

Md Zesun Ahmed Mia

Curriculum Vitae

Curiosity drives me to seek new questions and create new knowledge. I believe progress in science comes from collaboration, open-mindedness, and the courage to explore beyond boundaries.

Education

- 08/2022–08/2027 **Ph.D. in Electrical Engineering**, *Pennsylvania State University*, State College, PA, USA, *CGPA: 4.00/4.00*
(Expected) Advisor: Dr. Abhronil Sengupta
- 08/2022–08/2024 **M.S. in Electrical Engineering**, *Pennsylvania State University*, State College, PA, USA, *CGPA: 4.00/4.00*
Thesis: Neuromorphic Computing for Lifelong Learning
- 02/2015–04/2019 **B.Sc. in Electrical and Electronic Engineering**, *Bangladesh University of Engineering & Technology (BUET)*, Dhaka, Bangladesh, *CGPA: 3.81/4.00*

Appointments and Experience

- 05/2025–07/2025 **Graduate Technical Intern**, *Intel Corporation*, Hillsboro, OR
- Designed and executed Design of Experiments (DOE) for exploratory thin film deposition projects, contributing to advanced technology node development.
 - Investigated first-of-its-kind process integration tool for advanced technology node development, evaluating integration feasibility and process window optimization.
 - Conducted comprehensive material characterization using DSIMS, XRR, stress analysis, and TEM image analysis to validate process performance and material properties.
 - Developed predictive analysis framework using AI and machine learning to assess thin film deposition impact on semiconductor process flows and device characteristics.
- 08/2022–Present **Graduate Research Assistant**, *Penn State*, State College, PA
- Developed and applied machine learning models for device-circuit co-optimization, focusing on performance prediction and hardware-aware neural network design.
 - Explored neuroscience-inspired astromorphic algorithms for next-generation ML hardware, integrating astrocyte-like dynamics into neural network models to enhance computational efficiency and biological realism.
- 08/2024–05/2025 **Graduate Teaching Assistant**, *Penn State*, State College, PA
- Taught and supported Cadence Virtuoso, schematic/layout design, and lab courses.
- 02/2021–08/2022 **Lecturer**, *University of Liberal Arts Bangladesh*, Dhaka, Bangladesh
- Taught Digital Circuit Design, Device Physics, Power Electronics.
- 02/2020–02/2021 **Lecturer**, *BUET*, Dhaka, Bangladesh, part-time
- Supervised labs (Digital Circuit Design, Power Electronics).
- 09/2020–07/2021 **R&D Engineer**, *SEM WAVES Ltd.*, London, UK, part-time
- Designed 50 KW solar-hydro hybrid system (Bangladesh).

Teaching Experience

Graduate Teaching Assistant Penn State, 2024-2025. Courses: Cadence Virtuoso, Schematic/Layout Design, Lab Supervision.

Lecturer University of Liberal Arts Bangladesh, 2021–2022. Courses: Digital Circuit Design, Device Physics, Power Electronics.

Lecturer BUET, 2020–2021. Labs: Digital Circuit Design, Power Electronics.

Mentoring Supervised undergraduate research and lab projects in device fabrication and circuit design.

Research Interests

Neuromorphic Computing Brain-inspired hardware, spiking neural networks (SNNs), event-driven sensing/compute, on-chip learning (STDP), crossbar synapses, oscillatory/phase-change/spintronic neurons, temporal coding, algorithm-device co-design, low-power edge intelligence

Machine Learning Hardware DNN/GNN/Transformer accelerators, systolic and dataflow architectures, sparsity- and quantization-aware compute, mixed-signal MACs, compute-in-memory, near-memory compute, memory hierarchies, compilation and mapping, performance/energy modeling

Emerging Devices Spintronics (STT/SOT-MRAM), FeFET/NCFET, RRAM/PCM memristors, 2D materials, analog programmability, endurance and variability

Semiconductor Process Integration Device fabrication, FEOL/BEOL and BEOL-compatible memory, 3D monolithic integration, DTCO (design-technology co-optimization), compact modeling, variability and yield, process-device-circuit co-design

AI for Semiconductor ML for process/device optimization, virtual metrology, yield prediction and defect classification, Bayesian optimization and surrogate modeling, inverse design, reinforcement learning for tool control

Technical Skills

Research Teaching Neuromorphic Computing, ML, Device Physics, Circuits, Process Integration

Teaching Course Design, Lecturing, Mentoring, Lab Supervision

Programming Python, MATLAB, C++, Verilog, Shell

Modern Coding & AI Tools Advanced use of generative AI tools (Cursor, Copilot, VSCode, Cline) for research, teaching, and code development. Skilled in prompt engineering and integrating AI assistants into academic workflows.

Writing Scientific Writing, Grant Proposals, Peer Review

EDA/Simulation Cadence Virtuoso, Spectre, HSPICE, TCAD, COMSOL, MATLAB, Python, ModelSim, Synopsys (Design Compiler, PrimeTime, VCS)

Data Analysis Pandas, NumPy, JMP, Jupyter, Data Visualization, Statistical Analysis

Device/Process Characterization AFM, SEM, Probe Station, Electrical Testing, TEM, reliability testing, parameter extraction

Collaboration Git, Slack, Microsoft Office, Google Workspace

Research Projects

- Astromorphic Transformer** Lead Student Researcher, 2022–2025. Developed a neuromorphic algorithmic framework for transformer models with astrocytic memory, enabling biologically inspired sequence learning. See publication: [IEEE TCDS].
- Spintronic Device-Based Memory** Lead Student Researcher, 2023–Present. Led the fabrication and comprehensive characterization of spintronic memory arrays for machine learning systems, advancing non-volatile memory technologies to enhance computational performance.
- Neuromorphic Cybersecurity** Lead Student Researcher, 2023–2025. Developed neuromorphic approaches for cybersecurity in lifelong learning systems. Accepted at ICONS 2025. See publication: [arXiv], [ICONS 2025].
- RMAAT: Bio-Inspired Sequence Processing** Lead Student Researcher, 2024–Present. Developed RMAAT, a bio-inspired approach for efficient long-context sequence processing in transformers. Manuscript in preparation.
- MIPS Micro-processor Design** Lead Student Researcher, 2018–2019. Designed and implemented a 5-stage pipelined MIPS microprocessor in Verilog, supporting instruction/data memory, forwarding, and hazard detection. Verified functionality through simulation and synthesized for FPGA deployment.
- ECG Rats Processor** Lead Student Researcher, 2023. Developed a custom digital signal processing (DSP) processor, “ECG Rats,” for real-time ECG signal analysis. Implemented core modules for filtering, feature extraction, and arrhythmia detection. Demonstrated on FPGA with live biomedical data.
- IRFD: Electricity Fraud Detection** First Author, 2021. Developed IRFD, a feature engineering-based ensemble classification method for detecting electricity fraud in traditional meters. Demonstrated improved detection accuracy on real-world meter datasets using advanced machine learning. See publication: [IEEE ICCIT 2021].
- DCNN-LSTM Audio Classification** Co-Author, 2022. Developed a DCNN-LSTM based audio classification system combining multiple feature engineering and data augmentation techniques. Achieved robust performance on diverse audio datasets. See publication: [ICO 2021, Springer].
- 2D Monolayer GaN Nanoribbons** First Author, 2024. Investigated the impact of doping and defects on thermal transport of monolayer GaN nanoribbons using molecular dynamics simulation. Provided insights into nanoscale heat management for next-generation electronics. See publication: [ICECE 2024].
- Ultra Low Cost Electronic Braille Device** First Author, 2022-2024. Designed and implemented an ultra low cost, low power, high speed electronic Braille device for visually impaired people. The device improves accessibility and affordability for real-world applications. See publication: [iCACCESS 2024].

Research Grants

NSF Award #2318101: Graduate Researcher, 2023–Present. Supported research on neuromorphic hardware and algorithms for energy-efficient AI as part of an NSF-funded project. See award: [NSF 2318101].
Neuromorphic Computing Hardware

NSF Award #2333881: Graduate Researcher, 2024–Present. Contributed to NSF-funded research on brain-inspired AI and edge computing, focusing on neuromorphic models and hardware. See award: [NSF 2333881].
Brain-Inspired AI for Edge Computing

NSF Award #2028213: Graduate Researcher, 2022. Participated in NSF-funded work on AI hardware and scientific applications, including device-circuit-algorithm co-design. See award: [NSF 2028213].
AI Hardware for Scientific Discovery

Publications

- [1] Md Zesun Ahmed Mia, Malyaban Bal, and Abhronil Sengupta. “Delving deeper into astromorphic transformers”. In: *IEEE Transactions on Cognitive and Developmental Systems* (2025).
- [2] Md Zesun Ahmed Mia et al. “Neuromorphic Cybersecurity with Semi-supervised Lifelong Learning”. In: *arXiv preprint arXiv:2508.04610* (2025).
- [3] Md Zesun Ahmed Mia and Kazi Toukir Ahmed. “Ultra Low Cost, Low Power, High Speed Electronic Braille Device for Visually Impaired People”. In: *2024 International Conference on Advances in Computing, Communication, Electrical, and Smart Systems (iCACCESS)*. IEEE. 2024, pp. 1–6.
- [4] Md Zesun Ahmed Mia, Malyaban Bal, and Abhronil Sengupta. *RMAAT: A Bio-Inspired Approach for Efficient Long-Context Sequence Processing in Transformers*. 2024. URL: <https://openreview.net/forum?id=ikSrEv8FId>.
- [5] Md Zesun Ahmed Mia et al. “Impact of Doping and Defects on Thermal Transport of Monolayer GaN Nanoribbons: A Molecular Dynamics Simulation Study”. In: *2024 13th International Conference on Electrical and Computer Engineering (ICECE)*. IEEE. 2024, pp. 685–690.
- [6] Tao Zhang et al. “Self-sensitizable neuromorphic device based on adaptive hydrogen gradient”. In: *Matter* 7.5 (2024), pp. 1799–1816.
- [7] KM Ashraful Hoque Fahim et al. “Study of 3-nm Cylindrical GAAFETs with Variations in High-k Dielectric Gate-oxide Materials”. In: *2022 IEEE Symposium on Industrial Electronics & Applications (ISIEA)*. IEEE. 2022, pp. 1–5.
- [8] Md Moinul Islam et al. “DCNN-LSTM based audio classification combining multiple feature engineering and data augmentation techniques”. In: *Intelligent Computing & Optimization: Proceedings of the 4th International Conference on Intelligent Computing and Optimization 2021 (ICO2021)* 3. Springer. 2022, pp. 227–236.

- [9] Md Zesun Ahmed Mia et al. "Irfd: A feature engineering based ensemble classification for detecting electricity fraud in traditional meters". In: *2021 24th International Conference on Computer and Information Technology (ICCIT)*. IEEE. 2021, pp. 1–6.

Recognitions

- The Wormley Family Graduate Fellowship, Harry G. Miller Fellowships in Engineering (2025)
- Arthur Waynick Graduate Scholarship (2024)
- Milton and Albertha Langdon Memorial Fellowship (2023)
- Melvin P. Bloom Memorial Fellowship (2022)

Professional Affiliations

- Reviewer, Design Automation Conference (DAC) 2025, IEEE MWSCAS 2025, IACCESS 2024
- Student Member, IEEE (2015-Present)
- Executive Member, EDS, IEEE Bangladesh Section (2021-2022)

Outreach and Leadership

- | | |
|---------------------------------|--|
| Academic Service | Served as a lecturer at University of Liberal Arts Bangladesh (ULAB), teaching undergraduate courses and developing lab modules in electronics and device physics. |
| Research Leadership | Led and supervised student projects on semiconductor devices, circuits, and neuromorphic computing as a graduate research assistant and lecturer. |
| Interdisciplinary Collaboration | Collaborated with cross-functional teams in academia and industry on projects spanning AI, machine learning, and semiconductor process/device optimization. |
| Mentoring | Provided guidance and mentorship to undergraduate students, supporting their research initiatives and professional development. |

References

- Dr. Abhronil Sengupta Associate Professor, Penn State University, Email: sengupta@psu.edu
- Dr. Samia Subrina Professor, BUET, Email: samiasubrina@eee.buet.ac.bd