Md Badrul Hasan

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EDUCATION

University Of Maryland, Baltimore County (UMBC) *January, 2019 - Present*
Ph.D. in Mechanical Engineering
Department of Mechanical Engineering

University Of Maryland, Baltimore County (UMBC) *December, 2022*
M.S. in Mechanical Engineering
Department of Mechanical Engineering

Bangladesh University of Engineering and Technology (BUET) *2013 - 2017*
B.Sc. in Mechanical Engineering
Department of Mechanical Engineering

WORKSHOPS & TRAINING

Structure-Preserving Scientific Computing and Machine Learning: Summer School & Hackathon, University of Washington, Seattle June, 2025
Participant

- Selected as one of **40 graduate students** from across the U.S. and Canada; program supported in part by **NSF** and **PIMS**.
- Hackathon **Project D: Neural ODEs Exploring Time Integration Methods and Training Strategies**; relevant to *weather forecasting* and *nonlinear dynamical systems*.
- Activities included lectures, hands-on computational labs, and collaborative mini-projects at the intersection of scientific computing and machine learning.

WORK EXPERIENCE

Computational Mechanics Laboratory, UMBC January, 2020 - Present
Graduate Research Assistant

- Conducting *a posteriori* tests of invariance-embedded machine learning models for meso-scale hurricane boundary layer flows integrating ML closures into WRF for in-line hurricane simulations. (**UMBC 2025 COEIT Interdisciplinary Proposal Award**)
- Developing machine-learning-based models of backscatter-admitting sub-grid-scale (SGS) processes to improve hurricane boundary layer simulations.
- Advancing methods for detecting stealthy, long-term cyber-attacks on wind energy assets using physics-informed neural networks. (**UMBC 2024 Cybersecurity Leadership Exploratory Grant**)

Joint Centre for Earth Systems Technology (JCET), UMBC January, 2020 - June, 2022
Graduate Research Assistant

- Compared the numerical dissipation of different weather prediction models like WRF and NUMA with Dr. Stephen Guimond supported by the National Science Foundation (NSF) under grant AGS-2121366.
- Visualized and Compared the remote sensing radar data from Imaging Wind and Rain Airborne Profiler (IWRAP) with Dr. Stephen Guimond for NOAA/AOML/HRD Hurricane Field Program.

University Of Maryland, Baltimore County (UMBC) January, 2019 - May, 2024
Graduate Teaching Assistant

- Conducted the lab demonstrations and grading on ENME-432L, Fluids/Energy Lab with Dr. Meilin Yu.
- Assisted Dr. James Baughan on teaching and grading on the ENME-423, HVAC Design.

PUBLICATIONS

Journals

- **Hasan, M. B.**, Guimond, S. R., Yu, M., Reddy, S., & Giraldo, F. X. (2022). The Effects of Numerical Dissipation on Hurricane Rapid Intensification with Observational Heating. *Journal of Advances in Modeling Earth Systems*, 14, e2021MS002897. [DOI]
- **Hasan, M. B.**, Yu, M., & Oates, T. (2025), Invariance-embedded Machine Learning Sub-grid-scale Stress Models for Meso-scale Hurricane Boundary Layer Flow Simulation I: Model Development and *a priori* Studies. (2025) [DOI]. (*Under Review*)

Conference Proceedings

- **Hasan, M. B.**, Yu, M., Xiao, H. (2023). Sub-grid Scale Modeling of Meso-scale Hurricane Boundary Layer Flows using Machine Learning. In *AIAA SciTech 2023 Forum*, p. 2487. [DOI]
  Presented at AIAA SciTech 2023, National Harbor, MD.
- **Hasan, M. B.**, Yu, M., Oates, T. (2025). Comparison of Several Machine-Learning-Enhanced Sub-grid Scale Stress Models for Meso-scale Hurricane Boundary Layer Flow Simulation. In *AIAA SciTech 2025 Forum*, p. 2212. [DOI]
  Presented at AIAA SciTech 2025, Orlando, FL.
- **Hasan, M. B.**, Yu, M., Oates, T. (2025). Evaluating Machine Learning-Enhanced Sub-Grid Scale Stress Models With Invariance Embedding for Meso-Scale Hurricane Boundary Layer Flows. In *ASME Fluids Engineering Division Summer Meeting (FEDSM)*, 2025. (Accepted)
  Presented at ASME FEDSM 2025, Philadelphia, PA.

CONFERENCE PRESENTATIONS & SEMINARS

- Invariance-Embedded Machine Learning Sub-Grid-Scale Stress Models for Meso-Scale Hurricane Boundary Layer Simulations, *2025 Research Symposium on Environmental and Applied Fluid Dynamics*, The George Washington University, Washington, DC, May 2025. **[Oral]**
- Assessment of Invariance-Embedded Machine Learning Models for Sub-Grid Scale Stress in Meso-Scale Hurricane Boundary Layer Flows, *COEIT Research Day*, UMBC, Baltimore, MD, April 2025. **[Oral]**
- Sub-grid Scale Modeling of Meso-Scale Hurricane Boundary Layer Flows using Machine Learning, *COEIT Research Day*, UMBC, Baltimore, MD, April 2024. **[Oral]**
- Sub-grid Scale Modeling of Meso-Scale Hurricane Boundary Layer Flows using Machine Learning, *Poster Session, COEIT Research Day*, UMBC, Baltimore, MD, April 2024. **[Poster]**
- The Effects of Numerical Dissipation on Hurricane Rapid Intensification with Observational Heating, *AGU Fall Meeting*, New Orleans, LA, Dec 2021. **[Poster]**
- The Effects of Numerical Dissipation on Simulating Hurricane Intensification in a Realistic Regime, *AGU Fall Meeting*, San Francisco, CA, Dec 2020. **[Poster]**
- The Effects of Numerical Dissipation on Simulating Hurricane Intensification in a Realistic Regime, *Seminar Series*, Department of Mechanical Engineering, UMBC, Baltimore, MD, Nov 2020. **[Oral]**

AWARDS & SCHOLARSHIPS

2025 AIAA Professor Kirti "Karman" Ghia Memorial Award
Inaugural recipient for best student paper, Comparison of Several Neural Network-Enhanced Sub-grid Scale Stress Models for Meso-scale Hurricane Boundary Layer Flow Simulation, awarded by the Fluid Dynamics Technical Committee (FDTC) at AIAA SciTech 2025.

Graduate Student Association (GSA) Professional Development Grant, UMBC
Recipient in **May, 2025** and **December, 2024**; provided support for professional development and thesis-related research expenses.

University Technical Scholarship (2013–2017)
Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

TECHNICAL STRENGTHS

Programming Languages	Python, Matlab, Fortran
Modeling and Analysis	Ansys, Solidworks, COMSOL, AutoCad
Software & Tools	PyTorch, MS Office, LabView

LEADERSHIP & INVOLVEMENT

Bangladesh Student Association, UMBC September, 2019 -August, 2020
Treasurer

· Managed funds and coordinated events for Bangladeshi graduate students at UMBC, fostering community engagement.

Buet Photographic Society February, 2017 -October, 2017
Vice President

· Organized national-level photography exhibitions and workshops, engaging 500+ participants from engineering departments across BUET.

MEDIA COVERAGE & ONLINE FEATURES

UMBC News Feature

· **Modeling Hurricanes with Machine Learning**
Research featured in UMBC News highlighting ML-based hurricane modeling. (January 2025)