Muhammad Ahmad Sultan, M.S.

Ph.D. Candidate (Final Year), Electrical & Biomedical Engineering

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Education

- **Ph.D. Biomedical Engineering | Post-candidacy** *Dec 2026*
  The Ohio State University, Columbus, OH, USA *(Expected)*
  - GPA: 3.90/4.00
  - Advisor: Rizwan Ahmad, Ph.D., Lab: Cardiovascular Magnetic Resonance Lab [🌐]
  - **Research Focus**: Development of **self-supervised deep learning** methods for accelerated cardiac MRI reconstruction to improve image quality, reduce scan time, and streamline acquisition workflows.
- **M.S. Biomedical Engineering (Machine Learning)** *Dec 2024*
  The Ohio State University, Columbus, OH, USA
  - GPA: 3.90/4.00
  - **Relevant Coursework**: **Reinforcement Learning**, Optimization, Probability Theory, **Machine Learning** in BME, MR Spectroscopy & Imaging, Medical Imaging & Analysis
- **B.S. Electrical & Computer Engineering | Gold Medalist** *May 2021*
  University of Engineering and Technology, Lahore, Pakistan
  - GPA: 3.90/4.00, Class Rank: 1/200
  - **Relevant Coursework**: Signal Processing, **Machine Learning**, Data Structures & Algorithms, Calculus, Linear Algebra, Embedded Systems, Digital System & Logic Design

Relevant Experience

- **Graduate Research Associate @ Cardiovascular Magnetic Resonance Lab [🌐]** *Aug 2022 – Present*
  The Ohio State University, Columbus, OH, USA
  - Developed DISCUS, a self-supervised **generative deep learning** reconstruction framework, enabling accelerated dynamic MRI reconstruction by combining **deep image prior and temporal manifold learning of image series**, demonstrating improved diagnostic image quality using **NMSE & SSIM** for single-shot free-breathing LGE imaging. | **Paper** | **Code**
  - Extending ML-DIP framework, a multi-dynamic low-rank **deep learning-based generative** DIP, to motion-robust **3D LGE imaging** with **explicit deformation fields** for respiratory and cardiac motion, integrating Dixon fat-water modeling for multi-echo and joint sensitivity maps estimation, trained on **multi-GPU cluster with NVIDIA H100s**, for accelerated ~5-minutes iNAV acquisition, with better arrhythmia handling. | **MLE-DIPS Abstract** | **Cine ML-DIP Paper**
- **Research Assistant @ Signal, Image & Video Processing Lab** *Aug 2021 – July 2022*
  Lahore University of Management Sciences, Lahore, Pakistan
  - Developed a **machine learning** pipeline for a **Vitals Monitoring System** using only PPG time-series data, derived **spectro-temporal features**, applied regression for cough-less blood pressure estimation, achieved better **MAE** compared to state-of-the-art methods, integrated vitals in a fingertip oximeter, enabling continuous and non-invasive monitoring with one wearable sensor outside of a hospital setting. | **Paper**
- **Part-time Tutor @ AI Introductory Class** *Apr 2022 – July 2022*
  Lahore University of Management Sciences, Lahore, Pakistan
  - Tutored and mentored three junior-year computer science students in **foundational AI concepts**, including agent learning, **machine vision optimization**, and deep learning basics.

- **Senior-year Research Intern @ System Simulation Lab** *Feb 2021 – June 2021*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Explored emerging non-volatile memories, investigated shift errors in vertical racetrack memory & VT-codes, contributed to the development of an efficient **syndrome-calculator algorithm** for VRM using radix-4 method.

Skills

- **Research Areas:** Accelerated Image Reconstruction, Unsupervised Deep Learning, Time-Series Modeling, Medical Imaging, Generative Modeling, Motion-Robust Imaging, Signal & Image Processing, Inverse Problems
- **Programming Languages & Data Analysis:** Python, MATLAB, C, SQL, Verilog, JMP (DOE)
- **Frameworks & Libraries:** PyTorch, TensorFlow, Keras, Scikit-learn, NumPy, Pandas

Journal Publications

- C. Chen, M. Vornehm, Z. Bu, P. Chandrasekaran, **M.A. Sultan**, et al. "A multi-dynamic low-rank deep image prior (ML-DIP) for real-time 3D cardiovascular MRI." *Journal of Cardiovascular Magnetic Resonance Imaging (**JCMR**)*, Nov 2025. | **Paper**
- M. Vornehm, C. Chen, **M.A. Sultan**, et al. "Multi-dynamic deep image prior for cardiac MRI." *Magnetic Resonance in Medicine (**MRM**)*, 94 (6): 2668-2679, July 2025. | **Paper** | **Code**
- **M.A. Sultan**, C. Chen, et al. "An unsupervised method for MRI recovery: Deep image prior with structured sparsity." *Magnetic Resonance Materials in Physics, Biology and Medicine (**MAGMA**)*, 38: 859-871, May 2025. | **Paper** | **Code**
- **M.A. Sultan**, & W. Saadeh, "Continuous patient-independent estimation of respiratory rate and blood pressure using robust spectro-temporal features derived from photoplethysmogram only." *IEEE Open Journal of Engineering in Medicine and Biology (**EMB**)*, 5: 637-649, Nov 2023. | **Paper**

Conference Publications

- **M.A. Sultan**, C. Chen, Y. Liu, et al. "Deep image prior with structured sparsity for dynamic MRI reconstruction." 2024 *IEEE International Symposium on Biomedical Imaging **(ISBI)***, Athens, Greece, 1-5. | **Paper**
- X. Lei, P. Schniter, C. Chen, **M.A. Sultan**, et al. "Surface coil intensity correction for MRI." 2024 *IEEE International Symposium on Biomedical Imaging **(ISBI)***, Athens, Greece, 1-5. | **Paper**
- **M.A. Sultan**, & W. Saadeh, "Robust estimation of respiratory rate from photoplethysmogram with respiration quality analysis." 2022 *IEEE International Symposium on Circuits and Systems **(ISCAS)***, Austin, Texas, USA, 65-69. | **Paper**

Peer-Reviewed Abstracts

- **M.A. Sultan**, et al. "A motion-robust dual-echo 3D LGE reconstruction framework." *Journal of Cardiovascular Magnetic Resonance (**JCMR**)*, 28. Presented at **SCMR** 2026 Annual Scientific Sessions, Rio de Janeiro, Brazil. | **Link**
- M. Vornehm, C. Chen, **M.A. Sultan**, et al. "Motion-Guided Deep Image Prior for Dynamic Cardiac MRI." 2025 ***ISMRM & ISMRT** Annual Meeting & Exhibition*, Honolulu, Hawai'i, USA. | **Link**
- C. Chen, **M.A. Sultan**, et al. "FlowDIP: Real-time phase-contrast MRI reconstruction with flow-conditional deep image prior." *Journal of Cardiovascular Magnetic Resonance (**JCMR**)*, 27: 101504. Presented at **SCMR** 2025 Annual Scientific Sessions, Washington, DC. | **Link**
- **M.A. Sultan**, et al. "Deep image prior with structured sparsity for dynamic MRI reconstruction." 2023 ***ISMRM & ISMRT** Annual Meeting & Exhibition*, Toronto, Canada. | **Link**

Oral Presentations

- **M.A. Sultan** et al. "Motion-robust whole-heart MRI-based late gadolinium enhancement (LGE) reconstruction framework for accurate assessment of heart fibrosis." 2026 *Edward F. Hayes Advanced Research Forum*, The Ohio State University, Columbus, OH, USA.
- **M.A. Sultan**, C. Chen, Y. Liu, et al. "Deep image prior with structured sparsity for dynamic MRI reconstruction." 2024 *IEEE International Symposium on Biomedical Imaging **(ISBI)***, **Athens, Greece**, 1-5. | **Paper**

Poster Presentations

- **M.A. Sultan**. "Motion-robust 3D late gadolinium enhancement Imaging (LGE)." 2025 *Davis Heart and Lung Research Institute (DHLRI) Research Day'25*, Columbus, OH, USA.
- X. Lei, P. Schniter, C. Chen, **M.A. Sultan**, et al. "Surface coil intensity correction for MRI." 2024 *IEEE International Symposium on Biomedical Imaging **(ISBI)***, **Athens, Greece**, 1-5. | **Paper**
- **M.A. Sultan**, et al. "Deep image prior with structured sparsity for dynamic MRI reconstruction." 2023 ***ISMRM & ISMRT** Annual Meeting & Exhibition*, **Toronto, Canada**. | **Link**
- **M.A. Sultan**, & W. Saadeh, "Robust estimation of respiratory rate from photoplethysmogram with respiration quality analysis." 2022 *IEEE International Symposium on Circuits and Systems **(ISCAS)***, **Austin, Texas, USA**, 65-69. | **Paper**

Inventions & Patents

- R. Ahmad, **M.A. Sultan**, & S.M. Arshad, "3D real-time cardiovascular magnetic resonance imaging (CMR)." Patent pending, filed on Nov 2025, Application number: PCT/US2025/054129.
- R. Ahmad, **M.A. Sultan**, et al. "Systems and methods for dynamic image reconstruction." Patent pending, filed on Nov 2024, Application number: 63/716,363.

Pre-doctoral Fellowships Submitted

- **American Heart Association (AHA)**, "Motion-robust dual-echo magnetic resonance imaging-based 3D late gadolinium enhancement." Sept 2025.
- **The Ohio State University Presidential Fellowship**, "Accurate, Comprehensive Assessment of Heart Fibrosis Using 3D Motion-robust MRI-based Late Gadolinium Enhancement (LGE)." Oct 2025.

Funding, Honors & Awards

- **NIH-funded PHD Position – Cardiovascular Magnetic Resonance Lab [🌐]** *Aug 2022 - Present*
  The Ohio State University, Columbus, OH, USA
  ◦ Secured a fully-funded GRA Position in CMR Lab by contributing to several advisor's grants.
- **Honorable Mention – Top 5 Oral Presenters** *March 2026*
  Edward F. Hayes Advanced Research Forum, Columbus, OH, USA
  ◦ Recognized among the top 5 oral presenters for research presentation excellence.
- **Academic Excellence – Gold Medalist** *July 2021*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ **Awarded 5 gold medals** for highest departmental GPA across semesters.
- **Merit Scholarship – Top 5 Students** *2017 – 2021*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Dean's merit scholarship awarded to top 5 undergraduate students each semester.
- **Best Semester Project – ML Class** *Dec 2020*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Recognized for top project "NLP-based Fake News Detector" for machine learning class.
- **Sports Tournament – Best Player Award** *Mar 2019*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Best bowling performance and led the champions team in Cricket tournament, ElectroCup2k19.

Professional Services

- **Volunteer Work: Poster Presentation** *Oct 2025*
  The Ohio State University, Columbus, OH
  ◦ Presented a poster representing BME at the Graduate Engineering Research Symposium for undergraduate students.
- **Paper Reviewer**
  Journal of Imaging Informatics in Medicine (JDIM) *April 2026*
  ◦ Reviewed one full-length manuscript.
  Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2026 *April 2026*
  ◦ Reviewed three conference papers (8 page limit).

The IEEE International Conference on Multimedia and Expo (ICME) conference 2026 *Feb 2026*
◦ Reviewed one conference paper (6 page limit).
Medical Imaging with Deep Learning (MIDL) conference 2026 *Jan 2026*
◦ Reviewed five validation track full-length papers (14 page limit).

Undergrad Semester Projects

- **Fake News Detection Using Machine Learning & Natural Language Processing** *Jan 2021*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Used **Tf-Idf & word embeddings** for feature selection, compared performance of **Naive Bayes, SVC, ANN & LSTMs**, signified better performance using t-test with 95% confidence interval.
- **Fire & Smoke Alarm using CNN** *Sept 2020*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Utilized **Data Augmentation** to increase sample size, deployed **Transfer Learning** with MobileNet to enable faster training.
- **Skin Cancer Type Detection from Lesion Images** *May 2020*
  University of Engineering and Technology, Lahore, Pakistan
  ◦ Extended **ResNet-50 & Vgg-16** Models with Transfer Learning, achieved >85% accuracy to detect 10 types of skin cancer.

Certifications

- **Computer Vision & NLP Projects** *July 2020*
  ◦ Completed **3 projects** using keras and scikit-learn: twitter sentiment analysis (NLP), house price prediction (regression), and image classification with data augmentation & transfer learning. | **Coursera**
- **Deep Learning Specialization by Andrew Ng** *May 2020*
  ◦ **5-course** track covering neural networks, CNNs, sequence models, hyperparameter tuning, and model optimization with hands-on programming assignments. | **Coursera**

Workshops & Seminars

- Attending **weekly seminars** in BME department at The Ohio State University. *Aug 2022 – Present*
- Attended **Research Enhancement Sessions** on IEEE Xplore database & publications at EE, LUMS. *Jan 2022*
- Participated in NVIDIA Deep Learning Workshop on **Accelerated Data Science** held at EE, LUMS. *Dec 2021*

Additional Information

Languages: English, Urdu, Hindi, Punjabi
Interests & Activities: Cooking, reading scientific articles, media analysis, data storytelling (memes)

References

1. **Rizwan Ahmad** (Ph.D. Advisor)
   Professor, Biomedical Engineering Department
   The Ohio State University, Columbus, OH, USA
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2. **Orlando P. Simonetti** (Ph.D. Mentor)
   Professor of Radiology and Internal Medicine
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