

# Md AMIMUL Ehsan

Email: ehsanmdamimul@gmail.com

LinkedIn: md-amimul-ehsan

Website: amimulehsan.github.io

Phone: +1 (202) 509-5344



## INTEREST AREAS

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Interdisciplinary smart grid research to address fundamental problems with a goal to understand theories behind complex interactions and dynamics to ensure secure, green and reliable power system operations.

- **Control and optimization of dynamic systems:** model based approach to understand grid dynamics under high DER/IBR penetration.
- **Reliable and secure grid operation under uncertainty:** application of artificial intelligence, IoT sensors and modern (5G and beyond) communication technologies.
- **Modeling, simulation and validation of extreme test cases** in software and hardware-in-the-loop set-up for safety and emergency preparedness.

## SKILLS

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- **Programming Languages:** Python, Matlab, R, C/C++, VHDL, Structured Text (ST)
- **Machine Learning & AI:** Optimization, Data Analysis, Statistical Modeling, Time-Series Prediction
- **Power Systems:** Power Flow, Fault Studies, Stability, Inverter Based Resources– Grid Forming (GFM) and Grid Following (GFL) Modes, Controller Design
- **Modeling & Simulation Tools:** OpenDSS, ETAP, CYME, PSACD, PSS/E, PowerWorld, DigSILENT, Simulink, RT-LAB, RSCAD, SPICE, Vivado, Cadence, TwinCAT 3
- **Hardware Expertise:** OPAL-RT, Speedgoat, RTDS, NHR Grid Emulator & Programmable Load, Battery Energy Storage System (BESS), Hydrogen Energy Storage, SEL Relay Configuration, Impedance Analyzer, Power Quality Meter, Beckhoff PLC, Xilinx FPGA, Raspberry Pi, Arduino, Sensors
- **System Integration:** Communication Protocols and Interfacing (UDP, Modbus), Metrology
- **Soft Skills:** Leadership, Team Player, Diversity & Inclusion, Volunteerism, Authorship, Reviewing

## EDUCATION

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### University of North Carolina at Charlotte

Charlotte, NC

PhD in Electrical Engineering {courses: [https://amimulehsan.github.io/phd\\_courses.html](https://amimulehsan.github.io/phd_courses.html)}

2022–2027

Primary technical thrust group: Power Systems

Secondary technical thrust group: Communication, Control, and Signal Processing

### University of the District of Columbia

Washington, DC

MS in Electrical Engineering {courses}

2018–2019

Concentration: Computer Engineering

### Chittagong University of Engineering and Technology

Chittagong, Bangladesh

BS in Electrical and Electronic Engineering {courses}

2011–2016

## PROFESSIONAL EXPERIENCE

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### Energy Production & Infrastructure Center (EPIC), UNC Charlotte

Charlotte, NC

*Research Assistant (Term-II)*

Aug. 2023–May. 2024

*Research Assistant (Term-I)* Aug. 2022–May. 2023

- **Multi-site hardware in the loop simulation**  
Developed communication interface between power system simulation tools and hardware simulators. I implemented industry standard communication protocols (Modbus, UDP) to run a testbed scalable unto 10,000 DER nodes for observation and control data exchange.
- **Power outage prediction**  
Determined weather parameters for distribution network power outage prediction using machine learning models.
- **DER modeling and integration**  
Studied various modeling concepts and developed simulation models for DER/IBR grid integration. The objective is to study various grid scenarios including system level outages and control IBRs for a stable grid operation.

### Karlsruhe Institute of Technology (KIT)

Karlsruhe, Germany

*Summer Intern*

May. 2023–Aug. 2023

- **System level interfacing and control of distributed energy resources**  
Developed communication framework between controller and various DERs including battery energy storage, hydrogen energy storage, fuel cell, EV charger, programmable load etc. It involved programming Beckhoff PLC to communicate using various industrial protocols— Modbus TCP, Profinet, and CANbus for system level control of a DC microgrid (300–700V).

### National Institute of Standards and Technology (NIST)

Gaithersburg, MD

*Researcher* at Smart Grid Group | Communication Technology Laboratory

Jun. 2019–Aug. 2022

*Intern* at Smart Grid Program | Engineering Laboratory (Jun. 2019–Dec. 2019)

- **Contributed to the following projects**
- **Project: Inverter control and grid integration**  
Conducted study in identifying grid-strength challenges in inverter based resources (IBR) grid integration. Developed Simulink model to study weak grid DER integration scenarios that demonstrates voltage stability issues.
- **Project: DER co-ordination/ HiL validation**  
Supported the team with validation task of control and coordination framework to manage flexible grid resources and legacy control devices in low-voltage distribution grid. Primary contributions include modeling and simulation of various grid tie scenarios for IBR integration.
- **Project: Smart grid testbed modeling**  
Developed simulation capability of NIST smart grid testbed consisting electrical equipment that enable power Hardware in the Loop (pHIL) experiments to investigate the operational impacts of different grid architectures. This toolbox helps NIST researchers to analyze associated risks before running an experiment to the real hardware setup.
- **Project: Wide-band characterization of POI impedance**  
Collected wide band frequency impedance measurements from the NIST NZERTF and modeled in SPICE. The goal of this project is to understand the physics-based characteristics of edge circuits and utilize this information for control and optimization is dealing with high frequency disturbances.
- **Project: Sun-cloud occlusion**  
Annotated locally collected NIST sky image data and applied deep learning to track the occlusion events. The result of this research is then useful for controller input for optimized solar PV operation.

**Lockheed Martin***Research Fellow*

Washington, DC

2018

- Investigated deep supervised and unsupervised learning on the applications of classification and clustering.
- Applied CNN and RNN to classify handwritten digits with state-of-the-art accuracy.

**University of the District of Columbia***Graduate Research Assistant* at School of Engineering and Applied Sciences

Washington, DC

2019

- Conducted research in the focus areas of data analytics, statistical modeling, and machine learning applications.
- Supported grants: NSF #1900462, #2011927, #1505509; DoD #W911NF1810475, #W911NF2010274

**PRAN-RFL Group***Engineer* at Danga Industrial Park

Narsingdhi, Bangladesh

2016

- Led the machine and process development team focused in improved process safety and plant efficiency.
- Awarded best Kaizen team in December 2016 for innovation and development.

**Chittagong University of Engineering and Technology***Research Assistant* at Department of Electrical and Electronic Engineering

Chittagong, Bangladesh

2015

- Conducted research in developing energy neutral home systems for rural communities of Bangladesh.

**Dimik Electronics***Co-founder*

Chittagong, Bangladesh

2011–2015

- Designed and implemented embedded systems and robotics projects as per client requirements. Example projects: electronic voting machine, smart energy meter, low cost PIC micro-controller programmer.

## TEACHING BACKGROUND

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**University of the District of Columbia***Graduate Teaching Assistant* at School of Engineering and Applied Sciences

Washington, DC

2018–2019

- **Assisted professors with conducting lab experiments; graded reports, homework, and performances; and proctored exams. Taught lecture classes when needed. Courses taught:**
- Design of control systems and applications (Spring, Fall 2018,19)
- Signal and systems (Spring 2019)
- Digital integrated circuit design (Fall 2018)
- Digital system design and synthesis (Fall 2018)
- Electrical circuits (Spring, Summer 2018)

**Military Institute of Science and Technology***Lecturer* at Bangladesh Naval Academy

Chittagong, Bangladesh

2017

- **Taught lecture and lab courses listed below:**
- Electrical circuits- I & II (Term I,II 2017)
- Fundamentals of electrical engineering (Term I 2017)
- Electronics (Term II 2017).

## PUBLICATIONS

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Google Scholar link: <https://scholar.google.com/citations?user=HYjYOcAAAAAJ&hl=en>

### Government Documents, Technical Notes, User Guides

1. **M.A. Ehsan**, and D.M. Anand, “NIST smart grid testbed modeling 1.0”, *User Guide*. {available for internal use}
2. D.M. Anand, C. Freiheit, T.H. Chen, **M.A. Ehsan**, and T.C. Linn, “Validation capabilities of the NIST campus power system to evaluate distributed control of grid-edge DERs”, *NIST Technical Note*. {doi: [10.6028/NIST.TN.2173](https://doi.org/10.6028/NIST.TN.2173)}

### Journal Articles

1. **M.A. Ehsan**, “Cybersecurity Challenges in Distributed Control”, *arXiv e-prints*, arXiv-2106, Jun. 2021. {arXiv:2106.13712}
2. **M.A. Ehsan**, A. Shahirinia, N. Zhang, and T. Oladunni, “Investigation of data size variability in wind speed prediction of AI algorithms”, *Cybernetics and Systems*, vol. 52(1), Oct. 2020. {doi: [10.1080/01969722.2020.1827796](https://doi.org/10.1080/01969722.2020.1827796)}
3. C.K. Das, **M.A. Ehsan**, M.A. Kader, and M.J. Alam, “A practical biogas based energy neutral home system for rural communities of Bangladesh”, *Renewable and Sustainable Energy*, vol. 8(2), Mar. 2016. {doi: [10.1063/1.4942783](https://doi.org/10.1063/1.4942783)}

### Conference Proceedings

1. A. Kocher, J. Kovačević, A.C. Süß, C.B. Saner, B. Dindar, **M.A. Ehsan**, H.K. Çakmak, V. Hagenmeyer, “Privacy Protection in Collaborative Geographically Distributed Co-Simulation of Multimodal Energy Systems”, *ACM e-Energy*, Jun. 2024. {doi: [10.1145/3632775.36619](https://doi.org/10.1145/3632775.36619)}
2. S. Srivastava, S. Kharate, E. Shoubaki, **M.A. Ehsan**, R. Cox, B. Chowdhury, “Stability Analysis for a Co-Simulation Testbed Including Real-Time & Quasi Steady-State Simulators”, *IEEE NAPS*, Oct. 2023. {doi: [10.1109/NAPS58826.2023.10318593](https://doi.org/10.1109/NAPS58826.2023.10318593)}
3. **M.A. Ehsan**, W. Guo, D.M. Anand, and A. M. Gopstein, “Characterization of residential circuit impedance”, *IEEE ISGT*, Feb. 2021. {doi: [10.1109/ISGT49243.2021.9372248](https://doi.org/10.1109/ISGT49243.2021.9372248)}
4. N. Zhang, X. Dai, **M.A. Ehsan**, and T. Deksissa, “Development of a drought prediction system based on long short-term memory networks”, *ISNN, Springer LNCS series*, Dec. 2020. {doi: [10.1007/978-3-030-64221-1\\_13](https://doi.org/10.1007/978-3-030-64221-1_13)}
5. **M.A. Ehsan**, A. Shahirinia, J. Gill, and N. Zhang, “Dependent wind speed models: copula approach”, *IEEE EPEC*, Nov. 2020. {doi: [10.1109/EPEC48502.2020.9320024](https://doi.org/10.1109/EPEC48502.2020.9320024)}
6. **M.A. Ehsan**, A. Shahirinia, N. Zhang, and T. Oladunni, “Wind speed prediction and visualization using long short-term memory networks (LSTM)”, *IEEE ICIST*, Sep. 2020. {doi: [10.1109/ICIST49303.2020.9202300](https://doi.org/10.1109/ICIST49303.2020.9202300)}
7. **M.A. Ehsan**, C.K. Das, and M. Hasan, “Biogas based chain business: a road to sustainable rural development”, *IEEE ICDRET*, Jan. 2016. {doi: [10.1109/ICDRET.2016.7421505](https://doi.org/10.1109/ICDRET.2016.7421505)}
8. M.A. Matin, H. Rahman, M.R. Hossain, **M.A. Ehsan**, G.M.I. Hossain, and M.M.I. Mahfuj, “Present scenario and future prospect of renewable energy in Bangladesh”, *ICPSDT*, Aug. 2015. {link}
9. **M.A. Ehsan**, C.K. Das, and M.J. Alam, “Feasibility and safety study of nuclear power in Bangladesh: Perspective to Rooppur Nuclear Power Plant”, *ECERE*, Nov. 2014. {link}

### Thesis

1. “Predictive Models for Wind Speed Using Artificial Intelligence and Copula.”, *Master’s Thesis*, 2019. {link}
2. “Modeling, Analyzing and Simulation of Micro Grid System for CUET Campus.”, *Bachelor’s Thesis*, 2015. {link}

## TRAINING AND CERTIFICATES

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1. Speedgoat Programmable FPGA Jumpstart Workshop, Apr. 2022
2. IEEE Leadership Training, Jul. 2021. {certificate}
3. NIST P 7100: NIST Safe Return to Campus Training for Phase 1, Jun. 2021.{certificate}
4. Power Electronics Control Design with Simulink and Simscape, May. 2021.
5. Modeling Electrical Power Systems with Simscape, May. 2021.
6. OP-205: Power Electronics Real-Time Simulation with eFPGAsim - eHS, Jan. 2021.{certificate}
7. OP-101: Fundamentals of Real-Time Simulation with RT-LAB, Jan. 2021.{certificate}
8. NIST S 7101.21: Personal Protective Equipment Program 2019 Gap Training, Oct. 2019.{certificate}
9. NIST S 7101.56: Control of Hazardous Energy (Lockout/Tagout (LOTO)) - Gap training, Oct. 2019.{certificate}
10. NIST S 7101.64: Safe Electrical Work Practices – Comprehensive Course, Aug. 2019.{certificate}
11. NIST S 7101.20: Work and Worker Authorization Based on Hazard Review, Aug. 2019.{certificate}
12. CLC - Ladder Safety, Aug. 2019.{certificate}
13. NIST S 7101.21: Personal Protective Equipment Program Training, Aug. 2019.{certificate}
14. NIST S 7101.22: Hazard Signage Training - Program Requirements, Aug. 2019.{certificate}
15. NIST S 7101.55: Hearing Protection Program - Initial Training (Web-based), Jun. 2021.{certificate}
16. NIST S 7101.56: Control of Hazardous Energy (Lockout/Tagout (LOTO)), Aug. 2019.{certificate}
17. NIST S 7101.59: Chemical Hazard Communication Program Training, Aug. 2019.{certificate}
18. NIST S 7101.64: Electrical Safety for Laboratory Workers, Aug. 2019.{certificate}
19. NIST P 7100.00: General Safety Training, Aug. 2019.{certificate}

## SELECTED TALKS AND PRESENTATIONS

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- **Controllers for IBR integration to (weak) grid**, *SGCPS Grid Edge Control Journal Club*, Virtual, Mar. 22, 2022.{slide}
- **Cybersecurity of DC microgrid distributed control**, *SGCPS Grid Edge Control Journal Club*, Virtual, Aug. 10, 2021.{slide}
- **Influence of Inverter-based Resources on System Strength**, *SGCPS Grid Edge Control Journal Club*, Virtual, Apr. 06, 2021.{slide}
- **Impact of electric grid strength in inverter-based resources integration**, *UDC-PREP Spring Seminar Series (Invited speaker)*, Virtual, Mar. 26, 2021.{slide}
- **Delay aware wide-area control for power systems**, *SGCPS Grid Edge Control Journal Club*, Virtual, Dec. 26, 2020.{slide}
- **Educational Inequality**, *SGCPS Anti-Racism and Implicit Bias Forum Discussion*, Virtual, Oct. 14, 2020.{slide}
- **Racism & Social Injustice: A Personal Journey**, *SGCPS Anti-Racism and Implicit Bias Forum Discussion*, Virtual, Jun. 30, 2020.{slide}
- **NZERTF Impedance Measurement: Updates**, *NIST SGCPS annual research conference*, Rockville, MD, Feb. 26, 2020.{slide}

- **Impedance Characterization of the Net-Zero Energy Residential Test Facility (NZERTF)**, *STEM at HBCUs*, NIST, Gaithersburg, MD, Feb. 6, 2020. [{poster}](#)
- **Handwritten Digit Recognition Using Deep Learning**, *UDC*, Washington, DC, May. 10, 2019. [{slide}](#)
- **Basics of writing research papers**, *CUET*, Chittagong, Bangladesh, Apr. 4, 2016. [{slide}](#)
- **Global Positioning System**, *CUET*, Chittagong, Bangladesh, Mar. 2, 2015. [{slide}](#)

## REVIEWER

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1. **Applied Energy**. Publisher: *Elsevier*. Link: <https://www.sciencedirect.com/journal/applied-energy>
2. **IEEE Systems Journal**. Publisher: *IEEE*. Link: <https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=4267003>

## SCHOLARSHIPS AND AWARDS

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- Best poster award at IEEE EPEC 2020
- UDC F&T scholarship 2018–2019
- Best paper award at ICPSDT 2015
- First runner up at EEE day tech show 2014
- Dutch-Bangla bank foundation undergraduate scholarship 2011–2015

## PROFESSIONAL ORG. AFFILIATION

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- Member at **International Council on Large Electric Systems (CIGRE)** 2020–Present  
*Attended working group meetings, webinars and technical sessions.*
- Member at **Smart Electric Power Alliance (SEPA)** 2020–Present  
*Attended working group meetings, webinars and technical sessions.*
- Working group member at **North American SynchroPhasor Initiative (NASPI)** 2020–Present  
*Attended annual general meeting, webinars and technical sessions.*
- Member at **Institute of Electrical and Electronic Engineering (IEEE)** 2018–Present  
*Attended conferences, general meeting, webinars and technical sessions.*
- Member at **National Society of Black Engineers (NSBE)**, UDC-SB 2018–2019  
*Attended BEYA conference, participated on-campus events and volunteering activities.*
- Member Secretary at **Robo Mechatronics Association (RMA)** 2014–2015  
*Participated and volunteered in organizing robotic competitions, seminars and workshops.*

## EXTRACURRICULAR, VOLUNTEERING, ETC.

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- Volunteer at **Peak Load Management Alliance (PLMA) Load Management Leadership Conf.** Nov. 2021  
*Assisted organizing the conference and attended various sessions and workshops around virtual power plant and load management.*  
Volunteer at **IEEE PES General Meeting** Jul. 2021 Trained to assist session chairs with getting ready for the session, monitor Q&A and chat during session.
- Science fair Judge at **Stuart Hobson Middle School, Washington, DC** Feb. 2021  
*Judged 8 groups of middle school students on their science fair project. [{judge list}](#)*
- Volunteer at **Global Journey for Children** Summer 2018  
*Presented at the science and cultural enrichment program for the minority children, Mitchellville, MD.*