Md Abdur Rahaman

PH.D. CANDIDATE · SCHOOL OF COMPUTATIONAL SCIENCE AND ENGINEERING

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Research Interests

My research interests lie in the intersection of artificial intelligence (AI), computational neuroscience, and Health AI. I study AI challenges for designing computational models to learn insights from intensively voluminous, sparse, and high-dimensional data. I am passionate about human-centric AI, aiming to solve real-world problems with plausible clinical impacts.

Education

Georgia Institute of Technology — *Atlanta, Georgia, US*
PH.D. COMPUTATIONAL SCIENCE AND ENGINEERING — *Expected Fall 2024*
Advisor: Dr. Vince D. Calhoun
Thesis: Granular Factoring into Neuroimaging Dynamics across Space, Time, and Modality

University of New Mexico — *Albuquerque, New Mexico, US*
MS IN COMPUTER SCIENCE — *2016 - 2019*
Major: Computer Science

Chittagong University of Engineering & Technology — *Chittagong, Bangladesh*
B.SC. IN COMPUTER SCIENCE AND ENGINEERING — *2007 - 2013*
- Thesis: Computational Prediction of Toxic Protein.
- Advisor: Dr. Ibrahim Khan

Awards & Fellowships

2024 **Next Generation Scholar Award,** IEEE Engineering in Medicine & Biology Society.
2024 **Career Development Award,** Graduate School, Georgia Institute of Technology.
2024 **Student Travel Grant for Attending CVPR,** College of Science, Georgia Institute of Technology.
2024 **Student Travel Grant for Attending EMBC,** College of Engineering, Georgia Institute of Technology.
2017 **Graduate Education Travel Grant,** Bangladesh-Sweden Travel Trust Fund for Higher Education.
2008-2012 **Dean's List Merit Scholarship,** Dean of Engineering Faculty, Chittagong University of Engineering & Technology.
2007-2013 **Technical Board Scholarship,** the Government of Bangladesh.
2005-2007 **Educational Board Scholarship,** The Government of Bangladesh for Academic Excellence.

Publications

JOURNALS - 7

[J1] **Md Abdur Rahaman**, Jessica A Turner, Cota Navin Gupta, Srinivas Rachakonda, Jiayu Chen, Jingyu Liu, Theo GM Van Erp, Steven Potkin, Judith Ford, and Daniel Mathalon. 2019. "N-BiC: A method for multi-component and symptom bi-clustering of structural MRI data: Application to schizophrenia", IEEE Transactions on Biomedical Engineering, Volume 67, Issue 1, pp. 110-121, 2020.

[J2] **Md Abdur Rahaman**, Jiayu Chen, Zening Fu, Noah Lewis, Armin Iraji, Theo GM van Erp, and Vince D Calhoun, "Deep multimodal predictome for studying mental disorders." Human brain mapping Volume 44, Issue 2 pp: 509-522, 2023.

[J3] **Md Abdur Rahaman**, Eswar Damaraju, Debbrata K Saha, Sergey M Plis, and Vince D Calhoun, "Statelets: Capturing recurrent transient variations in dynamic functional network connectivity", Human Brain Mapping, Volume 43, pp: 2503-18, 2022.

[J4] Du, Yuhui, Zening Fu, Jing Sui, Shuang Gao, Ying Xing, Dongdong Lin, Mustafa Salman, Anees Abrol, **Md Abdur Rahaman**, and Jiayu Chen. "NeuroMark: An automated and adaptive ICA based pipeline to identify reproducible fMRI markers of brain disorders", NeuroImage: Clinical, Volume 28: 102375, 2020.

[J5] **Md Abdur Rahaman**, Eswar Damaraju, Jessica A Turner, Theo GM van Erp, Daniel Mathalon, Jatin Vaidya, Bryon Muller, Godfrey Pearlson, and Vince D Calhoun. "Tri-clustering dynamic functional network connectivity identifies significant

schizophrenia effects across multiple states in distinct subgroups of individuals", Brain Connectivity, Volume 12 pp: 61-73, 2022.

[J6] Rootes-Murdy, Kelly, Jesse T Edmond, Wenhao Jiang, **Md Abdur Rahaman**, Jiayu Chen, Nora I Perrone-Bizzozero, Vince D Calhoun, Theo GM Van Erp, Stefan Ehrlich, and Ingrid Agartz. "Clinical and cortical similarities identified between bipolar disorder I and schizophrenia: A multivariate approach", Frontiers in Human Neuroscience, Volume 16: 755, 2022.

[J7] Saha, Rekha., Saha, D. K., **Md Abdur Rahaman**, Fu, Zening, Liu, Jing., and Calhoun, V. D. "A method to estimate longitudinal change patterns in functional network connectivity of the developing brain relevant to psychiatric problems, cognition, and age". Brain Connectivity, Volume 14, Issue 2, pp:130-140, 2024.

Conferences - 11

[C1] **Md Abdur Rahaman**, Zening Fu, Armin Iraji and V. D. Calhoun, "A Deep Biclustering Framework for Brain Network Analysis". In Workshop Proceedings of Computer Vision and Pattern Recognition (CVPR): Domain adaptation, Explainability, Fairness in AI for Medical Image Analysis, 2024.

[C2] **Md Abdur Rahaman**, Yash Garg, Armin Iraj, Zening Fu, Jiayu Chen, and Vince Calhoun, "Two-Dimensional Attentive Fusion for Multi-Modal Learning of Neuroimaging and Genomics Data." In Proceedings of IEEE 32nd International Workshop on Machine Learning for Signal Processing (MLSP), 2022.

[C3] Baker, Bradley Thomas, Noah Lewis, Debratta Saha, **Md Abdur Rahaman**, Sergey Plis, and Vince Calhoun, "Information Bottleneck for Multi-Task LSTMs." In Workshop Proceedings of Conference on Neural Information Processing Systems (NeurIPS): Information-Theoretic Principles in Cognitive Systems, 2022

[C4] **Md Abdur Rahaman**, Fu, Z., Iraji, A., & Calhoun, V, "SpaDE: Semantic Locality Preserving Biclustering for Neuroimaging Data" In the Proceedings of 46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2024.

[C5] **Md Abdur Rahaman**, E. Damaraju, D. K. Saha, V. D. Calhoun and S. M. Plis, "Statelets: A Novel Multi-Dimensional State-Shape Representation Of Brain Functional Connectivity Dynamics" In Proceedings of IEEE 18th International Symposium on Biomedical Imaging (ISBI), 2021.

[C6] **Md Abdur Rahaman**, Amanda Rodrigue, David Glahn, Jessica Turner, and Vince Calhoun, "Shared sets of correlated polygenic risk scores and voxel-wise grey matter across multiple traits identified via bi-clustering." In Proceedings of 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2021

[C7] **Md Abdur Rahaman**, J. Chen, Z. Fu, N. Lewis, A. Iraji, and V. D. Calhoun, "Multi-modal deep learning of functional and structural neuroimaging and genomic data to predict mental illness." In 43rd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2021

[C8] Dolci, G., **Md Abdur Rahaman**, Galazzo, I. B., Cruciani, F., Abrol, A., Chen, J., ... & Calhoun, V. D. (2023, June). "Deep Generative Transfer Learning Predicts Conversion To Alzheimer's Disease From Neuroimaging Genomics Data". In Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing Workshops (ICASSPW), 2023

[C9] Saha, Rekha, Debbrata K Saha, **Md Abdur Rahaman**, Zening Fu, and Vince D Calhoun, "Longitudinal Whole-Brain Functional Network Change Patterns Over A Two-Year Period In The ABCD Data." In Proceedings of IEEE 19th International Symposium on Biomedical Imaging (ISBI), 2022.

[C10] Dolci, Giorgio, **Md Abdur Rahaman**, Jiayu Chen, Kuaikuai Duan, Zening Fu, Anees Abrol, Gloria Menegaz, and Vince D Calhoun, "A deep generative multimodal imaging genomics framework for Alzheimer's disease prediction." In Proceedings of IEEE 22nd International Conference on Bioinformatics and Bioengineering (BIBE),2022.

[C11] **Md Abdur Rahaman**, and Md Ibrahim Khan, "Computational prediction of toxic protein." In the Proceedings of the 9th International Forum on Strategic Technology (IFOST), 2014.

Presentations

Poster & Demo Presentations

[D1] **Md Abdur Rahaman**, Zening Fu, Armin Iraji, Vince D. Calhoun. "Deep Biclustering for Granular Subgrouping of Neuroimaging Data". IEEE International Symposium on Biomedical Imaging (ISBI), Cartagena, Columbia, 2023

[D2] **Md Abdur Rahaman**, Zenning Fu, Armin Iraji, Vince D. Calhoun. "Deep Sparse Autoencoder based Biclustering for Neuroimaging Data". The Organization for Human Brain Mapping (OHBM), Montreal, Canada, 2023

[D3] **Md Abdur Rahaman**, KuaiKuai Duan, Zening Fu, Rogers F. Silva, Vince D. Calhoun. "DICA: a joint approach to estimate functional links at variable spatial scales across the brain". The Organization for Human Brain Mapping (OHBM), Glasgow, Scotland, 2022

[D4] Saha, R, D Sara, **Md Abdur Rahaman**, and Z Fu. 2022. "Whole brain functional patterns of change in adolescents", The Organization for Human Brain Mapping (OHBM), Glasgow, Scotland, 2022.

[D5] **Md Abdur Rahaman**, Eswar Damaraju, Debbrata Kumar Saha, Vince D Calhoun, and Sergey M Plis. "Statelets: A novel approach to capture transient evolution of dynamic states". The Organization for Human Brain Mapping (OHBM), 2020.

[D6] Du, Yuhui, Zening Fu, Dongdong Lin, Mustafa Salman, **Md Abdur Rahaman**, Anees Abrol, Jing Sui, Shuang Gao, Elizabeth A Osuch, and Vince D Calhoun, "A unified ICA framework for identifying neuro-markers in functional connectivity among multiple different brain disorders." 28th Annual Meeting of International Society for Magnetic Resonance in Medicine, Montreal, QC, Canada, 2019.

[D7] Yuhui Du, Zening Fu, Dongdong Lin, Godfrey Pearlson, Peter Kochunov, Mustafa Salman, **Md Abdur Rahaman**, Anees Abrol, Vince Calhoun, "Do Schizophrenia and Autism Spectrum Disorder Share the Same Root?" A Neuroimage Evidence. 25TH ANNUAL MEETING OF THE ORGANIZATION FOR HUMAN BRAIN MAPPING, Roma, Italy, 2019

[D8] **Md Abdur Rahaman**, Eswar Damaraju, Vince Calhoun. "Tri-clustering of dynamic functional connectivity", 25TH ANNUAL MEETING OF THE ORGANIZATION FOR HUMAN BRAIN MAPPING, Roma, Italy, 2019

[D9] Yuhui Du, Zening Fu, Dongdong Lin, Mustafa Salman, **Md Abdur Rahaman**, Anees Abrol, Vince D. Calhoun, "Shared and specific changes in functional networks in schizophrenia and autism spectrum disorder". The 24th Annual Meeting of the Organization for Human Brain Mapping, Singapore, 2018.

[D10] Dongdong Lin, Yuhui Du, Zening Fu, Mustafa Salman, **Md Abdur Rahaman**, Anees Abrol, Jiayu Chen, Jing Sui, Vince Calhoun, "Cross-cohort study of resting fMRI biomarkers for schizophrenia", 24TH ANNUAL MEETING OF THE ORGANIZATION FOR HUMAN BRAIN MAPPING, Singapore, 2018

Invited Talks

[T1] **Md Abdur Rahaman**, "Multi-modal Imaging-genetics Fusion for Studying Mental Disorder", National Science Foundation (NSF) Center for Dynamic Multiscale and Multimodal Brain Mapping across the Lifespan (D-MAP), Georgia State University, 2023.

[T2] **Md Abdur Rahaman**, "Deep Modules for Integrating Multiple Biological Modalities", IEEE 32nd International Workshop on Machine Learning for Signal Processing (MLSP), 2022.

[T3] **Md Abdur Rahaman**, E. Damaraju, D. K. Saha, V. D. Calhoun and S. M. Plis, "Statelets: A Novel Multi-Dimensional State-Shape Representation Of Brain Functional Connectivity Dynamics" IEEE 18th International Symposium on Biomedical Imaging (ISBI), 2021.

[T4] **Md Abdur Rahaman**, "Data-driven Methods in Exploratory Research", Spring Research Symposium, Sandia National Laboratories, 2019.

[T5] **Md Abdur Rahaman**, "Multi-variate Biological Time Series Analysis- a Data Mining Perspective", Computer Science Student Conference, University of New Mexico, 2018.

Academic and Research Appointments

Joint Georgia Tech, Georgia State, & Emory University Center for Translational Research in Neuroimaging & Data Science (2019-Present)

Graduate Research Associate, My doctoral research with Professor Vince Calhoun focused on developing computational models for knowledge discovery from extensive datasets. I designed (AI/ML/statistical) frameworks for analyzing a wide spectrum of data including, biological, experimental, neuroimaging, and health informatics. I worked on robust algorithms for granular factoring into big data dynamics - bi-clustering/tri-clustering. These studies are tailored to understand biomedical data to help study psychiatric diseases like schizophrenia, Autism, Alzheimer's, etc. These models can perform a variety of tasks like disease classification, progression, subtyping, personalized treatment planning, and drug discovery. I've actively collaborated/mentored with researchers from diverse fields of study e.g., statistics, computational science, neuroscience, and clinical psychiatry.

The Mind Research Network, University of New Mexico (2017-2019)	**Graduate Research Assistant,** My research work in this role started with exploring neuroimaging basics, data acquisition, and preprocessing. I studied robust parcellation methods like Group Independent Component Analysis (G-ICA) for high-dimensional and sparse brain imaging data (4D) to extra meaningful sources. Moreover, I've worked on data mining models for multivariate time series - motif detection and summarization. Also, I designed exhaustive search-based solutions for biclustering and tri-clustering algorithms.
International Islamic University of Chittagong (IIUC) (2014 - 2016)	**Research Advisor,** I led a Bioinformatics research group while serving as a lecturer at IIUC. I advised several undergraduate students for their final year thesis. In these studies, we worked on computational informatics problems including protein toxicity prediction using deep neural networks, detecting malignant lesions from mammography using CNN, characterizing protein folding regions, 3D visualization of molecular structures, etc.
International Islamic University of Chittagong (IIUC) (2013 - 2016)	**Lecturer,** I've worked as a lecturer in the Electrical and Electronics Engineering Department. • Instructed undergraduate classes for C, C++ Programming, Object-oriented Design, Data Structures and Algorithms, and Numerical Analysis. • I lectured on the programming lab manuals and conducted exams for undergraduate semesters. • I trained programming teams for problem solving and assisted them attending National Collegiate Programming Contest (NCPC) • I worked as an Academic Advisor of a sophomore section (25 students) and mentored them for course selection, advising for prerequisites, and academic load distribution. • Undergraduate thesis advisor in Spring/Fall 2014, 2015, Spring 2016
Chittagong University of Engineering & Technology (2011-2013)	**Undergraduate Researcher,** During my undergraduate research with Professor Ibrahim Khan, I designed a statistical module to analyze protein data from amino acid sequences. I used the public NCBI protein database to run an exploratory analysis of the data to perform feature engineering. We extensively studied the protein's characteristics and empirically validated 7 features informative about the toxicity. Our model can predict toxicity scores for any unseen protein sequence from a sole amino acid chain with comprehensive reports on its properties. During my undergraduate study, I also led several research projects on databases, operating systems, and image processing.

Industrial Experience

NOKIA BELL LABS (Sep 2021 - Dec 2021)	**Data Science Research Intern,** Project Title: Automatic Routing of IT Tickets to the Service Team • I built a summarizer for machine logs to compress log files with billions of lines. • Designed a multi-modal LLM-log model to identify errors using customer reports and machine logs. • Instantiated BERT model for learning ticket descriptions and deep neural network for summary logs. • The deployed model achieved 9.7 % improvement over human performance routing the tickets.

Teaching Experience

Fall 2022	**CSE 8903: AI in Healthcare and Neuroimaging Analysis** Guest Instructor, School of Computational Science and Engineering (CSE), Georgia Institute of Technology.
Spring 2017	**CS 357: Declarative Programming** Teaching Assistant, The Department of Computer Science, University of New Mexico.
Fall 2016	**CS 361: Algorithms and Data Structures** Teaching Assistant, The Department of Computer Science, University of New Mexico.
Fall 2016	**CS 261: Discrete Mathematics** Teaching Assistant, The Department of Computer Science, University of New Mexico.

Spring/Fall 2013-2015	**CSE 1105: Computer Programming I** Instructor, The Department of Electrical and Electronics Engineering, International Islamic University Chittagong.
Spring/Fall 2013-2015	**CSE 1106: Object Oriented Programming** Instructor, The Department of Electrical and Electronics Engineering, International Islamic University Chittagong.
Fall 2013-2015	**EEE 2306: Numerical Analysis** Instructor, The Department of Electrical and Electronics Engineering, International Islamic University Chittagong.

Outreach & Professional Development

Organizer Role

2024	**Technical program committee member,** International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC).
2021,2022	**Technical program committee member,** Organization of Human Brain Mapping (OHBM)
2022	**Organizing ommittee member,** IEEE 32nd International Workshop on Machine Learning for Signal Processing (MLSP)
2019	**Organizing Secretary,** UNM CS Graduate Student Conference
2020	**Technical program committee member,** Association for the Advancement of Artificial Intelligence (AAAI).

Journal Editorial Role

2023	**Editor in Brain imaging Methods,** Frontier of Neuroscience.
2023	**Member of Editorial Board,** Journal of Human Anatomy (JHUA)

Journal Reviewer (Selected)

2022-23	IEEE Transactions on Pattern Analysis and Machine Intelligence.
2022-23	IEEE Transactions on Biomedical Engineering (TBME).
2022-2024	Nature Communication.
2023-2024	Nature Scientific Reports
2022-23	Brain Research
2023-2024	Brain Imaging and Behaviour
2021-2022	Schizophrenia Bulletin, Oxford University Press.

Conference Reviewer (Selected)

2023	Conference on Computer Vision and Pattern Recognition (CVPR)
2021-2023	Conference on Neural Information Processing Systems (NeurIPS).
2020-2022	International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)
2019-2022	IEEE International Symposium on Biomedical Imaging (ISBI).
2023	Artificial Intelligence and Statistics (AISTATS).
2021-2022	Machine Learning for Health Symposium (ML4H)
2022	IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)
2023	IEEE-EMBS Conference on Biomedical and Health Informatics (BHI))
2018-2023	International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)

References

- Dr. Vince D. Calhoun
Director, Tri-institutional Center for Translational Research in Neuroimaging and Data Science(TReNDS), GSU, GATech, Emory
Distinguished University Professor,
Professor, Georgia Institute of Technology
(*Electrical and Computer Engineering, Computational Science and Engineering, Biomedical Engineering)
Georgia State University
(*Psychology, Computer Science, Neuroscience, Math)
Professor, Emory University
(*Neurology, *Pediatrics, BioEngineering, Psychiatry)
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- Dr. Elizabeth M. Cherry
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