Chowdhury Mohammad Abid Rahman

Email: cr00071@mix.wvu.edu
Scholar: CMA Rahman

Education

West Virginia University — Morgantown, WV
PhD in Electrical Engineering, GPA: 4.00/4.00 (up to Fall 2025) — Fall, 2023–
- Supervisor: Dr. Prashnna K. Gyawali, Assistant Professor, LCSEE

Military Institute of Science and Technology, (MIST) — Dhaka, Bangladesh
M.Sc. in Electrical, Electronic and Communication Engineering, GPA: 3.58/4.00 — 2014–2020
- Thesis: "Automatic ROI Selection for Multi-modal Medical Images"
- Supervisor: Dr. Hussain Md. Abu Nyeem, Assoc Professor,MIST

Rajshahi University of Engineering & Technology,(RUET) — Rajshahi,Bangladesh
B.Sc. in Electrical and Electronic Engineering, GPA: 3.63/4.00,76.6% Marks — 2009–2013
- Thesis: "Design of A Near Zero Ultra-flattened Chromatic Dispersion Holey-Fiber for Tele-communication Application"
- Supervisor: Dr. S M Abdur Razzak, Professor, RUET

Test Scores

- **IELTS:** Test taken on 4 September 2021

Reading	Writing	Speaking	Listening	Overall
8.0	7.0	7.0	8.0	7.5

- **GRE:** Test taken on January 2023: Verbal-152, Quant- 157, AWA- 3.5

Research Interests

- Image Processing
- AI for Material Science
- Computer Vision
- Renewable Energy
- Optimization
- Smart Grid

Experience

West Virginia University — Morgantown, WV, USA
PhD Student/ Graduate Research Assistant — August 2023 - till
- Lane Dept of Computer Science and Electrical Engineering

Military Institute of Science and Technology — Dhaka, Bangladesh
Major/Instructor Class B/ Assistant Professor — November 2020- March 2023
- Electrical, Electronic and Communication Engineering Dept

Military Institute of Science and Technology — Dhaka
Captain/Instructor Class C/Lecturer — January-November 2020
- Electrical, Electronic and Communication Engineering Dept

Bangladesh Military Academy Chittagong
Captain/Instructor Class C/Lecturer January 2017 – December 2019

– Electrical, Electronic and Communication Engineering Dept

Military Institute of Science and Technology Dhaka
Captain/Instructor Class C/Lecturer July 2014 – January 2017

– Aeronautical Engineering Dept

Publications

[1] C. M. A. Rahman, N. B. Alam, A. S. El-Wakeel, J. Ryu, and P. Gyawali, "Multi-task learning for material property prediction", in *2024 International Conference on Machine Learning and Applications (ICMLA)*, IEEE, 2024, pp. 1065–1070.

[2] C. M. A. Rahman, G. Bhandari, N. M. Nasrabadi, A. H. Romero, and P. K. Gyawali, "Enhancing material property prediction with ensemble deep graph convolutional networks", *Frontiers in Materials*, vol. 11, p. 1 474 609, 2024.

[3] F. Shivam, M. Leight, M. K. Kelly, C. Davis, K. Clodfelter, J. Thrasher, C. M. A. Rahman, Y. Reddy, and P. K. Gyawali, "Segmentation of maya hieroglyphs through fine-tuned foundation models", in *2024 International Conference on Machine Learning and Applications (ICMLA)*, IEEE, 2024, pp. 540–545.

[4] R. Chataut, Y. Usman, C. M. A. Rahman, S. Gyawali, and P. K. Gyawali, "Enhancing phishing detection with ai: A novel dataset and comprehensive analysis using machine learning and large language models", in *2024 IEEE 15th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)*, IEEE, 2024, pp. 0226–0232.

[5] S. P. Shyam, R. K. Bhuiyan, S. S. Mim, and C. Rahman, "An advanced cascaded unet architecture with dual attention for bio-medical image segmentation", in *2024 IEEE International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE)*, IEEE, 2024, pp. 001–006.

[6] M. S. R. Chowdhury, P. K. Partho, C. M. A. Rahman, S. P. Shyam, S. S. Mim, and R. K. Bhuiyan, "Enhancing coronary disease prediction using stacking and voting-based ensemble machine learning models", in *2024 27th International Conference on Computer and Information Technology (ICCIT)*, IEEE, 2024, pp. 1–6.

[7] C. M. A. Rahman and H. Nyeem, "Tensor-enhanced shock energy-driven active contours: A novel approach for knowledge-based image segmentation", *Journal of Visual Communication and Image Representation*, vol. 103, p. 104 218, 2024.

[8] S. P. Shyam, C. M. A. Rahman, P. K. Partho, and R. K. Bhuiyan, "Non-linear statistical filter fusions for optimal intensity fitting in active contour-based image segmentation", in *2024 6th International Conference on Electrical Engineering and Information & Communication Technology (ICEEICT)*, IEEE, 2024, pp. 190–195.

[9] K. Raja, A. Rashid, C. Rahman, D. Chanda, and N. Ahmad, "Automated quality inspection: An embedded machine vision system for process optimization", in *2024 3rd International Conference on Advancement in Electrical and Electronic Engineering (ICAEEE)*, IEEE, 2024, pp. 1–6.

[10] S. S. Mim, S. P. Shyam, C. M. A. Rahman, S. Akter, J. Fardous, and M. A. Samad, "A gaussian-extremum image pre-fitted active contour for accurate and faster image segmentation", in *2024 6th International Conference on Electrical Engineering and Information & Communication Technology (ICEEICT)*, IEEE, 2024, pp. 687–692.

[11] C. M. A. Rahman, R. K. Bhuiyan, S. P. Shyam, R. Subnom, and A. B. Rashid, "Attention enabled multiresunet for bio-medical image segmentation", in *2024 6th International Conference on Electrical Engineering and Information & Communication Technology (ICEEICT)*, IEEE, 2024, pp. 622–627.

[12] C. M. A. Rahman and S. P. Shyam, "Noise optimized order-statistic energy pre-fitted active contour for accurate image segmentation", in *33rd International Conference on Computer Theory and Applications (ICCTA 2023)*, IEEE, 2023, pp. 1–6.

[13] S. P. Shyam, C. M. A. Rahman, R. K. Bhuiyan, and P. K. Partho, "Edge and region synergy driven active contour models for natural image segmentation", in *2023 IEEE 5th International Conference on Sustainable Technologies for Industry 5.0 (STI 2023)*, IEEE, 2023, pp. 1–6.

[14] M. Prantikuzzaman, C. M. A. Rahman, and M. M. Islam, "Local dispersion optimized log and image fitting for intensity inhomogeneous image segmentation", in *2022 25th International Conference on Computer and Information Technology (ICCIT)*, IEEE, 2022, pp. 605–610.

[15] S. P. Shyam, C. M. A. Rahman, and H. Rashid, "A faithful dog is all you need", in *2022 25th International Conference on Computer and Information Technology (ICCIT)*, IEEE, 2022, pp. 751–756.

[16] C. M. A. Rahman and H. Nyeem, "Relative entropy pre-fitting model for noisy and intensity inhomogeneous image segmentation", in *2019 IEEE International Conference on Telecommunications and Photonics (ICTP)*, IEEE, 2019, pp. 1–4.

[17] C. M. A. Rahman and H. Nyeem, "A new weighted relative entropy pre-fitting for active contour based image segmentation", in *2019 IEEE International Conference on Signal Processing, Information, Communication & Systems (SPICSCON)*, IEEE, 2019, pp. 86–89.

[18] C. M. A. Rahman and H. Nyeem, "Active contour based segmentation of rois in medical images", in *2019 International Conference on Electrical, Computer and Communication Engineering (ECCE)*, IEEE, 2019, pp. 1–6.

[19] C. M. A. Rahman and H. Nyeem, "Developing poly-mask for automatic roi selection of medical images", in *2017 2nd International Conference on Electrical & Electronic Engineering (ICEEE)*, IEEE, 2017, pp. 1–4.

[20] K. S. Kabir, C. M. A. Rahman, A. Farayez, and M. Ferdous, "An experimental model of an indigenous bci based system to help disabled people to communicate", in *AIP Conference Proceedings*, AIP Publishing LLC, vol. 1919, 2017, p. 020 003.

[21] C. M. A. Rahman and H. Nyeem, "Roni segmentation for medical image watermarking", in *2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT)*, IEEE, 2016, pp. 1–6.

[22] C. M. A. Rahman, M. A. Wahed, and T. Sarkar, "Design of near zero ultra flattened chromatic dispersion holey fiber for tele communication application", in *2015 International Conference on Electrical Engineering and Information Communication Technology (ICEEICT)*, IEEE, 2015, pp. 1–4.

Skills

- **Programming Language:** Matlab, Python, C
- **Simulation:** COMSOL, ORCAD, Proteus
- **Microsoft office:** Word, Excel, Power Point
- **Formatting:** Latex

Languages

- **English:** Advanced
- **Bangla:** Advanced
- **Arabic:** Elementary

Research and Projects

- Supervised Pretraining for Material Property Prediction (Under review)
  Summary: Accurate prediction of material properties facilitates the discovery of novel materials with tailored functionalities. Deep learning models have recently shown superior accuracy and flexibility in capturing structure-property relationships. However, these models often rely on supervised learning, which requires large, well-annotated datasets—an expensive and time-consuming process. Self-supervised learning (SSL) offers a promising alternative by pretraining on large, unlabeled datasets to develop foundation models that can be fine-tuned for material property prediction. In this work, we propose supervised pretraining, where available class information serves as surrogate labels to guide learning, even when downstream tasks involve unrelated material properties. We evaluate this strategy on two state-of-the-art SSL models and introduce a novel framework for supervised pretraining. To further enhance representation learning, we propose a graph-based augmentation technique that injects noise to improve robustness without structurally deforming material graphs. The resulting foundation models are fine-tuned for six challenging material property predictions, achieving significant performance gains over baselines, ranging from 2 % to 6.67 % improvement in mean absolute error (MAE)—and establishing a new benchmark in material property prediction. This study represents the first exploration of supervised pertaining with surrogate labels in material property prediction, advancing methodology and application in the field.

- Multi-task Learning for Material Property Prediction (ICMLA-2024)
  Summary: Material property prediction is a critical task within material science and other related fields where the identification of advanced materials with dynamic characteristics is essential for developing innovative technologies, improving product performance, and driving scientific discoveries. The search for suitable candidate materials aimed at specific applications is traditionally conducted through time-consuming experimental methods. Conversely, computational approaches, such as density functional theory (DFT) calculations, necessitate the resolution of complex mathematical equations and significant computational resources. Machine learning (ML) models have significantly transformed this field by automating the tedious process of material searching within extensive search spaces. However, these models are unable to incorporate diverse features of varying dimensions for different materials and properties. Recently, graph convolutional neural networks (GCNNs), have been employed to analyze the complex structures of materials, thereby efficiently predicting their associated properties. In this work, we demonstrate the potential of multi-task learning (MTL) in conjunction with the GCNNs in material property prediction. Our findings suggest that the MTL framework integrated into the GCNN architecture such as Crystal Graph Convolutional Neural Network (CGCNN) and its advanced variant Orbital Graph Convolutional Neural Network (OGCNN) can enhance the generalization and efficiency of property predictions. Notably, we achieved a maximum improvement of 7.95% in one of our setups, underscoring the potential of these models to handle multiple property predictions with considerable effectiveness.
- Enhancing Material Property Prediction with Ensemble Deep Graph Convolutional Networks (Frontiers in Materials-2024)
  Summary: Machine learning (ML) models have emerged as powerful tools for accelerating materials discovery and design by enabling accurate predictions of properties from compositional and structural data. These capabilities are vital for developing advanced technologies across fields such as energy, electronics, and biomedicine, potentially reducing the time and resources needed for new material exploration and promoting rapid innovation cycles. Recent efforts have focused on employing advanced ML algorithms, including deep learning (DL), for property prediction. Additionally, ensemble models have proven to enhance the generalizability and robustness of ML and DL. However, the use of such ensemble strategies in deep graph networks for material property prediction remains underexplored. Our research provides a pioneering evaluation of ensemble strategies in graph neural network-based models, specifically targeting material property prediction tasks. By testing the Crystal Graph Convolutional Neural Network (CGCNN) and its multitask version, MT-CGCNN, we demonstrated that ensemble techniques, especially prediction averaging, substantially improve precision beyond traditional metrics for key properties like formation energy per atom (ΔE^f), band gap (E_g) and density (ρ) in 33,990 stable inorganic materials. These findings support the broader application of ensemble methods to enhance predictive accuracy in the field.
- Local Gradient Optimized Second order Edge-based Active Contour Model for Intensity In-homogeneous and Noisy Image Segmentation. (Undergrad student project, 2022, presented in 25^{th} ICCIT)
  Summary: This work reports an effective fusion of optimized Difference of Gaussian (DoG) edge estimation, with the region scalable fitting (RSF) model to capitalize on their attributes. A locally computed edge entropy image is also used as a weight to the energy functional to infuse local edge information in the energy functional. With the integration of relevant edge and region-based feature descriptors, the proposed model thereby, outperforms the established ACMs in terms of iteration time, noise tolerance, initial contour convergence, inhomogeneity suppression and segmentation accuracy.
- Local Dispersion Optimized Second order Edge-based Active Contour Model for Intensity In-homogeneous and Noisy Image Segmentation. (Undergrad student project, 2022, presented in 25^{th} ICCIT)
  Summary: This work reveals a new technique to optimize Laplacian of Gaussian (LoG), the popular second order edge detector by local dispersion based edge estimation. The local dispersion computed image assists optimization process to smooth the region without object boundary and simultaneously enhances the boundaries. The optimized LoG is added with the local image fitting (LIF) energy functional inside a variational framework with suitable scaling parameters. Thus an efficient fusion of region based energy and optimized edge energy performs with greater efficiency in terms of segmentation accuracy, noise tolerance, initial contour placement, iteration time and complex background suppression.

- Design of An HF Antenna for Existing Radio Sets of BD Military. (Undergrad student project, 2020)

- Automatic Intelligent Scoring System of Shooting Targets Using Image Processing (Undergrad student project, 2020)

- Automatic ROI Selection for Multi-modal Medical Images (MS Thesis)
  Summary: The Region of Interests (ROIs) in Medical Images (MIs) contain a specialized form of clinical and biological data necessary for medical procedures and practices. Their detection with higher accuracy and representation with more efficiency have become two critical requirements of many region-based MI processing. The development of an efficient and automatic ROI selection method has, therefore, been investigated in this thesis to attain two major requirements: (i) faster and accurate ROI segmentation and (ii) efficient representation of the segmented ROI. An Active Contour Model (ACM) based segmentation scheme is developed to effectively tackle intensity inhomogeneities and different shapes, sizes and locations of ROIs, and thereby, to automatically segment the ROIs with higher accuracy. For the efficient representation of the segmented ROIs, the segmented region is defined by its original shape with reduced information by an effective polygonal decimation process. The utilization of the proposed RoI selection method would be promising for the region-based MI processing and its security protection applications.
- Design of A Near Zero Ultra-flattened Chromatic Dispersion Holey-Fiber for Tele-communication Application (BS Thesis)
  Summary: This work presents dispersion flattened holey optical fiber (DF-HF) for tailoring nearly zero ultra flattened dispersion of $0.65ps/nm/km$ and low confinement losses of the order less than 10^{-5} dB/km for 1.25-1.60 μm (350 nm bandwith) wavelength range. The finite-element method with perfectly matched layers (PML) boundary condition is used to investigate the guiding properties. It has been shown theoretically that it is possible to obtain nearly zero ultraflattened dispersion of $0.65ps/nm/km$ in a wavelength range of 1.25 to 1.60 μm with low confinement losses of the order less than 10^{-5} dB/km within the entire band of interest from a five-ring HF.

Scholarships and Awards

- **IEEE Bangladesh section Best paper award** for "A Gaussian-Extremum Image Pre-fitted Active Contour for Accurate and Faster Image Segmentation" in 2024 6th International Conference on Electrical Engineering and Information & Communication Technology (ICEEICT) 02-04 May 2024, Military Institute of Science and Technology (MIST), Dhaka-1216, Bangladesh 2024
- **Best paper award** for "A New Weighted Relative Entropy Pre-fitting for Active Contour Based Image Segmentation" in SPICSCON 2019 with Lt Col Hussain Md Abu Nyeem,PhD,EME. 2019
- Champion, inter-department Electronics Project Competition organized by IEEE RUET Student Branch for 'Design of Automatic Water Supply and Monitoring System of a House with LCD Display' December 2011
- Government Scholarship for Higher Secondary School Certificate Exam 2008
- Government Scholarship for Secondary School Certificate Exam 2006

Extracurricular & Professional Activities

- Student Coordinator IEEE RUET Student Branch 2011–2012
- Member of The Institution of Engineers Bangladesh (IEB) 2017–Current
- Member of $IEEE$ 2014–Current
- Organizing Joint Secretary of Intl Conference on Electrical Engineering and Information & Communication Technology $ICEEICT-2021$ July 2021–November, 2021
- Organizing Member of Intl Conference on Tele-communication and Photonics $ICTP-2021$ July 2021–December, 2021
- Editorial Member of General Science and Technology Pamphlet (GSTP) $BangladeshArmy$ January 2021–December, 2021
- Member of Committee for technical evaluation and validation of locally manufactured ventilators, Director General of Drug Administration ($DGDA$), Bangladesh April 2020–December, 2020