

Rafid Umayer Murshed

Education

- 2025– **University of Illinois Urbana-Champaign**,
PhD in Computer Science, (GPA-4.00/4.00).
- 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 Systems: 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. Dhruva, M. T. I. Bhuiyan 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 (Accepted)

- September 2026 S.U. Rahman, **R. U. Murshed**, A. Dmitriev, C. Tanriover, R.C. Shah and E. Soltanaghahi, "**WiNeRF: Hardware-Constrained Radiance Fields for Actionable Wireless Channel Modeling**", *Accepted to The 23rd International Conference on Embedded Wireless Systems and Networks (EWSN)*, Dresden, Germany, 2026.
- Hardware-constrained cone-based NeRF that embeds antenna geometry and phase uncertainty into the channel
 - Outperforms neural baselines by 3–6.7 dB SNR with near-oracle beamforming gain and 13° median AoA error
- 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**", *Accepted to Elsevier's Array*.
- 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**", *Accepted to IEEE Access (pending minor revisions)*.
- 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

- 2026- **ML Research Intern**, *InterDigital AI Lab, Los Altos, CA, USA*.
- Developing unsupervised physics-based CSI compression frameworks that enable compact AI-native channel representations for next-generation 3GPP and 6G wireless systems
 - Developing spatiotemporal AI models that forecast wireless channel dynamics in high-mobility environments, enabling actionable wireless digital twins for simulation, optimization, and autonomous 6G network control

- 2025- **Graduate Research Assistant**, *Computer Science, University of Illinois Urbana-Champaign, USA.*
- Developing generative models (NeRFs) to build high-fidelity digital twin systems
 - Applying physics-informed deep learning to model complex physics-based systems and interactions
 - Developing specialized neural operators for object-centric wireless channel modeling with applications in integrated sensing and communications
- 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.*
- Conducted comprehensive survey on earthquake early warning dissemination networks around the world
 - 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 Nvidia Aerial, 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,
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