Swapnil Saha

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Education

Rutgers, The State University of New Jersey **2025 – Present**
Doctor of Philosophy in Electrical and Computer Engineering *CGPA 3.94:4*

Rutgers, The State University of New Jersey **2023 – 2025**
Master of Science in Electrical and Computer Engineering *CGPA : 3.94/4*

Bangladesh University of Engineering and Technology (BUET) **2017 – 2022**
Bachelor of Science in Electrical and Electronic Engineering *CGPA : 3.64/4*

Research Experience

Covert and Secure Wireless Communication **2025-Present**
Supervisor: *Predrag Spasojevic, Professor, Dept. of ECE, Rutgers*

- Conducting research on advanced security techniques for wireless communication systems.

Distributed Computing **2023–2025**
Supervisor: *Emina Soljanin, Professor, Dept. of ECE, Rutgers*

- Worked on implementing a faster-distributed computing algorithm on a distributed workload system.

Deep Mismatch Channel Estimation in IRS based 6G Communication **2023**
Supervisor: *Dr. Md. Forkan Uddin, Professor, Dept. of EEE, BUET*

- Prposed a channel estimation (CE) protocol for intelligent reflecting surface (IRS) based 6G communication.
- Showed the effectiveness of the proposed scheme by doing simulation experiments.

Privacy-preserving Non-negative Matrix Factorization with Outliers **2021 – 2022**
Supervisor: *Dr. Hafiz Imtiaz, Associate Professor, Dept. of EEE, BUET*

- Developed privacy preserving Non-negative Matrix Factorization algorithm using Differential Privacy (DP).
- Showed the algorithm's effectiveness in topic modeling and face decomposition tasks.

Heart Abnormality Detection from Heart Sound Signals using MFCC Featur **2021**
Supervisor: *Talha Ibn Mahmud, Lecturer, Dept. of EEE, BUET*

- Analyzed the PCG signal to detect the abnormal heart sound.
- Proposed a novel deep learning based dual stream network with attention mechanism.

mHealth Research group **2020 – 2021**
Undergraduate Researcher

- Implemented machine learning, deep learning-based research project.
- Performed exploratory data analysis and experimented with computer vision and biomedical research applications.

Publications

Journal articles

- **Saha, S.**, Imtiaz, H., Privacy-preserving Non-negative Matrix Factorization with Outliers. ACM Transactions on Knowledge Discovery from Data, 18(3), pp.1-26.
- Ghosh Dastider, A., **Saha, S.**, Islam Sukanya, M. and Chakraborty, R., Comparative analysis among materials for passive shielding in a manned Mars mission. Astrophysics and Space Science, 366(12), pp.1-10.
- **Saha, S., Uddin F.**, Deep Mismatch Channel Estimation in IRS based 6G Communication.(under review at IEEE Communications Letters).

Conference proceedings

- **Saha, S.**, Aggarwal, R., Dagefu, F., Kong, J., Choi, J., Kim, B. & Spasojević, P. (2026) Covert Routing with DSSS Signaling Against Cycle Detectors. Submitted to the IEEE Wireless Communications and Networking Conference (WCNC), under review.
- **Saha, S.**, Soljanin, E. and Whiting, P. On Optimal Batch Size in Coded Computing, in 2025 IEEE International Symposium on Information Theory (ISIT 2025)
- Ghosh, P., Akib, A., Mohammad S., **Saha, S.**, and Kamal U. A Sequence Agnostic Multimodal Pre-Processing for Clogged Blood Vessel Detection in Alzheimer's Diagnosis. In 2023 IEEE International Conference on Acoustics, Speech, and Signal Processing Workshops (ICASSPW) (pp. 1-5). IEEE

Research Interests

Security in Wireless Communication | Anonymity & Privacy | Distributed Systems | Wireless Network | Quantum Computing

Skills

Programming Languages: C, C++, Python, Assembly, Verilog, SystemVerilog.
Software Tools: Matab, Simulink, Arduino, Proteus, Quartus, ModelSim, Cadence, Emu 8086
Library: SimPy, Numpy, Pandas, Matplotlib, Seaborn, Pytorch, Keras, Scikit-learn, Qiskit.
Scientific Writing: LaTeX.
Linguistic Proficiency: English (Fluent Working Proficiency), Bengali (Native Language).

Highlighted Academic Projects

Distributed Optimization Augmented Lagrangian ADMM | *MPI, Numpy* | GitHub link **Spring 2024**

- Exploresd the theoretical foundations of ADMM.
- Reviewed the distributed ADMM to solve the consensus problem.
- Implemented the distributed ADMM to solve the global consensus problem by MPI.

Surface Code | ResearchGate **Fall 2023**

- Studied the surface code for quantum error correction, its code construction, and how the syndrome is generated in the presence of errors.
- Overviewed one of the decoding algorithms: Minimum Weight Perfect Matching Decoder.

Over Voltage Protection System for Industrial Loads | *Arduino, Proteus* | GitHub link **2021**

- Implement a protection system of a three-phase power system in the event of overload voltage.
- Evaluate the system performance on Proteus software.
- Develop the PCB design of the software implementation.

VLSI Design Project: Configurable Logic Block (CLB) | *Cadence* | ResearchGate **2021**

- Implement a Configurable Logic Block (CLB) that performs logical OR operation.
- Evaluate the design metrics of delay, frequency, leakage, loading, average, and active energy.
- Optimize the design area, so the design block gains the best figure of merit.

Achievements

Student Travel Grant Recipient at ISIT 2025.

- Awarded in recognition of fulfilling all eligibility criteria for participation and travel support.

TA of the Semester Award Spring 2024.

- Conducted Digital Signal Processing simulation lab and recitation class.

Quantum Excellence at Qiskit Global Summer School 2022.

- Achieved knowledge and experience in quantum computation, utilizing the physics, math, and python skills required to model a molecule using Qiskit.
- Gained knowledge on quantum simulations using noisy intermediate-scale quantum (NISQ) hardware.

Top 6 teams among the 384 teams at Robi Datathon 2.0 2022.

- Performed data analytics, feature engineering, and data visualization tasks.
- Inspected the insights of data that can contribute to improving the business decision.

Global Champion at IEEE Video and Image Processing Cup (VIP Cup) 2020.

- Built a deep neural network model to detect vehicles in fisheye images.
- Identified the challenges of the dataset and reviewed the state of the art methods to solve them.

7^{th} among the 915 teams at Advance Alzheimer's Research with Stall Catchers 2020.

- Analyzed video dataset to classify vessel segments as stalled and non-stalled.
- Built a late fusion model to capture temporal and spatial features from video data.

5^{th} at IEEE Signal Processing Cup 2020.

- Built an unsupervised trained model to detect the autonomous aerial system abnormality.
- Analyzed the ROS-based data of drone motion as a task of EDA.

Silver Medal at the 2019 University Physics Competition.

- Prepared a technical report on protecting humans in a spacecraft traveling to Mars from most radiation.
- Comparing with other materials, we proposed a novel material for protection.

1^{st} Runner's Up-Satellite Mission Idea Contest: 4th session of the BIRDS International Workshop 2019.

- Proposed a machine learning-based solution to estimate agricultural yield from a satellite image.
- Created a Gantt chart for planning and scheduling the sub-tasks of the projects.

Relevant Coursework

- Quantum Computing & Communications Algorithms
- Quantum Computing & Information System
- Convex Optimization
- Signal and Systems
- Digital Signal Processing
- Random Signal Processing
- Wireless Communication
- Communication System
- Linear Algebra *(MIT Openc.)*
- Probability and Statistics
- Deep Learning Specialization *(Coursera)*

Work Experience & Leadership

WINLAB, Rutgers, The State University of New Jersey **Fall 2023-Present**

Graduate Assistant

- Conduct research on enhancing the performance of distributed computing systems and improving security in wireless communications.

Department of ECE, Rutgers, The State University of New Jersey **Spring 2024**

Graduate Teaching Assistant

- Course Taught: ECE 348: Digital Signal Processing Lab .

Department of EEE, Bangladesh University of Engineering and Technology **2023**

Contractual Research Assistant

- Conducted research on resource allocation in IRS based 6G communication.

Department of EEE, Southeast University **2022 – 2023**

Adjunct Lecturer

- Course Taught: EEE 227 (Engineering Electromagnetics), EEE 237 (Continuous Signals and Systems), EEE 336 (Control Systems Laboratory), EEE 326 (Digital Signal Processing I Laboratory), EEE230 (Electronics Laboratory).

Ostad Limited **2022 – 2023**

Data Science Trainer

- Operated classes on elementary data science and basic Python programming.