390/mi15060686>
- Esha Francis, Charles Ma, J. Ma, **Muhammad Abdun Nafi**, Mahmud Karim, Muhammad P. Jahan, "An Experimental Investigation on Nanosecond Laser Ablation of Single Crystalline Silicon Wafers", *International Manufacturing Science and Engineering Conference*, vol. 87240. American Society of Mechanical Engineers, 2023. <https://doi.org/10.1115/MSEC2023-104565>
- Charles K. Ma, Lesly Aguilar, Mahmud Karim, **Muhammad Abdun Nafi**, Jianfeng Ma, Muhammad P. Jahan, "Experimental Investigation of Nanosecond Laser Machining of 3D Printed Carbon Fiber Reinforced Polymer (CFRP) Composite", *Manufacturing Letters* 35, (2023): 399-409. <https://doi.org/10.1016/j.mfglet.2023.08.077>
- **Muhammad Abdun Nafi**, ABM Toufique Hasan, "3D computational study of thrust vectoring using bypass mass injection in a propulsion nozzle", *AIP Conference Proceedings*, 2019, 2121(1), 050013. www.doi.org/10.1063/1.5115900

GRADUATE PROJECTS

- **A finite element analysis of one-dimensional transient heat transfer in solid material.** [Jan. 2022 – May. 2022]
(Advisor: Dr. James Moller, Associate Professor, MME, Miami University)
 - The strong and weak forms of 1D transient heat conduction problem were found and applied for each element and A global system of equation was formed
 - The partial differential equations were solved using forward, backward, and central difference method. The solutions in each case were compared and analyzed
 - MATLAB was used to solve and plot the temperatures in various nodes
- **Solving non-differential equation gained by EFM with double layer capacitance.** [Jan. 2022 – May. 2022]
(Advisor: Dr. Shashi Lalvani, Professor, CPB, Miami University)
 - The non-linear differential equation gained by electrochemical frequency modulation (EFM) with double layer capacitance was solved and plotted
 - The plots were developed using MATLAB
- **A review on stainless steel for orthopedic implants.** [Jan. 2022 – May. 2022]
(Advisor: Dr. Amy Yousefi, Professor, CPB, Miami University)
 - A detailed study was conducted on the current research trends on 316L stainless steel for orthopedic implants.
 - Mechanical and tribological properties, biocompatibility of 316L stainless steel were broadly discussed.

- **A comparative study on stress analysis between experimental and simulation results of 3D printed PC specimens.** [Aug. 2021 – Dec. 2021]
(Advisor: Dr. Amit Shukla, Professor, MME, Miami University)
 - Two orientations of polycarbonate (PC) specimen were modeled and run in Abaqus commercial software
 - The stress-strain curve, Young's modulus, ultimate tensile stress, yield strength were obtained in the simulation process and were validated

- **Balance control of Seesaw- Cart- Pendulum System.** [Aug. 2021 – Dec. 2021]
(Advisor: Dr. Jim Chagdes, Associate Professor, MME, Miami University)
 - A simulation project for which the mechanical, electrical, and state-space model of the seesaw-cart-pendulum system were developed
 - Variation of translational position of load cart, seesaw, pendulum cart and pendulum with time were plotted by using MATLAB
 - Balance time and balance index were further calculated

- **Computational analysis of plastic zone of a panel containing a center crack using Von Mises and Tresca yield criterion for plasticity.** [Aug. 2021 – Dec. 2021]
(Advisor: Dr. Yingbin Hu, Assistant Professor, MME, Miami University)
 - The plastic zone of center cracked panel was simulated by using Abaqus simulation software
 - The shapes of the plastic zone, stresses at the crack tip region were analyzed for two different criteria

HONORS & AWARDS

- **Graduate Summer Research Fellowship**, MME, Miami University [Summer 2022 & 2023]
- **Dean's List Scholarship**, Faculty of Mechanical Engineering, BUET [Jan. 2014 session]
- **Education Board Technical Scholarship**, BUET [2014 –2018]
- **Intra University Idea Contest** [2015]
(Champion)
- **HSC Education Board Scholarship** [2013]