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Rafid Umayer Murshed

Education

2025– **University of Illinois Urbana-Champaign**,
PhD in Computer Science (in progress).

2023– 2025 **The University of Texas at Dallas**,
M.Sc. (Thesis) in Electrical Engineering, **(GPA-4.00/4.00)**.

2017–2022 **Bangladesh University of Engineering and Technology**,
B.Sc. in Electrical and Electronic Engineering.

Research Interests

Physics-Informed AI for Next-Generation Wireless: Building high-fidelity digital twins for 6G networks by deep learning complex wave propagation, enabling advanced beamforming, sensing, and integrated communication-sensing.

Journal Publications

March 2025 **R. U. Murshed**, M. S. Ullah, M. Saquib and M. F. Uddin, **"Beyond Traditional Beamforming: Singular Vector Projection Techniques for MU-MIMO"**, *IEEE Commun. Lett. (IF: 4.2), DOI: 10.1109/LCOMM.2024.3522939*.
- Established the first rigorous theoretical upper bound for interference in MU-MIMO systems
- A novel, low-complexity beamforming algorithm derived from this theory to achieve near-optimal performance

March 2024 **R. U. Murshed**, K. Noshin, M. A. Zakaria, M. F. Uddin, A. F. M. S. Amin and M. E. Ali, **"Real-time Seismic Intensity Prediction using Self-supervised Contrastive GNN for Earthquake Early Warning"**, *IEEE Trans. Geosci. Remote Sens. vol. 62, pp. 1-19, 2024, Art no. 5909119, doi: 10.1109/TGRS.2024.3373643*.
- Developed a physics-aware GNN that learns seismic wave dynamics from minimal labeled data
- Achieved a 234% performance improvement over state-of-the-art, enabling EEW with over 10s of lead time

December 2023 **R. U. Murshed**, M.A. Istiak, M.T. Rahman, Z.B. Ashraf, M.S. Ullah and M. Saquib, **"A CNN-based Multifaceted Signal Processing Framework for Heart Rate Proctoring Using Millimeter Wave Radar Ballistocardiography"**, *Array, Volume 20, 2023, 100327, ISSN 2590-0056, DOI: 10.1016/j.array.2023.100327*.
- Achieving medical grade accuracy (98.73% correlation) for cardiovascular monitoring using noninvasive sensing
- Multi-physics signal processing: Novel CNN architecture extracting heartbeat signatures from complex radar backscatter, advancing contactless health monitoring

April 2023 **R. U. Murshed**, Z. B. Ashraf, A. H. Hridhon, K. Munasinghe, A. Jamalipour and M. F. Hossain **"A CNN-LSTM-based Fusion Separation Deep Neural Network for 6G Ultra-Massive MIMO Hybrid Beamforming"**, *in IEEE Access, vol. 11, pp. 38614-38630, 2023, doi: 10.1109/ACCESS.2023.3266355*.
- Domain-knowledge fused neural architecture with spatial CNN and temporal LSTM for real-time beamforming
- Attained $> 100\times$ speedup over traditional iterative algorithms while preserving optimal performance

Conference Proceedings

September 2024 S. Reza, **R. U. Murshed**, M. Saquib and I. Mahbub, **"Reconfigurable Intelligent Surface Assisted Interference Suppression With Impedance Regulated Deep Neural Network (IR-DNN)"**, *2024 54th European Microwave Conference (EuMC), Paris, France, 2024, pp. 968-971, doi: 10.23919/EuMC61614.2024.10732225*.
- Achieves MSE of only 0.004 and inversely predicts design variables with higher than 97% accuracy

June 2024 **R. U. Murshed**, M. S. Ullah, M. Saquib and M. Z. Win**, "Self-supervised Contrastive Learning for 6G UM-MIMO THz Communications: Improving Robustness Under Imperfect CSI"**, *2024 IEEE International Conference on Communications Workshops (ICC Workshops), Denver, CO, USA, 2024, pp. 220-226, doi: 10.1109/ICCWorkshops59551.2024.10615313*.

- Maintains high throughput even below 10dB CSI SNR, improves performance by 17 times compared to baselines

March 2024 **R. U. Murshed**, M. S. Ullah and M. Saquib, **"A Fast Effective Greedy Approach for MU-MIMO Beam Selection in mm-Wave and THz Communications"**, *2024 58th Annual Conference on Information Sciences and Systems (CISS), Princeton, NJ, USA, 2024, pp. 1-6, doi: 10.1109/CISS59072.2024.10480178*.

- Low-complexity greedy algorithm for MU-MIMO beam- selection and its theoretical, computational advantages

August 2023 **R. U. Murshed**, K. Noshin, M. A. Zakaria, M. F. Uddin, A. F. M. S. Amin and M. E. Ali, **"Analysis of Frequency Content and Statistical Relationship among Earthquake Parameters of Seismic Data in Bangladesh"**, *2023 12th International Structural Engineering and Construction Conference, Chicago, IL, USA, 2023, DOI: 10.14455/ISEC.2023.10(1).RAD-08*.

- Multi-resolution signal analysis combining Fourier and wavelet transforms to extract hidden patterns in seismic wave propagation and novel statistical frameworks for parameter correlation analysis in complex physical systems

December 2022 **R. U. Murshed**, S. K. Dhruba, M. T. I. Bhuian and M. R. Akter, **"Automated Level Crossing System: A Computer Vision-Based Approach with Raspberry Pi Microcontroller"**, *2022 12th International Conference on Electrical and Computer Engineering (ICECE), Dhaka, Bangladesh, 2022, pp. 180-183, doi: 10.1109/ICECE57408.2022.10089007*.

- Real-time computer vision deployment on resource-constrained Raspberry Pi hardware, demonstrating edge AI capabilities for safety-critical applications (Patent Application Filed)

December 2021 **R. U. Murshed**, A. H. Hridhon and M. F. Hossain, **"Deep Learning Based Power Allocation in 6G URLLC for Jointly Optimizing Latency and Reliability"**, *2021 5th International Conference on Electrical Information and Communication Technology (EICT), Khulna, Bangladesh, 2021, pp. 1-6, doi: 10.1109/EICT54103.2021.9733558*.

- Deep learning acceleration of weighted minimum mean square error (WMMSE) optimization, achieving 3000× computational speedup for ultra-reliable communications

Manuscripts under submission

August 2025 S. Qazi, J. Alejandro, **R. U. Murshed**, T.S. Evans, J. Lippert and M. Saquib, **"I-NAV: Inverse Navigation for Questionnaire-Based Geolocation in GPS-Denied Environments"**, *Submitted to IEEE Access*.

- Matches commercial routing engines within 2-3 minutes of travel-time accuracy while working fully offline
- Achieves an IoU of 0.795 with the corresponding ORS region, together with precision 0.848 and recall 0.928

July 2025 **R. U. Murshed**, M.S.A. Rafi, S. Reza, M. Saquib and I. Mahbub, **"MetaFAP: Meta-Learning for Frequency Agnostic Prediction of Metasurface Properties"**, *Submitted to IEEE Transactions on Machine Learning in Communications and Networking*.

- Novel framework built on the meta-learning paradigm for predicting metasurface properties
- Achieves MSE lower than 0.01 and 80% correlation on datasets of varying difficulty

Professional Experience

2023-2025 **Graduate Research Assistant**, *Department of ECE, The University of Texas at Dallas, USA*.

- Performing research on physics-informed AI for 6G wireless systems and signal processing under Dr. Saquib
- Research leadership: Co-authored 7 papers (5 as first-author) in top-tier venues, establishing new theoretical foundations for AI-native wireless networks and THz communications
- Grant development expertise: Contributed to research proposals to NSF, NIH, FAA, and DARPA, developing technical sections on machine learning for wireless sensing and 6G infrastructure

2022-2023 **Research Assistant**, *Japan Institute of Disaster Prevention and Urban Safety (JIDPUS), BUET*.

- Pioneered Bangladesh's first comprehensive seismic dataset, curating and processing wave propagation data from 48 earthquakes using the national sensor network
- Discovered novel seismic wave attenuation patterns specific to the Bengal Basin's geology through data-driven analysis, establishing new regional seismic models

Major Academic Recognitions and Honors

2025 Siebel School of Computing and Data Science Graduate Fellowship, UIUC, Illinois
2025 Summer Research Fellowship, Harvard University
2025 Marie Skłodowska-Curie Doctoral Fellowship, European Union
2024, 2025 NSF Travel Grant Award, ARAFest in Ames, IOWA
2024 Invited Speaker in the show and tell session at MERIF24 in Kansas City, Missouri
2023-2024 Graduate Research Assistantship awarded by UT Dallas
2023 Graduate Teaching Assistantship Award, Purdue University (declined in favor of research position)
2017-2022 University Technical Scholarship (Bangladesh University of Engineering and Technology)

Skills

Programming Python, C++, C, MATLAB, Bash, Verilog, Assembly
ML & DL PyTorch, TensorFlow, Keras, NVIDIA Sionna, Pandas, SciPy, OpenCV
DevTools Git, Docker, Kubernetes, AWS, OpenStack, Linux Environment, LaTeX
Simulation Simulink, PSpice, Quartus, Proteus
Languages English (Fluent), Bengali (Native), Hindi (Conversational), Arabic (Reading/Writing)

Mentorship & Leadership Experience

2023-2025 **Student Research Mentor**, *Department of ECE, The University of Texas at Dallas*.
- Guided multiple undergraduate and MS students in deep learning applications for wireless communications
- Trained students in PyTorch, Sionna simulation framework, and advanced signal processing techniques

2022-2023 **Research leadership**, *JIDPUS, BUET*.
- Supervised 2 undergraduate researchers in earthquake early warning system development
- First-authored 3 papers in top-tier venues, led an interdisciplinary team of electrical, computer, & civil engineers

Academic Service

Peer Reviewer IEEE JSAC, IEEE TMLCN, IEEE TWC, IEEE TCOM, Frontiers, ICMLCN 2024 (10+ reviews completed)

Standardized Test Scores

June 2022 **Test of English as a Foreign Language (TOEFL iBT): Total Score – 114/120**,
Reading: 30/30, Listening: 30/30, Speaking: 28/30, Writing: 26/30.

December 2021 **Graduate Record Examinations (GRE): Total Score – 332/340**,
Verbal: 163/170 (92%), Quantitative: 169/170 (94%), Analytical Writing: 4.5/6 (80%).

References

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Dr. Elahe Soltanaghai,
Assistant Professor,
CS, UIUC,
elahe@illinois.edu.