

Ratun Rahman

PH.D. CANDIDATE IN COMPUTER ENGINEERING | QUANTUM COMPUTING & MACHINE LEARNING

Huntsville, AL, USA | Available January 2027

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Academic Profile

Ph.D. candidate in Computer Engineering with research spanning **quantum computing, quantum machine learning, federated learning, trustworthy AI, and distributed learning**. Research focuses on noise-resilient and heterogeneous learning systems, including adaptive quantum error mitigation, quantum federated learning, variational quantum sensing, probabilistic/personalized federated learning, and real-hardware quantum experimentation. Experienced in developing research software and simulation platforms and validating methods on superconducting quantum processors through Amazon Braket.

Research Interests

Quantum Machine Learning; Quantum Error/Noise Mitigation; Quantum Federated Learning; Variational Quantum Algorithms; Quantum Sensing; Federated and Distributed Learning; Personalized and Probabilistic Learning; Trustworthy AI; Machine Learning; Structured/Graph-Based Reasoning.

Education

University of Alabama in Huntsville

PH.D. IN COMPUTER ENGINEERING — QUANTUM COMPUTING & DISTRIBUTED SYSTEMS

GPA: 3.83/4.00

Huntsville, AL, USA

Aug 2023 – Dec 2026 (Expected)

Islamic University of Technology

B.SC. IN SOFTWARE ENGINEERING — SECURITY & MACHINE LEARNING

GPA: 3.62/4.00

Gazipur, Bangladesh

Jan 2018 – May 2022

Academic & Research Appointments

University of Alabama in Huntsville

GRADUATE RESEARCH ASSISTANT, NETWORK INTELLIGENCE AND SECURITY LAB

- Conduct research on quantum machine learning, quantum noise mitigation, federated/distributed learning, and trustworthy AI for noisy and heterogeneous systems.
- Develop adaptive zero-noise extrapolation, personalized/heterogeneous quantum federated learning, variational quantum sensing, and probabilistic learning methods.
- Build reproducible simulation and real-hardware experimentation workflows using Qiskit, PennyLane, Amazon Braket, PyTorch, Linux, GPU/HPC execution, and Rigetti superconducting QPUs.

Huntsville, AL, USA

Aug 2023 – Present

King Abdullah University of Science and Technology (KAUST)

QUANTUM SECURITY RESEARCH INTERN

- Developed a scalable hybrid quantum-classical machine-learning framework for malware-family classification using supervised feature projection, fidelity-based quantum kernels, Nyström approximation, and multiclass ridge regression.
- Evaluated the framework on 18,836 PE samples across 23 labels using repeated stratified splits, classical baselines, ablation studies, and statistical testing.
- Validated quantum-kernel circuits on the Rigetti Cepheus-1-108Q superconducting QPU through Amazon Braket.
- First author of a manuscript submitted to *IEEE Transactions on Dependable and Secure Computing (TDSC)* and currently under revision.

Thuwal, Saudi Arabia

Jan 2026 – Jun 2026

Peer-Reviewed Journal Publications

1. **Ratun Rahman**, Shaba Shaon, and Dinh C. Nguyen. "Tackling Heterogeneity in Quantum Federated Learning: An Integrated Sporadic-Personalized Approach." *IEEE Transactions on Computers*, 2026.
2. **Ratun Rahman** and Dinh C. Nguyen. "Escaping Barren Plateaus in Variational Quantum Algorithms Using Negative Learning Rate in Quantum Internet of Things." *IEEE Internet of Things Journal*, 2025.
3. **Ratun Rahman**, Dinh C. Nguyen, Christo Kurisummoottil Thomas, and Walid Saad. "Towards Heterogeneous Quantum Federated Learning: Challenges and Solutions." *IEEE Network*, 2025.
4. Md. Raihan Uddin, Shaba Shaon, **Ratun Rahman**, Dinh C. Nguyen, Octavia Dobre, and Dusit Niyato. "Quantum Federated Learning: A Comprehensive Survey." *IEEE Communications Surveys & Tutorials*, 2025.
5. Dinh C. Nguyen, Md. Bokhtiar Al Zami, **Ratun Rahman**, Shaba Shaon, Tuy Tan Nguyen, and Fatemeh Afghah. "When Quantum Federated Learning Meets Blockchain in 6G Networks." *IEEE Communications Standards Magazine*, 2025.
6. **Ratun Rahman**, Sina Shaham, and Dinh C. Nguyen. "Towards Personalized Quantum Federated Learning for Anomaly Detection." *IEEE Transactions on Network Science and Engineering*, 2025.

7. Samia Rahman and **Ratun Rahman**. "Semantic Communication-Aware Federated Fine-Tuning of Large Language Models." *IEEE Communications Letters*, 2025.
8. **Ratun Rahman**, Pablo Moriano, Samee U. Khan, and Dinh C. Nguyen. "Electrical Load Forecasting over Multihop Smart Metering Networks with Federated Learning." *IEEE Internet of Things Journal*, 2025.
9. **Ratun Rahman**, Falguni Patadia, Jinhui Wang, and Dinh C. Nguyen. "Multimodal Federated Learning for Air Quality Estimation with Model Personalization over Aerial-Ground Networks." *IEEE Geoscience and Remote Sensing Letters*, 2025.
10. **Ratun Rahman** and Dinh C. Nguyen. "Improved Modulation Recognition Using Personalized Federated Learning." *IEEE Transactions on Vehicular Technology*, 2024.
11. **Ratun Rahman** and Md. Rafid Islam. "Best Practices for Facing the Security Challenges of Internet of Things Devices Focusing on Software Development Life Cycle." *International Journal of Education and Management Engineering*, 2023.
12. M. R. Islam, **Ratun Rahman**, A. Ahmed, and R. Jany. "A Survey of Software Metrics for Transitioning to an Updated Version of the Current Existing Framework or a New Framework." *Journal of Electrical Electronics Engineering*, 2022.

Peer-Reviewed Conference & Workshop Publications

1. **Ratun Rahman**, Atit Pokharel. "Rethinking Structured Generation: Can Graph-Based Reasoning Resolve Ambiguity?" *Advances in Neural Information Processing Systems (NeurIPS)*, 2026.
2. **Ratun Rahman**, Atit Pokharel, and Dinh C. Nguyen. "Toward High-Precision Variational Quantum Sensing via Asynchronous Federated Learning." *IEEE International Conference on Quantum Computing and Engineering (QCE)*, 2026.
3. Atit Pokharel, **Ratun Rahman**, Thomas Morris, and Dinh C. Nguyen. "Differential Privacy for Distributed Quantum Sensing via Quantum Noise." *IEEE International Conference on Quantum Computing and Engineering (QCE)*, 2026.
4. **Ratun Rahman**, Atit Pokharel, and Dinh C. Nguyen. "SimQFL: A Quantum Federated Learning Simulator with Real-Time Visualization." *IEEE International Conference on Quantum Computing and Engineering (QCE)*, 2025.
5. Atit Pokharel, **Ratun Rahman**, Shaba Shaon, Thomas Morris, and Dinh C. Nguyen. "Differentially Private Federated Quantum Learning via Quantum Noise." *IEEE International Conference on Quantum Computing and Engineering (QCE)*, 2025.
6. **Ratun Rahman**, Atit Pokharel, and Dinh C. Nguyen. "Sporadic Federated Learning Approach in Quantum Environment to Tackle Quantum Noise." *FedVision 2025, CVPR Workshop*, 2025.
7. Atit Pokharel, **Ratun Rahman**, Shaba Shaon, Thomas Morris, and Dinh C. Nguyen. "Quantum Federated Learning for Multimodal Data: A Modality-Agnostic Approach." *BEAM 2025, CVPR Workshop*, 2025.
8. **Ratun Rahman** and Dinh C. Nguyen. "Multimodal Federated Learning with Model Personalization." *OPT 2024: Optimization for Machine Learning, NeurIPS Workshop*, 2024.
9. Md. Raihan Uddin, **Ratun Rahman**, and Dinh C. Nguyen. "False Data Injection Attack Detection in Edge-Based Smart Metering Networks with Federated Learning." *IEEE Consumer Communications & Networking Conference (CCNC)*, 2024.
10. **Ratun Rahman** and Dinh C. Nguyen. "Electrical Load Forecasting in Smart Grid: A Personalized Federated Learning Approach." *IEEE Consumer Communications & Networking Conference (CCNC)*, 2024.
11. **Ratun Rahman** and Dinh C. Nguyen. "Enabling Efficient Communication Using Federated Learning over Satellite Networks." *Von Braun Space Exploration Symposium*, 2023.
12. **Ratun Rahman**, M. R. Islam, A. Ahmed, M. K. Hasan, and H. Mahmud. "A Study of Permission-Based Malware Detection Using Machine Learning." *15th International Conference on Security of Information and Networks (SIN)*, 2022.

Manuscripts Under Review / In Revision

1. **Ratun Rahman** and Dinh C. Nguyen. "Readout Noise Mitigation with Bayesian Methods for Quantum Neural Networks. extitIEEE Transactions on Neural Networks and Learning Systems (TNNLS). Revision 1 under review, 2026.
2. **Ratun Rahman** and Dinh C. Nguyen. "On Resource-Efficient Quantum Convolutional Neural Networks with Provable Convergence Guarantees. extitIEEE Transactions on Neural Networks and Learning Systems (TNNLS). Under review, 2026.
3. Md. Rafid Islam, Rafsan Jany, Mohammad Saifuddin, and **Ratun Rahman**. "Quantum Learning for Automated Sleep Stage Classification Using Polysomnographic Recordings. extitIEEE Transactions on Emerging Topics in Computational Intelligence (TETCI). Under review, 2026.
4. **Ratun Rahman** and Dinh C. Nguyen. "Toward Optimized Variational Quantum Sensing in Distributed Networks. extitIEEE Network. Under review, 2026.
5. **Ratun Rahman** and Dinh C. Nguyen. "Error-Mitigated Quantum Federated Learning over Heterogeneous Nodes under Dynamic Noise. extitIEEE Journal of Selected Topics in Signal Processing (J-STSP). Under review, 2026.
6. **Ratun Rahman** and Dinh C. Nguyen. "Language-Model-Aware Reward Shaping for Contextual-Bandit Adaptive Zero-Noise Extrapolation." *AAAI 2027 Conference Submission*. Under review, 2026.

7. **Ratun Rahman** and Dinh C. Nguyen. "Layer-Resolved Noise Degradation and Adaptive Dynamical Decoupling in Quantum Neural Networks." *Physical Review A*. Submitted as a Regular Article, 2026.
8. **Ratun Rahman** and Dinh C. Nguyen. "Operation-Resolved Zero-Noise Extrapolation for Quantum Neural Networks with Qubit Reuse." *Quantum Machine Intelligence*. Submitted as a Research Article, 2026.
9. **Ratun Rahman**, Hassan Jalil Hadi, Christopher Gabriel Pedraza Pohlenz, and Ali Shoker. "Scalable Malware Family Classification Using Quantum Kernel-Based Machine Learning." *IEEE Transactions on Dependable and Secure Computing (TDSC)*. Under revision, 2026.

Selected Research Contributions

CMAB-ZNE

Amazon Braket / Rigetti
Cepheus-1-108Q

ADAPTIVE ZERO-NOISE EXTRAPOLATION ON REAL QUANTUM HARDWARE

2026

- Developed a contextual multi-armed-bandit framework for adaptive selection of ZNE noise-scaling strategies using accuracy, uncertainty, and execution-cost signals.
- Executed and tracked 240 QPU tasks on the Rigetti Cepheus-1-108Q superconducting processor through Amazon Braket.

Quantum Federated Learning

HETEROGENEOUS AND PERSONALIZED QUANTUM FEDERATED LEARNING

2024 – 2026

- Developed learning methods addressing non-IID data, sporadic participation, quantum noise, personalization, and heterogeneous QPU constraints.

Federated / Asynchronous Quantum Sensing

VARIATIONAL QUANTUM SENSING

2025 – 2026

- Investigated asynchronous and federated strategies for high-precision variational quantum sensing under heterogeneous sensing conditions and quantum noise.

Research Software & Open-Source Projects

QuNoise

QUANTUM NOISE SIMULATOR AND VISUAL ANALYTICS PLATFORM

2026

- Developed a quantum noise-aware simulation and visualization framework for depolarizing, amplitude-damping, phase-damping, and readout noise in quantum-learning pipelines.
- Implemented zero-noise extrapolation, probabilistic error cancellation, measurement error mitigation, and Clifford data regression, with real-time fidelity and feature-map visualization.

SimQFL

github.com/Ratun11/SimQFL

QUANTUM FEDERATED LEARNING SIMULATOR

2024 – 2026

- Client-server simulator for heterogeneous and personalized quantum federated learning with QPU-level noise modeling, configurable participation, and real-time visualization.

QuSenseSim

github.com/Ratun11/QuSenseSim

VARIATIONAL QUANTUM SENSING SIMULATOR

2025 – 2026

- Interactive multi-sensor quantum sensing simulator supporting configurable sensing conditions, quantum noise, and mitigation workflows.

CMAB-ZNE

github.com/Ratun11/cmab_zne

ADAPTIVE ZNE HARDWARE EVALUATION FRAMEWORK

2026

- Research code and evaluation pipeline for adaptive zero-noise extrapolation and real-QPU experimentation.

Teaching Experience

[Teaching appointments, courses taught, instructional responsibilities, and teaching-development activities to be added.]

Honors, Fellowships & Awards

2026	Alabama EPSCoR GRSP Round 21 Fellowship , Graduate Research Scholars Program fellowship from the Alabama Commission for Higher Education	Alabama, USA
2026	Mary Makima and Lester Ross Scholarship , College of Engineering graduate scholarship	UAH, USA
2023	Top-30 Paper Award , Von Braun Space Exploration Symposium; work on federated learning over satellite networks	USA
2020	ICPC Bangladesh Finalist , International Collegiate Programming Contest selection	Bangladesh
2019	Bronze Prize , IUT Programming Competition	Bangladesh

Presentations & Research Recognition

- 2025

Oral Presentation, “Sporadic Federated Learning in Quantum Environments for Tackling Quantum Noise,” CVPR Workshop

USA
- 2025

Featured Research, Research on federated learning for smart metering and personalized federated learning for smart grids highlighted by Oak Ridge National Laboratory and Pacific Northwest National Laboratory

ORNL & PNNL, USA

Additional Professional Experience

- Alienide Interactive**

Dhaka, Bangladesh

GAME DEVELOPER

Jun 2022 – May 2023
- Developed and tested interactive applications using Unity, C#, Blender, and Python, including work with VR/AR technologies and AI-assisted game development.

Professional Service

- Peer Reviewer:** IEEE Internet of Things Journal; ACM Computing Surveys; NeurIPS 2025; ICLR 2026; IEEE Transactions on Network Science and Engineering; IEEE Transactions on Vehicular Technology; IEEE Network; IEEE Transactions on Dependable and Secure Computing; ACM Transactions on Knowledge Discovery from Data; Journal of Information Security and Applications; Journal of Big Data; IEEE Access; Scientific Reports; Evolutionary Intelligence; Discover Artificial Intelligence; IEEE Open Journal of the Communications Society; IEEE Internet of Things Magazine; IEEE Wireless Communications and Networking Conference (WCNC); IEEE SoutheastCon 2026.
- Additional Technical Service:** Main web developer for an NSF-funded Research Experiences for Undergraduates (REU) site at the University of Alabama in Huntsville.

Selected Research Collaborations

Collaborative research with researchers at NASA Langley Research Center; Oak Ridge National Laboratory; Pacific Northwest National Laboratory; Meta; Kansas State University; University of South Alabama; Worcester Polytechnic Institute; and Virginia Tech.

Technical Skills

- Quantum:** Qiskit, Qiskit Aer, PennyLane, Amazon Braket, Variational Quantum Circuits, Quantum Machine Learning, Quantum Federated Learning, Quantum Sensing, Quantum Noise Modeling, Zero-Noise Extrapolation
- Machine Learning:** PyTorch, Deep Learning, Federated Learning, Personalized Federated Learning, Probabilistic/Bayesian Learning, Meta-Learning, Multimodal Learning
- Programming & Systems:** Python, C++, Rust, CUDA, NumPy, Linux, Git, GPU Acceleration, HPC Workflows, Distributed Execution

References

Available upon request. *[Named academic references can be added for faculty applications.]*