# Md Abir Hossain

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## Research Profile

Md Abir Hossain is a Ph.D. candidate in the mechanical and aerospace engineering department at The Ohio State University, specializing in theory development, modeling and simulation, mechanical testing, and advanced manufacturing for elevated temperature applications. Within the gamut of mechanics of materials at extreme environments, creep, creep-fatigue, high temperature mechanical testing are key areas. Mr. Hossain authored 10+ scholarly articles in these areas that are published in reputed journals, presented in international conferences, and submitted as annual reports. Current research involves the development of constitutive models and advanced life prediction tools, low-cost manufacturing of next-generation alloys, and accelerated screening and qualification of metallic materials. Mr. Hossain's research has been sponsored by the US Department of Energy, Air Force Research Laboratory, and UTEP-NASA Aerospace Center.

## Skills

**RESEARCH EXPERTISE:** Theory Development, Constitutive Modeling, Probabilistic Modeling, Uncertainty Quantification, Finite Element Analysis, Mechanical Testing, Materials Characterization, Machine Learning.

**INSTRUMENT AND TESTING:** Instron 5969 Electro-Mechanical Testing Machine, MTS Servo hydraulic Testing Machine, ATS furnace, KSL Muffle furnace, Epsilon Extensometer, DIC, Keyence Digital Microscope, Apreo and Quattro SEM

**DATA ANALYSIS:** Test Matrix Design, DMM, DOE, ANSYS UPF

**PROGRAMMING SKILLS:** MATLAB, ANSYS FEA, Rstudio, MathCAD, Mathematica, Fusion 360, Solidworks, AutoCAD, Hypermash, Abaqus, Minitab, Gmash, Fortran

## Education

### PH.D. | AUGUST 2022 – PRESENT | THE OHIO STATE UNIVERSITY
· Department of Mechanical and Aerospace Engineering
· Research Advisor: Dr. Calvin M Stewart
· Research Topic: Accelerated Qualification of Creep Resistant Materials for Elevated Temperature Applications.
· CGPA – **4.00**/4.00

### M.SC.| AUGUST 2018 – AUGUST 2020 | THE UNIVERSITY OF TEXAS AT EL PASO
· Department of Mechanical Engineering
· Research Advisor: Dr. Calvin M Stewart
· Thesis: A Probabilistic Creep Constitutive Model for Creep Deformation, Damage, and Rupture.
· CGPA – **4.00**/4.00

### B.SC. | MARCH 2011-MARCH 2016 | BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLGY (BUET)
· Department of Naval Architecture and Marine Engineering
· Thesis: Analysis of Potential Flow Past Two-Dimensional Hydrofoil by Surface Panel Method and Vortex Lattice Method.

- CGPA – **3.70**/4.00
- Related coursework: Mechanics of Materials; Ship Structure; Finite Element Method; Marine Hydrodynamics; Resistance and Propulsion of Ships

## Experience

### GRADUATE RESEARCH ASSOCIATE | AUGUST 2022 – PRESENT | MATERIALS AT EXTREME LAB (MATX), THE OHIO STATE UNIVERSITY

- Develop the design of experiment and conduct dynamic mechanical testing of AM metallic materials.
- Demonstrated the modeling framework to calibrate the dynamic negative stepped isostress method (DN-SSM) test data of AM materials.
- Developed the machine learning framework for novel alloy discovery and high-throughput creep models.

### GRADUATE RESEARCH ASSISTANT | AUGUST 2018 – PRESENT | NASA AEROSPACE CENTER, UT EL PASO

- Pioneered the Accelerated Creep Testing (ACT) method for rapid discovery of alloys for high temperature application.
- Envisioned the phenomenological probabilistic creep-damage model for safe and reliable operation of plants subjected to mechanical and environmental extremes.
- Developed the Reduced Order Modeling (ROM) approach for probabilistic creep and failure response.
- Developed the human-in-the-loop machine learning (HITL-ML) for modeling candidate materials applied in FE applications.
- Lead, supervised, and trained multidisciplinary teams of undergrads in scientific research.

### INSTRUCTOR OF PRACTICE | JANUARY 2021 – AUGUST 2022 | MECHANICAL ENGINEERING DEPARTMENT, UT AT EL PASO

- Effectively integrated a range of classroom tools, including lectures, interactive discussions, team-building exercises, demonstrations, and illustrative examples.
- Enhanced team working, interpersonal, and research-oriented skills by facilitating multiple group projects among the students.
- Independently delivered over 350 hours of lecture on course MECH 1305: Graphics and Design Fundamentals consisting of 45 students in SY 22.
- Developed proficiency in explaining complex technical subject matter to the inexperienced audiences.
- Course Taken:
    o MECH 1305: Graphics Design and Fundamentals

### GRADUATE TEACHING ASSISTANT | JANUARY 2021 – DECEMBER 2021 | UT AT EL PASO

- Trained and supervised the students on experiment and data collections.
- Lectured as substitute instructor as per requirement of the course.
- Course Taken:
    o MECH 3323: Solid Mechanics Lab
    o MECH 4326: Finite Element Analysis
    o MECH 4395: Nuclear Engineering

**GRADUATE TEACHING ASSISTANT | MAY 2018 – AUGUST 2018 | OLD DOMINION UNIVERSITY**

· Course Taken:
    o MAE 111: Mechanical and Aerospace Engineering Information Literacy and Research.

**GRADUATE RESEARCH ASSISTANT| JANUARY 2018 – AUGUST 2018| OLD DOMINION UNIVERSITY**

· Research topic: Mechanical Characterization of Hybrid Composites Manufactured by Compression Molding.
· Supervised the experimental characterization of compression molded hybrid composite.
· Devised computational modeling of the progressive damage evolution of thermosetting and thermoplastic molding compounds.
· Conducted mechanical testing with Digital Image Correlation (DIC) to correlate structure-property relationship and material characterization.

**LECTURER | APRIL 2016 – DECEMBER 2017 | MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY (MIST)**

· Department of Naval Architecture and Marine Engineering
· Courses Taken: Resistance and Propulsion of Ships, Ship Design and Drawing Labs, Thermodynamics Labs, Marine Engineering Labs.

## Research Impact

· Google Scholar Citations (November 8, 2022): **64**
· Google Scholar h-index (November 8, 2022): **5**
· Journal Publication – **5**
· Peer-Reviewed Conference Article - **8**

## Journal Article

· **(J5) Hossain, M.A.**, Cano, J.A., Stewart, C.M., "Probabilistic Creep with Wilshire-Cano-Stewart (WCS) Model*.*", *International Journal of Pressure Vessel and Piping*. (Under Review)
· **(J4)** Cano, J.A., Haque, M.S., **Hossain, M.A.**, Stewart, C.M., "Accelerated Qualification of Creep Resistant Materials using a Datum Temperature Method (DTM) to Calibration.", *International Journal of Pressure Vessel and Piping*. https://doi.org/10.1016/j.ijpvp.2022.104746
· **(J3) Hossain, M.A.**, Cottingham, J.R., Stewart, C.M., "An Extrema Approach to Probabilistic Creep Modeling in Finite Element Analysis*.*", *ASME Journal of Engineering for Gas Turbine and Power*. https://doi.org/10.1115/1.4052260
· **(J2) Hossain, M.A.**, Stewart, C.M., "A Probabilistic Creep Model Incorporating Test Condition, Initial Damage, and Material Property Uncertainty.", *International Journal of Pressure Vessel and Piping,* 193 (2021) 104446. https://doi.org/10.1016/j.ijpvp.2021.104446.
· **(J1)** Stewart, C.M., **Hossain, M.A.**, Pellicotte, J., Mach, R., Alexander, D., "Accelerated Creep Testing of Inconel 718 using the Stepped Isosteres Method (SSM)." *Materials Performance and Characterization,* 11(2), (2021) https://doi.org/10.1520/MPC20200174.

# Peer-Reviewed Conference Papers

- **(C8) Hossain, M.A.**, Stewart, C.M.,” A Reduced Order Modeling in Finite Element for Rapid Qualification of Creep-Resistant Alloys.” *Proceedings of ASME PVP 2022, Pressure Vessels and Piping Conference*. Las Vegas, Nevada, USA July 17-22, 2022. https://doi.org/10.1115/PVP2022-82065
- **(C7) Hossain, M.A.**, Haque, M.S., Stewart, C.M.,” A Datum Temperature Calibration Approach for Long-Term Minimum-Creep-Strain-Rate and Stress-Rupture Prediction using Sine-Hyperbolic Creep-Damage Model.” *Proceedings of ASME PVP 2022, Pressure Vessels and Piping Conference*. Las Vegas, Nevada, USA July 17-22, 2022. https://doi.org/10.1115/PVP2022-82064
- **(C6) Hossain, M.A.**, Mireles, A.J., Stewart, C.M.,” A Machine Learning Approach for Stress-Rupture Prediction of High Temperature Austenitic Stainless Steels.” *Proceedings of ASME Turbo Expo 2022, Turbomachinery Technical Conference and Exposition*. Rotterdam, Netherlands, June 13-17, 2022. https://doi.org/10.1115/GT2022-84352
- **(C5) Hossain, M.A.**, Cottingham, J.R., Stewart, C.M.,” A Reduced Order Modeling Approach to Probabilistic Creep-Damage Prediction in Finite Element Method.” *Proceedings of ASME Turbo Expo 2021, Turbomachinery Technical Conference and Exposition*. Virtual, Online, June 7-11, 2021. https://doi.org/10.1115/GT2021-58480
- **(C4) Hossain, M.A.**, Stewart, C.M.,” Probabilistic Minimum-Creep-Strain-Rate and Stress-Rupture Prediction for the Long-Term Assessment of IGT Components.” *Proceedings of ASME Turbo Expo 2020, Turbomachinery Technical Conference and Exposition*. Virtual, Online, September 21-25, 2020. https://doi.org/10.1115/GT2020-14870
- **(C3) Hossain, M.A.**, Mach, R., Pellicotte, J Stewart, C.M.,” Calibration of CDM-Based Creep Constitutive Model Using Accelerated Creep Test (ACT) Data” *Proceedings of ASME Turbo Expo 2020, Turbomachinery Technical Conference and Exposition*. Virtual, Online, September 21-25, 2020. https://doi.org/10.1115/GT2020-16017
- **(C2) Hossain, M.A.**, Stewart, C.M.,” Probabilistic Creep Modeling of 304 Stainless Steel using Modified Wilshire Creep-Damage Model” *Proceedings of the ASME2020, Pressure Vessel and Piping Conference*. Virtual, Online, August 3-7, 2020. https://doi.org/10.1115/PVP2020-21613
- **(C1) Hossain, M.A.**, Stewart, C.M.,” Reliability Prediction of 304 Stainless Steel using Sine-Hyperbolic Creep-Damage Model with Monte Carlo Simulation Method.” *Proceedings of the ASME 2019, Pressure Vessel and Piping Conference.* San Antonio, Texas, July 14-19, 2019. https://doi.org/10.1115/PVP2019-93712

# Plenary Talk

- **(T3) A Machine learning Aided Long-Term Stress-Rupture Prediction Model of Sanicro 25 Steel.** The Southwest Emerging Technology Symposium (SETS) 2022, April 12-13, 2022, El Paso, TX.
- **(T2) A Guideline for the Assessment of Uniaxial Creep and Creep-Fatigue Data and Models.** 2019 DOE Annual Meeting for Cross-cutting Research, April 9-11, 2019, Pittsburgh, PA.
- **(T1) Probabilistic Evaluation of 304 Stainless Steel using Sine-Hyperbolic Creep-Damage Model.** The Southwest Emerging Technology Symposium (SETS) 2019, April 17-18, 2019, El Paso, TX.

## Poster Presentation

- **(P3) A Machine Learning Augmented Creep Model of High Temperature Alloys.** Scarlett and Gray MAE Research Day, The Ohio State University, October 28, 2022.
- **(P2) Modeling Spatial Uncertainty for Creep Resistant Alloy**. ASME Turbo Expo 20021: Turbomachinery Technical Conference and Exposition, June 7-11, 2021, Virtual Conference and Exposition
- **(P1) Probabilistic Creep Modeling with Sine-Hyperbolic Creep-Damage Model**. NASA Visit Poster Session, The University of Texas at El Paso, May 30, 2019.

## Research Grant Worked for

- **(G3) Real-Time Mechanical State Tool for the Predictive Maintenance of Turbomachinery.** Air Force Research Lab HBCU/MI Program under the agreement number **FA8650-21-F-2014**
- **(G2) An Accelerated Creep Testing (ACT) Program for Advanced Creep Resistant Alloys for High Temperature Fossil Energy (FE) Applications.** Department of Energy; National Energy Technology Laboratory (NETL) under award number **DE-FOA-0001715**
- **(G1) A Guideline for Assessment of Uniaxial Creep and Creep-Fatigue Data and Models.** Department of Energy; National Energy Technology Laboratory (NETL) under award number **DE-FE-0027581**

## Award and Honors

- **NSF-Funded ASPIRE** West Texas Research Collaborative Associate Fellowship – Spring 2022
- **2021 MERG Research Excellence Award** for excellence in research quality and production in 2021.
- **ASME International Gas Turbine Institute (IGTI) 2022** Student Advisory Committee Travel Awards (SACTA)
- **Graduate School Travel Grants**- April 2019
- **Graduate School Travel Grants**- February 2020

## Professional Activities

- **Conference Reviewer**
    - **ASME TurboExpo (2022) –** 2 Papers
    - **ASME PVP (2022) –** 1 Paper
    - **ASME TurboExpo (2021) –** 3 Papers
    - **ASME PVP (2021) –** 1 Paper
    - **ASME TurboExpo (2020) –** 2 Papers
    - **ASME PVP (2020) –** 2 Papers
- Reviewer at **2023 NSF** Graduate Research Fellowship Program (GRFP).
- Mentor at **ASME Mentorship Program** Spring 2022.

## Student Research Supervision

- Antonio Arango (UG) – Fall 2019-Present
    - Graduated in Fall 2020. Currently pursuing M.S.M.E. at UTEP

- Jacqueline Cottingham (UG) – Fall 2020-Summer 2021
  - Currently working as R&D Engineer in Los Alamos National Lab
- Adan J. Mireles (UG) – Spring 2021-Present
  - Currently pursuing M.S.M.E. at Rice University
- Robert Mach (UG) – Fall 2019 – Summer 2022
  - Recipient of GEM Fellowship, pursuing M.S.M.E. at Texas A&M University
- Caitlin Benway (UG) – Fall 2020-Summer 2021
  - Currently pursuing M.S.M.E. at UT Austin

## Membership

- Student member of
  - **ASME –** June 2019 - Present
  - **ASTM –** September 2020 - Present
  - **Data Visualization Society (DVS) –** October 2021 – Present

## Collaborators

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| Dr. Mohammad Shafinul Haque | Assistant Professor | Angelo State University |
| Dr. Onome-Scott Emuakpor | Aerospace Engineer | Air Force Research Lab |
| William David Day | Chief Engineer | PSM – a Hnwha Company |
| Dr. Christian Kontermann | Director at High Temperature Materials | TU Darmstadt |
| Andrea Riva | Materials Engineer | Ansaldo Energia |

## Reference

- References available upon request.