

# Abdullah Al Amin, Ph.D.

Postdoctoral Fellow, Northwestern University

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## RESEARCH INTERESTS

- Energy & Materials
  - Metal Matrix Composites, Superconducting Wires, Fusion Energy
  - Organic Solar Cells
- Additive Manufacturing
  - Laser Powder Bed Fusion Process Modeling
  - AM Part Qualification and Quantification
- Computational Science
  - Atomic, molecular, and continuum modeling of solar cell, medical imaging device, additively manufactured parts
  - Multi-physics Modeling (magnetic, electric, thermal, and mechanical)
  - Exa-scale High Performance Computation, GPU Accelerated Computation
  - Scientific Machine Learning (Deep Neural Network for PDE approximation)
- Medical Devices
  - Magnetic Resonance Imaging (MRI) background magnet
  - Bio crystal detection devices

## EDUCATION

|   |                        |       |      |
|---|------------------------|-------|------|
| <b>Case Western Reserve University</b><br><u>Thesis:</u> Multiscale Multiphysics Thermo-Mechanical Modeling of an MgB <sub>2</sub> Based Conduction Cooled MRI Magnet System.<br><u>Adviser:</u> Michael Martens and Ozan Akkus | Mechanical Engineering | Ph.D. | 2018 |
| <b>The University of Akron</b><br><u>Thesis:</u> High throughput particle separation using differential Fermat spiral microchannel with variable channel width.<br><u>Adviser:</u> Jiang Zhe                                    | Mechanical Engineering | M.S.  | 2014 |
| <b>Bangladesh University of Engineering and Technology</b><br><u>Thesis:</u> Design, Improvement, Modification & Fabrication of Mechanisms and Control Systems of Robots for ABU ROBOCON<br><u>Adviser:</u> Maglub Al Nur       | Mechanical Engineering | B.S.  | 2009 |

## RESEARCH EXPERIENCE

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|--|---------------------|
| <b>Postdoctoral Fellow</b> , Northwestern University, Evanston, IL<br><u>Adviser:</u> Wing Kam Liu<br>Project: Development of an FVM based high fidelity multiphysics laser powder bed fusion solver.  | Feb 2021 ~ Present  |
| <b>Research Engineer</b> , Bridgestone Americas Technical Center, Akron OH.<br>Relevant Projects: <ul style="list-style-type: none"><li>• Development of a hybrid analytical-FEA tire analysis framework for cornering and braking.</li><li>• Composite polymer material modeling.</li></ul> | Jan 2018 ~ Jan 2021 |

**Graduate Research Assistant**, Case Western Reserve University, Cleveland OH Aug 2013 ~ Dec 2017  
Project: Development of a multiscale multiphysics model of a full body 1.5 T MRI main magnet.

**Graduate Research Assistant**, The University of Akron, Akron, OH Aug 2010 ~ Jul 2013  
Relevant Projects:

- Characterization of a high temperature, high vacuum soft microgripper.
- Development of a high throughput micro particle separation device.

## TEACHING EXPERIENCE

**Assistant Director** Fall '22~Present

Predictive Science and Engineering Design (PSE&D), Northwestern University  
A Northwestern University fellowship program where fellows are selected from a pool of applicants and trained with concurrent state of the art computational modeling techniques through three quarters (Fall, Winter, Spring) of courses.

**Guest Lecturer** Summer '22, '21  
Northwestern university Spring '21

- Summer Mechanistic Data Science
- Advance FEM II: Materials and reduced order models

**Graduate Teaching Assistant** Fall '14  
Case Western Reserve University Fall '15  
Spring '16

- Musculoskeletal Biomechanics
- Mechanical Engineering Measurements Laboratory
- Senior Design Project

**Graduate Teaching Assistant** Aug '11 ~ Jul '13  
The University of Akron

- Mechanical Engineering Drawing
- Tools for Mechanical Engineering Lab

**Lecturer** Jun '10 ~ Aug '10  
Green University of Bangladesh

- Introduction to Mechanical Engineering
- Machine Ergonomics
- Mechanical Engineering Drawing

**Lecturer** Feb '10 ~ May '10  
College of Aviation Technology, Bangladesh

- Introduction to Mechanical Engineering

**Adjunct Lecturer** Oct '09 ~ May '10  
Green University of Bangladesh

- Mechanical Engineering Drawing

## HONORS AND AWARDS

1. Participant, NASA GPU Hackathon 2022. (September 19, 26-28). Only nine teams selected worldwide.
2. 1st Place, NIST-AMBench, CHAL-AMB2022-03-PSCR: Best modeling results predicting the cooling rate immediately following solidification at specified locations within 2D scan tracks on IN718, August 2022.
3. 1st Place for NIST-AMBench, CHAL-AMB2022-03-PMPG: Best modeling results predicting the melt pool geometry at specified locations within 2D laser scan tracks on IN718, August 2022.

4. 1<sup>st</sup> Place for NIST-AMBench, CHAL-A-AMB2022-01-Scan-MWD & ASR Scan Geometry: Best modeling results predicting the melt pool geometry for a scanned laser weld, August 2022.
5. 2nd Place for NIST-AMBench, CHAL-AMB2022-03-TTAM: Modeling results predicting the time above melting temperature for individual laser tracks on IN718 with different processing conditions, August 2022.
6. Fellow, NSF CMMI Game Changer Academies for Advancing Research Innovation, December 2021.
7. NSF Fellow, Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology (July 30, 2021).
8. Contest Runner-Up, Superconductivity News Forum (SNF), Applied Superconductivity Conference (October 2016)
9. Financial Assistance, Applied Superconductivity Conference, Denver, Colorado; USA (September 2016)
10. Fellowship, MIT Professional Education, Multiscale Material Design, Boston, USA (Summer 2016) [Covered 50% of the Registration]
11. Graduate Student Travel Award, Graduate School, Case Western Reserve University (May 2016)
12. ISMRM Educational Stipend, 23rd annual meeting of ISMRM, Singapore City, Singapore (May 2016)
13. ISMRM Educational Stipend, 22nd annual meeting of ISMRM, Toronto, Canada (May 2015)
14. Sweden Bangladesh Travel Grant, Government of Bangladesh (December 2011)
15. University Blazer, Award recognizing participation to ABU Robocon 2008, Bangladesh University of Engineering and Technology, Dhaka. (September 2008)
16. Merit Scholarship, Government of Bangladesh (2004 – 2008)

#### **VOLUNTEER SERVICES**

1. Reviewer, Superconductor Science and Technology (October 2022-Present)
2. Reviewer, Computational Mechanics (March 2021 – Present)
3. Reviewer, Applied Superconductivity and Electromagnetic Devices (March 2021 – Present)
4. Reviewer, Journal of Mechanical Engineering Science, [IF: 1.015] (March 2021– Present)
5. Reviewer, IEEE Transactions of Applied Superconductivity, [IF: 1.324] (November 2019 – Present)
6. Reviewer, Society of Automotive Engineering (October 2019 – October 2020)
7. Award Committee, Tire Society (August 2018 – October 2020)
8. Conference Committee, Tire Society (July 2018 – May 2022)
9. Reviewer, Composite Structures [IF: 4.829] (January 2018 – Present)

#### **PROFESSIONAL MEMBERSHIP**

- The Minerals, Metals & Materials Society (2022 - Present)
- Tire Society (2018 – 2021)
- Society of Automotive Engineering (2018)
- United States Association for Computational Mechanics (2018)
- IEEE Council of Superconductivity (2016 – 2017)
- International Society of Magnetic Resonance in Medicine (2015-2016)

#### **JOURNAL PUBLICATIONS (250+ citations, h-index: 8, i10-index: 7)**

- J1. Hannah Huang, Satyajit Mojumder, Derick Suarez, Abdullah Al Amin, Mark Fleming, Wing Kam Liu, “Knowledge database creation for design of polymer matrix composite” Computational Material Science, Accepted: July 30, 2022.

- J2. Lu Y, Li H, Saha S, Mojumder S, Amin A, Suarez D, Liu Y, Qian D, Liu WK, "Reduced Order Machine Learning Finite Element Methods: Concept, Implementation, and Future Applications", Computer Modeling in Engineering & Sciences, September 14, 2021
- J3. Islam M, Thakur MSH, Mojumder S, Amin AA, Islam MM, "Mechanical and Vibrational Characteristics of Functionally Graded Cu-Ni Nanowire: A Molecular Dynamics Study", Composite Part B: Engineering, 108212
- J4. Sultana N, Amin A, Metin D, Gaston N, "Unveiling the structures and electronic properties of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> interfaces with TiO<sub>2</sub>, ZnO, and SnO<sub>2</sub>: a first-principles study", Journal of Materials Science, p. 1-15, August 2019.
- J5. Poole C, Amin A, Baig T, Martens M, "Mechanical analysis of an MgB<sub>2</sub> 1.5 T MRI main magnet protected using Coupling Loss Induced Quench", Cryogenics, Volume 100, p. 18-27, June 2019.
- J6. Amin AA, Sabri L A, Poole C R, Baig T N, Deissler R J, Rindfleisch M, Tomsic M, Doll D, Akkus O, Martens M, "Computational homogenization of the elastic and thermal properties of superconducting composite MgB<sub>2</sub> wire" Composite Structures, Volume 188, p. 313-329, March 2018.
- J7. Deissler R J, Baig T, Charles P, Amin A, Doll D, Tomsic M, and Martens, "A Computational Study to Find an Optimal RRR Value for a 1.5 T Persistent-Mode Conduction-Cooled MgB<sub>2</sub> MRI Magnet from a Quench Protection Point of View.", IEEE Trans. Appl. Supercond, Volume 99, Issue 4, June 2017
- J8. Baig T, Amin A, Deissler R J, Sabri L, Poole C, Brown R W, Tomsic M, Doll D, Rindfleisch M, Peng X and others, "Conceptual designs of conduction cooled MgB<sub>2</sub> magnets for 1.5 and 3.0 T full body MRI systems.", Superconductor Science and Technology, Volume 30, Issue 4, March 2017
- J9. Amin A, Baig T N, Deissler R J, Sabri L A, Doll D, Tomsic M, Akkus O and Martens M A, "Mechanical Analysis of MgB<sub>2</sub> Based Full Body MRI Coils Under Different Winding Conditions.", IEEE Trans. Appl. Supercond, Volume 27, Issue 4, June 2017
- J10. Deissler R J, Baig T, Poole C, Amin A, Doll D, Tomsic M and Martens M, "Numerical simulation of quench protection for a 1.5 T persistent mode MgB<sub>2</sub> conduction-cooled MRI magnet.", Superconductor Science and Technology, Volume 30, Issue 2, December 2016
- J11. Amin A, Baig T, Deissler R J, Yao Z, Tomsic M, Doll D, Akkus O and Michael Martens, "A multiscale and multiphysics model of strain development in a 1.5 T MRI magnet designed with 36 filaments composite MgB<sub>2</sub> superconducting wire.", Superconductor Science and Technology, Volume 29, Issue 5, March 2016.
- J12. Mojumder S, Amin A, and Islam M M, "Mechanical properties of stanene under uniaxial and biaxial loading: A molecular dynamics study," Journal of Applied Physics, Volume 118, Issue 12, September 2015
- J13. Amin A, Jagtiani A, Vasudev A, Hu J, and Zhe J, "Soft microgripping using ionic liquids for high temperature and vacuum applications.", Journal of Micromechanics and Microengineering, Volume 21, Issue 12, December 2011

#### **JOURNAL PUBLICATIONS (Under Review/In Preparation)**

- J1. Satyajit Mojumder, Zhengtao Gan, Abdullah Al Amin, Wing Kam Liu, "Linking Process Parameters with Lack-of-Fusion Porosity for Metal Additive Manufacturing" (Under Review with Additive Manufacturing)
- J2. Yangfan Li, Ye Lu, Abdullah Al Amin, and Wing Kam Liu, Stochastic additive manufacturing simulations: from experimental data to surface roughness and porosity predictions. (<https://arxiv.org/pdf/2208.02907.pdf>)
- J3. Abdullah Al Amin, Satyajit Mojumder, Wing Kam Liu, "An open-source GPU accelerated high fidelity multiphysics FVM framework for additive manufacturing simulations." (In Preparation)

- J4. Abdullah Al Amin, Yangfan Li, Satyajit Mojumder, Wing Kam Liu, "Getting the heat source right for Laser Powder Bed fusion additive manufacturing simulations." (In Preparation)
- J5. Abdullah Al Amin, Yangfan Li, Ye Lu, Xiaoyu Xie, Zhengtao Gan, Satyajit Mojumder, Gregory J. Wagner, Wing Kam Liu, "Predicting the single-track and multi-track laser powder bed fusion process of IN718 NIST AM Benchmark Tests." (To be submitted)

## CONFERENCE PROCEEDINGS

- C1. S Mojumder, H Huang, D Suarez, AA Amin, WK Liu, "Mechanistic data science approach for reinforced polymer composites design" Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology, San Diego, CA, September 26-29, 2021.
- C2. H Li, AA Amin, Y Lu, WK Liu, Advances and Applications of Mechanistic Machine Learning, Reduced-order and Data-driven Analyses, 16<sup>th</sup> USNCCM 2021, Chicago, IL July 25-29, 2021.
- C3. AA Amin, B Bhusal, TN Baig, RJ Deissler, L Sabri, O Akkus, and MA Martens, "A comparative study of coil winding techniques of a full body 1.5 T MgB<sub>2</sub> based MRI magnets.", ISMRM 25th annual meeting & exhibition, Hawaii, USA, April 2017
- C4. AA Amin, TN Baig, RJ Deissler, L Sabri, D Doll, M Tomsic, O Akkus and MA Marten, "Effect of Mechanical Support Conditions of Winding on the Strain Development of a Composite MgB<sub>2</sub> Based Full Body, MRI Coil.", Applied Superconductivity Conference, Denver, Colorado, USA, October 2016 [Superconductivity News Forum Contest Runner Up, SNF Contest for Best ASC 2016 Contributed Preprints – PART II, 2016]
- C5. RJ Deissler, TN Baig, CR Poole, AA Amin, D Doll, M Tomsic, M Martens, "A Computational Study to Find an Optimal RRR Value for a 1.5 T Persistent-Mode Conduction-Cooled MgB<sub>2</sub> MRI Magnet from a Quench Protection Point of View.", Applied Superconductivity Conference, Denver, Colorado, USA, October 2016
- C6. AA Amin, B Bhusal, TN Baig, RJ Deissler, L Sabri, O Akkus, and MA Martens, "Variation in strain characteristics for multiscale multiphysics models of a 1.5T conduction cooled MRI system based on a 36 filament MgB<sub>2</sub> composite wire.", ISMRM 24th annual meeting & exhibition, Singapore City, Singapore, May 2016
- C7. AA Amin, TN Baig, Z. Yao and MA Martens, "Stress and Strain Sensitivity Study of 1.5T Conduction Cooled MgB<sub>2</sub> Magnet Design.", ISMRM 23rd annual meeting & exhibition, Toronto, Canada, May 2015

## DEVELOPED SOFTWARE PROGRAMS

1. AM-CFD: An FVM based Additive Manufacturing Part Modeling Program (<https://github.com/neoceph/AM-CFD>)
2. Tire F&M: Hybrid analytical-FEM tire force analysis program.
3. M S H Thakur, M Islam, A Amin, S Mojumder, M M Islam (2019), "LAMMPS Input Structure Generator for Functionally Graded Materials (FGM)," <https://nanohub.org/resources/fgmbuilder>. (DOI: 10.21981/JC41-XT92).

## WORKSHOP/SHORT COURSE

1. Mechanistic Data Science for STEM students. (May 30 – August 10) Summer 2022 [Co-Instructor]
2. CMMI Game Changer Academics, NSF Division of CMMI, May 18, 2022. [Participant]
3. Mechanistic Data Science for STEM Education and Applications, Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering & Technology, Sand Diego, CA. September 26, 2021. [Co-organizer]
4. Mechanistic Data Science for STEM Education and Applications, 16<sup>th</sup> USNCCM, July 25, 2021, Chicago, IL. [Co-organizer]

5. Mechanistic Data Science for STEM students. (June 8 – August 11) Summer 2021. [Co-organizer]
6. Multiscale Material Design, Instructor: Dr. Markus Buehler, MIT Professional Education, June 2016. [Participant]

## PATENTS

- P1. Deissler R J, Baig T N, Amin A A, Brown R W, Grimberg B G, “Magneto-Optical detection and discernment of biofluid crystals.” February 28, 2019, US 2019/0064113 A1

## SUCCESSFUL GRANTS

- G1. August 11, 2022, “NASA GPU HACKATHON 2022.” Three-day intensive GPU training in collaboration with NASA and NVIDIA.
- G2. December 3, 2021, “GPU accelerated computational modeling of laser powder bed additive manufacturing of metallic parts” Quest High Performance Computing Cluster, Northwestern University. 35,000 compute hours.
- G3. November 2016, “Crystics: A biocrystal detection system,” VentureWell Stage I grant, VentureWell, Boston; USA. 5000 USD. (PI)
- G4. August 2016, “Supercomputer to model MRI quench strains.” Ohio Supercomputer Center, August 2016. 5000 RU≈50,000 compute hours.

## GRANTS (Co-Investigator)

- G1. April 2022, “GPU Accelerated Computational Mechanics at Northwestern University”, McCormick Equipment Awards, Evanston, IL. 20,000 USD.
- G2. April 2021, “Thermal-CFD simulation of melt pool dynamics in additive manufacturing of metals”, XSEDE Startup Grant. 2,500 GPU compute hours, 1,000 GB Storage.

## GRANTS (Contributed Writing)

- G1. September 2022, “CDS&E/Collaborative Research: Convolution HiDeNN-Tensor Decomposition for Integrating Multiscale Topological Optimization with Additive Manufacturing”. (Neither PI nor Co-PI)
- G2. August 2021, “Hierarchical Deep Learning Neural Networks Artificial Intelligence (HiDeNN-AI)”, NSF-SBIR. (Neither PI nor Co-PI) [Not Awarded]
- G3. December 2021, “Collaborative Research: Framework Implementations: HiDeNN-CI: Hierarchical Deep-learning Neural Network Cyberinfrastructure”, NSF - Cyberinfrastructure for Sustained Scientific Innovation. (Neither PI nor Co-PI) [Not Awarded]
- G4. January 2022, “Hybrid Equivalence- and Model-Based Approach for Machine-to-Machine Fatigue Life Qualification” NIST Metals-based Additive Manufacturing Grant Program. (Neither PI nor Co-PI) [Not Awarded]

## INVITED TALKS

- I1. “AM-CFD: a Well-validated Thermal-fluid Simulator for Additive Manufacturing Part Qualification”, Yangfan Li, Abdullah Al Amin, Sourav Saha, Wing Kam Liu, August 18, 2022, Additive Manufacturing Benchmarks (AM-Bench 2022), Bethesda, MD.
- I2. “Building the Next Generation Magnetic Resonance Imaging (MRI) Machines”, October 2017, Intel Corporation, Oregon, USA.
- I3. “Next Generation Magnetic Resonance Imaging (MRI) Magnet”, August 2017, Bridgestone Americas, Ohio, USA.
- I4. "A comparative study of coil winding techniques of a full body 1.5 T MgB<sub>2</sub> based MRI magnets.", April 2017, ISMRM 25th annual meeting & exhibition, Hawaii, USA.

15. "Effect of Mechanical Support Conditions of Winding on the Strain Development of a Composite MgB<sub>2</sub> Based Full Body, MRI Coil.", October 2016, Applied Superconductivity Conference, Denver, Colorado, USA.
16. "A Computational Study to Find an Optimal RRR Value for a 1.5 T Persistent-Mode Conduction-Cooled MgB<sub>2</sub> MRI Magnet from a Quench Protection Point of View.", October 2016, Applied Superconductivity Conference, Denver, Colorado, USA.
17. "Variation in strain characteristics for multiscale multiphysics models of a 1.5T conduction cooled MRI system based on a 36 filament MgB<sub>2</sub> composite wire.", May 2016, ISMRM 24th annual meeting & exhibition, Singapore City, Singapore.
18. "Stress and Strain Sensitivity Study of 1.5T Conduction Cooled MgB<sub>2</sub> Magnet Design.", May 2016, ISMRM 23rd annual meeting & exhibition, Toronto, Canada.
19. "High throughput microparticle separation on curved microchannel based on inertial microfluidics.", September 2013, Intel Corporation, Oregon USA.

## MENTORING

1. Satyajit Mojumder, Graduate Student, Northwestern University. (2021-Present)
2. Sourav Saha, Graduate Student, Northwestern University. (2021-Present)
3. Hengyang Li, Graduate Student, Northwestern University. (2021-Present)
4. Yangfan Li, Graduate Student, Northwestern University. (2021-Present)
5. Turash Haque Pial, Bangladesh University of Engineering and Technology (Current Position: Postdoctoral Scholar, Northwestern University, Evanston, IL). (2016-2019)
6. Rabiul Hasan Kabir, Bangladesh University of Engineering and Technology (Current Position: Lecturer, Sonargaon University). (2016-2019)
7. Moinuddin Shuvo, Bangladesh University of Engineering and Technology (Current Position: Ph.D. Student, Penn State University). (2016-2019)
8. Oishwarya Bhowmik, Bangladesh University of Engineering and Technology (Current Position: Graduate Student, Pennsylvania State University). (2016-2019)
9. Md Shajedul Hoque Thakur, Bangladesh University of Engineering and Technology. (2020)
10. Mahmudul Islam, Bangladesh University of Engineering and Technology. (Current Position: Graduate Student, MIT) (2020)



## REFERENCES

### **Ozan Akkus, Ph.D.**

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Case Western Reserve University  
Phone: 216.368.4175  
email: [oxa@case.edu](mailto:oxa@case.edu)

### **Robert Brown, Ph.D.**

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email: [rwb@case.edu](mailto:rwb@case.edu)

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### **Gregory Wagner, Ph.D.**

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email: [gregory.wagner@northwestern.edu](mailto:gregory.wagner@northwestern.edu)

### **Md Mahbubul Islam, Ph.D.**

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5050 Anthony Wayne Dr. Room 2119  
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### **Zhengtao Gan, Ph.D.**

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Department of Aerospace and Mechanical  
Engineering  
University of Texas El Paso  
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