BISWADEEP CHAKRABORTY

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RESEARCH SUMMARY

My research develops AI systems as dynamic, self-regulating entities capable of continuous adaptation in complex, data-driven environments. By treating AI as a neuro-adaptive dynamical system, I've created frameworks that maintain stable performance under varying conditions and computational constraints. This approach has direct applications to financial modeling, where real-time adaptation and resilient performance are critical. My work demonstrates expertise in stochastic optimization, adaptive algorithms, and robust system design—core skills essential for developing sophisticated quantitative strategies.

RESEARCH EXPERIENCE

GREEN Lab, Georgia Institute of Technology
Atlanta, USA
Graduate Research Assistant
January 2020- Present

My research advances methodologies for **adaptive** and **efficient** learning in complex, data-driven environments. I developed frameworks utilizing spiking neural networks (SNNs) and state-space models that enable real-time processing of high-frequency data with robust performance under resource constraints. Key innovations include heterogeneous learning algorithms that reduce computational overhead by 70% while maintaining prediction accuracy, and Koopman operator-based representations that enhance stability in dynamic systems. My work on multi-agent systems demonstrates sophisticated modeling of complex interactions and temporal dependencies—capabilities directly applicable to market dynamics and systematic trading strategies.

PanAgora Asset Management
Boston, USA
Stock Selector & Equity Strategies Team
May 2023-August 2023

- Worked as *Quantitative Research Intern - Equities* with Mr. Lei Liu and Mr. Richard Tan at the Stock Selector and Equity Strategies team.
- Built and implemented novel event-driven volatility trading strategies using large language models and optimal control-based reinforcement learning.
- Developed automated systems for real-time market event processing and strategy adaptation, incorporating multi-factor analysis and risk management frameworks.
- Implemented robust backtesting infrastructure to evaluate strategy performance across various market conditions, achieving significant improvement in Sharpe ratio and drawdown metrics compared to baseline approaches.
- Applied state-of-the-art machine learning techniques to extract tradable signals from unstructured market data while maintaining computational efficiency.

National University of Singapore
Singapore
NUS-Singtel Cyber-Security Research and Development Laboratory
July 2019-December 2019

- Worked as *Research Assistant* at the Singtel-NUS Lab with Prof. Mohan Gurusamy, Dr. Dinil Divakaran, Dr. Ido Nevat, and Prof. Gareth Peters on developing and implementing a risk-aware feature selection algorithm for IoT Device Classification.

University of Sherbrooke
Quebec, Canada
INTERLAB Research Laboratory
May 2018-August 2018

- Worked on research projects involving developing algorithms and a simulator using VPython to perform stochastic simulations of the nano-wire formation in a nano-communication network.

Jadavpur University   West Bengal, India
Artificial Intelligence Lab   *December 2017 - June 2019*

· Worked under Prof. Amit Konar on several research projects based on deep learning and signal processing-based modeling and characterization of EEG and fMRI signals and their applications in novel brain-computer interface algorithms.

Indian Academy of Sciences   New Delhi, India
National Physical Laboratory   *May 2017– July 2017*

· Worked under Dr. Amitava Sen Gupta, ex-Director, National Physical Laboratory, India, on modeling an algorithm for shooter localization from gunshot acoustics using wireless sensor networks.

Jadavpur University   West Bengal, India
Advanced Embedded and Digital Systems Laboratory   *May 2016 – December 2017*

· Worked as an undergraduate research assistant under Dr. Amitava Mukherjee, IBM India, and Prof. Mrinal Kanti Naskar on future 5G Communication Networks, Information Centric Networks, and Network Security.

EDUCATION

Georgia Institute of Technology   *January 2020 - Present*
Ph.D. in Electrical and Computer Engineering   *Advisor: Prof. Saibal Mukhopadhyay*
Minor in Mathematics
Masters in Electrical and Computer Engineering
Thesis: *Model-Uncertainty Aware Neural Architecture Search*

Jadavpur University   *July 2015 - June 2019*
B.Tech. in Electronics and Telecommunication Engineering   *Advisor: Prof. Amit Konar*
First Class with Honors & Distinction
Thesis: *Enhancing EEG Classification with Phase-Sensitive Common
Spatial Pattern and Optimal Electrode Selection*

PUBLICATIONS

Thrust 1: Learning Algorithms as Adaptive Control Systems

[C30] **B. Chakraborty**, B. Kang, H. Kumar, and S. Mukhopadhyay. "Sparse Spiking Neural Network: Exploiting Heterogeneity in Timescales for Pruning Recurrent SNN." In *International Conference in Learning Representations* **(ICLR, 2024)**.

[C29] **B. Chakraborty** and S. Mukhopadhyay. "Heterogeneous Neuronal and Synaptic Dynamics for Spike-Efficient Unsupervised Learning: Theory and Design Principles." In *International Conference on Learning Representations* **(ICLR, 2023)**.

[C28] **B. Chakraborty** and S. Mukhopadhyay. "Topological Representations of Heterogeneous Learning Dynamics of Recurrent Spiking Neural Networks." In *International Joint Conference on Neural Networks* **(IEEE IJCNN, 2024) [Oral]**.

[J27] **B. Chakraborty** and S. Mukhopadhyay. "Heterogeneous Recurrent Spiking Neural Network for Spatio-Temporal Classification." In *Frontiers in Neuroscience, 2022*. (IF: 4.3)

[J26] **B. Chakraborty** and S. Mukhopadhyay. "Characterization of Generalizability of Spike Time Dependent Plasticity trained Spiking Neural Networks." In *Frontiers in Neuroscience, 2021*. (IF: 4.3)

[C25] B. Kang, P. Saha, S. Sharma, **B. Chakraborty**, and S. Mukhopadhyay. "Online Relational Inference for Evolving Multi-agent Interacting System." In *Neural Information Processing Systems* **(NeurIPS), 2024**.

[P6] **B. Chakraborty**, H. Kumar, and S. Mukhopadhyay. "Tackling Oversmoothing in Large Dense Graphs Using Hebbian-based Attention." Submitted to *Transactions in Machine Learning Research (TMLR), 2025*.

[P5] H. Kumar, B. Kang, **B. Chakraborty**, and S. Mukhopadhyay. "Has the Deep Neural Network learned the Stochastic Process? An Evaluation Viewpoint." Submitted to *International Conference on Learning Representations (ICLR), 2025*.

Thrust 2: Dynamic Model Architecture as a State Evolution System

[J24] **B. Chakraborty**, X. She, and S. Mukhopadhyay. "A Fully Spiking Hybrid Neural Network for Energy-Efficient Object Detection." In *IEEE Transactions on Image Processing, 2021*. (IF: 4.83)

[C23] **B. Chakraborty**, U. Kamal, X. She, S. Dash, and S. Mukhopadhyay. "Brain-Inspired Spatiotemporal Processing Algorithms for Efficient Event-Based Perception." In *Design, Automation and Test in Europe Conference (DATE, 2023)*.

[J22] **B. Chakraborty** and S. Mukhopadhyay. "μ DARTS: Model Uncertainty-Aware Differentiable Architecture Search." In *IEEE Access, 2022*. (IF: 3.9)

[C21] B. Kang, **B. Chakraborty**, and S. Mukhopadhyay. "Unsupervised 3D object learning through neuron activity aware plasticity." In *International Conference on Learning Representations (ICLR), 2023*.

[C20] B. Kang, P. Saha, S. Sharma, **B. Chakraborty**, and S. Mukhopadhyay. "Online Relational Inference for Evolving Multi-agent Interacting System." In *Neural Information Processing Systems (NeurIPS), 2024*.

[C19] **B. Chakraborty** and S. Mukhopadhyay. "Self-Organizing Spiking Neural Network for Continual Time Series Prediction." In *International Joint Conference on Neural Networks (IEEE IJCNN, 2023)*.

[C18] B. Kang, H. Kumar, M. Lee, **B. Chakraborty**, and S. Mukhopadhyay. "Recurrent Neural Cellular Automata with Self-Attention for Multi-agent System." In *Learning for Dynamics & Control (L4DC), 2024*.

[C17] H. Kumawat, **B. Chakraborty**, and S. Mukhopadhyay. "STEMFold: Stochastic Temporal Manifold for Multi-Agent Interactions in the Presence of Hidden Agents." In *Learning for Dynamics & Control (L4DC), 2024*.

[C16] H. Kumawat, **B. Chakraborty**, and S. Mukhopadhyay. "Control Conditioned Visual Representations for Dynamics Learning in Robotics." In *Conference on Robot Learning (CoRL), 2024*.

[P4] **B. Chakraborty** and S. Mukhopadhyay. "SPLR: A Spiking Neural Network for Long-Range Temporal Dependency Learning." Submitted to *International Conference on Learning Representations (ICLR), 2025*.

Collaborative work on Co-Design of Models and Physical Platforms

[J15] D. Kim, **B. Chakraborty**, X. She, E. Lee, B. Kang, and S. Mukhopadhyay. "MONETA: A Processing-In-Memory-based Hardware Platform for Hybrid Convolutional Spiking Neural Network with On-line Learning." In *Frontiers in Neuroscience, 2021*. (IF: 4.3)

[C14] T.H. Pantha, A. Khanna, H. Ye, **B. Chakraborty**, et al. "Towards 3D CMOS+X Ising Machines: Addressing the Connectivity Problem with Back-end-of-line FeFETs." In *IEEE International Electron Devices Meeting (IEDM), 2024*.

[J13] H. Kumar, **B. Chakraborty**, S. Sharma, and S. Mukhopadhyay. "XMD: An Expansive Hardware-Telemetry-Based Mobile Malware Detector to Enhance Endpoint Detection." In *IEEE Transactions on Information Forensics & Security, 2023*. (IF: 6.8)

[P3] S. Sharma, **B. Chakraborty**, D. Kim, and S. Mukhopadhyay. "SATori: Distributed k-SAT Accelerator Based on Stochastic Recurrent Neural Networks." Submitted to *International Symposium on Computer Architecture (ISCA), 2025*

[P2] L. Shamieh, **B. Chakraborty**, W. Wang, and S. Mukhopadhyay. "State-Space-Model Meets Compute-In-Memory: A Path to Efficient and Scalable Neural Network" Submitted to *Design Automation Conference (DAC), 2025*

Other Publications

Journal Papers

- **[J12]** A. Ghosh, **B. Chakraborty**, A. Raha, and A. Mukherjee. "Improving Network Throughput by Hardware Realization of a Dynamic Content Caching Scheme for Information-Centric Networking (ICN)." In *Wireless Personal Communications, 2021*, Vol. 116, No. 4, pp.2873-2898. (IF: 2.2)

- **[J11]** **B. Chakraborty**, D.M. Divakaran, I. Nevat, G.W. Peters, and M. Gurusamy. "Cost-aware Feature Selection for IoT Device Classification." In *IEEE Internet of Things Journal, 2021*. (IF: 10.238)

- **[J10]** **B. Chakraborty**, L. Ghosh, and A. Konar. "Optimal selection of EEG electrodes using interval type-2 fuzzy-logic-based semi-separating signaling game." In *IEEE Transactions on Cybernetics, 2020*. (IF: 11.8)

- **[J9]** **B. Chakraborty**, L. Ghosh, and A. Konar. "Designing phase-sensitive common spatial pattern filter to improve brain-computer interfacing." In *IEEE Transactions on Biomedical Engineering, 2019*, Vol. 67, No. 7, pp. 2064-2072. (IF: 4.8)

Conference Papers

- **[C8]** N. Miller, **B. Chakraborty**, and S. Mukhopadhyay. "A Reconfigurable Quantum State Tomography Solver in FPGA." In *IEEE International Conference on Quantum Computing & Engineering (QCE), 2023*.

- **[C7]** M. Lee, X. She, **B. Chakraborty**, S. Dash, B. Mudassar, and S. Mukhopadhyay. "Reliable Edge Intelligence in Unreliable Environment." In *2021 Design, Automation & Test in Europe Conference & Exhibition (DATE), 2021*, pp. 896-901, IEEE.

- **[C6]** D. Dewan, L. Ghosh, **B. Chakraborty**, A. Chowdhury, A. Konar, and A.K. Nagar. "Cognitive Analysis of Mental States of People According to Ethical Decisions Using Deep Learning Approach." In *2020 International Joint Conference on Neural Networks (IJCNN), 2020*, pp. 1-8, IEEE.

- **[C5]** A. Chowdhury, **B. Chakraborty**, L. Ghosh, D. Dewan, and A. Konar. "A Dynamical Phase Synchronization Based Approach to Study the Effects of Long-Term Alcoholism on Functional Connectivity Dynamics." In *International Conference on Pattern Recognition and Machine Intelligence (PReMI), 2020*, pp. 218-226, Springer, Cham.

- **[C4]** **B. Chakraborty**, S. Ghosal, L. Ghosh, A. Konar, and A.K. Nagar. "Phase-Sensitive Common Spatial Pattern for EEG Classification." In *2019 IEEE International Conference on Systems, Man, and Cybernetics (IEEE SMC), 2019*, pp. 3654-3659, IEEE. *[Oral]*

- **[C3]** O.A. Dambri, S. Cherkaoui, and **B. Chakraborty**. "Design and Evaluation of Self-Assembled Actin-Based Nano-Communication." In *2019 15th International Wireless Communications & Mobile Computing Conference (IEEE IWCMC), 2019*, pp. 208-213, IEEE. *[Oral]*

- **[C2]** S. Ghosal, **B. Chakraborty**, M. Laha, and A. Konar. "Phase-Synchrony And Causality Analysis Of Brain Signals To Determine Signal Transduction Pathways In Color Perception." In *2019 IEEE Region 10 Symposium*, pp. 778-783, IEEE, 2019. *[Oral]*

- **[C1]** **B. Chakraborty**, B. Banerjee, A. Mukherjee, and M.K. Naskar. "Optimal cache allocation in a mobility-based heterogeneous network using Bayesian games." In *2017 IEEE Calcutta Conference*, pp. 423-427, IEEE, 2017. *[Oral]*

Pre-Print

- **[P1]** **B. Chakraborty**, H. Kumawat, B. Kang and S. Mukhopadhyay. "Dynamic Graph Structure Estimation for Learning Multivariate Point Process using Recurrent Spiking Neural Networks." Submitted to *Transactions on Machine Learning Research (TMLR)*.

HONORS AND AWARDS

- **Colonel Oscar P. Cleaver Award**   2023-2024
  Awarded for the most outstanding Ph.D. dissertation proposal by the School of Electrical and Computer Engineering (ECE) at Georgia Tech, recognizing exceptional quality and originality. [Link]

- **Outstanding ECE Graduate Research Assistant Award**   2024
  Recognized for excellence as a Graduate Research Assistant within the School of Electrical and Computer Engineering at Georgia Tech. [Link]

- **2024 ML and Systems Rising Stars**   2024
  Selected as one of the top Ph.D. students and postdoctoral researchers in machine learning and systems, identifying potential future leaders in the field. [Link1] [Link2]

- **ECE STEER Fellowship**   2024
  Fellowship awarded by Georgia Tech's School of Electrical and Computer Engineering to support teaching excellence and professional development for aspiring academics. [Link]

- **ECE Research Rally - Best Presentation Award**   2024
  Recognized for the best research presentation at the ECE Research Rally, showcasing graduate research within the School of Electrical and Computer Engineering at Georgia Tech. [Link]

- **Best Lightning Talk Award** *CogniSense Annual Review* [Link]   2024

- **Best Poster Award** *CogniSense Annual Review* [Link]   2024

- **DAC 2024 PhD Forum and Travel Award Winner**   2024
  Selected to present research at the Design Automation Conference (DAC) Ph.D. Forum, receiving a travel award to attend.

- **Supercomputing (SC24) PhD Symposium**   2024
  Selected to present significant research contributions at the Supercomputing Conference's Ph.D. Symposium in high-performance computing.

- **J.P. Morgan Fellowship University Finalist**   2022
  Finalist for the J.P. Morgan Fellowship, recognizing potential in financial technology research.

- **Qualcomm Innovation Fellowship Finalist**   2022
  Recognized as a finalist in the Qualcomm Innovation Fellowship program for innovative research proposals in technology. [Link]

- **ICLR Travel Award**   2023, 2024
  Received travel awards to attend the International Conference on Learning Representations, supporting engagement in leading machine learning research.

- **MITACS Globalink Fellow**   2018
  Participated in the MITACS Globalink program, facilitating international research collaborations and professional development. [Link]

- **Indian Academy of Sciences Summer Research Fellow**   2017
  Awarded a fellowship by the Indian Academy of Sciences to conduct summer research, fostering scientific inquiry and innovation. [Link]

- **First Class with Honors & Distinction** in Bachelor of Engineering   2019
  Graduated with top academic honors from the Department of Electronics and Telecommunication Engineering, Jadavpur University.

- **Google Cloud Research Credit Award**

TEACHING & MENTORING

Instructor of Record *Fall 2024*

Will teach a section of ECE 2020 (Digital Hardware Design) for non-ECE majors in Fall 2024. As the instructor of record, I am responsible for running my section of the course—determining course policies, creating the syllabus and schedule, preparing and delivering lectures, and designing and assessing homework and tests.

Tech 2 Teaching Certification *2024*

Completed the Tech to Teaching program, a Georgia Tech certification designed to prepare graduate students and postdocs for college teaching roles. Developed a pedagogical approach that leverages evidence-based teaching practices and reflective mentoring experience.

Mentoring Experience

- **Graduate Students:** Mentored four junior PhD students at Georgia Tech on neuromorphic computing, state-space machines, and quantization. Provided regular feedback through structured monthly reviews and brainstorming sessions, resulting in skill development and publications in top-tier conferences.
- **Undergraduate Students:** Supervised undergraduates on fundamental and applied research projects, including guiding one student on Koopman theory for dynamical systems and mentoring two other students in developing ANN-to-SNN conversion algorithms.

TALKS

2024 SRC TechCon
Title: Brain-Inspired Spiking Neural Networks for Online Learning

2024 Georgia Tech ECE Research Rally
Title: Brain-Inspired Spiking Neural Networks for Online Learning

2024 Georgia Tech DCL Symposium Spotlight Talk
Title: Evolution Strategies in Heterogenous Recurrent Spiking Neural Network for Dynamical Control

2023 SNUFA: Invited Talk and Poster
Title: Dynamics in Diversity: Harnessing Heterogeneity in Neuronal and Synaptic Dynamics in SNNs
Link

2023 ICERM Workshop on Mathematical and Scientific Machine Learning
Title: Learning to Predict Using Network of Spiking Neurons *Link*

2019 IEEE International Conference on Systems, Man and Cybernetics (SMC)
Title: Phase-Sensitive Common Spatial Pattern for EEG Classification.

PROFESSIONAL ACTIVITIES

Reviewing Responsibilities

- **Journals:** IEEE Transactions on Neural Networks and Learning Systems, Neurocomputing, IEEE Transactions on Image Processing, Neural Networks
- **Conferences:** IEEE SMC, CVPR, AAAI, IEEE PReMI, NeurIPS, ECCV, ICLR, AISTATS, ICML, IJCNN

Program Committee: WCCI 2024, AAAI 2025

Mentorship Mentored six new Ph.D. students as a part of the Georgia Tech ECE Graduate Student Organization (GSO) mentorship program.

Student Government Association: Was elected as a senator for the Georgia Tech Student Government Association to represent the graduate students of the School of Electrical and Computer Engineering