

ZAHID HASSAN TUSHAR
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RESEARCH INTERESTS

Foundation Models, Generative AI, Representation Learning, Self-Supervised Learning, Multimodal Learning, Parameter-Efficient Deep Learning, Trustworthy and Secure AI, Applied Machine Learning for Scientific and Engineering Systems, High-Dimensional Data Modeling, AI for Remote Sensing and Medical Imaging.

RESEARCH SUMMARY

PhD candidate in Information Systems (AI/ML focus) developing foundation models and machine learning methods for high-dimensional geospatial scientific and engineering data. My work introduces parameter-efficient and physics informed architectures that improve scalability and reliability of AI systems under limited supervision and operational constraints. These methods have supported NASA-funded remote sensing research and produced peer-reviewed publications across remote sensing, computer vision, and geoscience communities.

EDUCATION

Doctor of Philosophy, Information Systems (AI/ML focus) 2022-2026 (expected)
University of Maryland Baltimore County (UMBC), USA
Thesis: Advanced AI Techniques for Atmospheric Cloud and Aerosol Properties
Retrievals from Satellite Observations

Master of Science, Information Systems (AI/ML focus) 2022-2024
University of Maryland Baltimore County (UMBC), USA

Master of Science, Image Processing and Computer Vision (IPCV) 2019-2021
University of Bordeaux (UBx), France
Universidad Autónoma de Madrid (UAM), Spain
Pazmany Peter Catholic University (PPCU), Hungary

Bachelor of Science, Electrical, Electronic and Communication Engineering 2013-2017
Military Institute of Science and Technology, (MIST), Bangladesh

ACADEMIC APPOINTMENTS

Graduate Research Assistant Jan 2022-Current
University of Maryland Baltimore County Baltimore, MD

- Develop **foundation models** using representation learning for *hyperspectral geospatial data*, including parameter-efficient architectures for *large-scale Earth observation*.
- Design deep learning models (Transformers, UNets, diffusion models, CNNs) for inverse problems in atmospheric science, incorporating physical structure and multi-angle observations.
- Study trustworthy AI topics including adversarial robustness, safety of biomedical LLMs, and bias in generative models.
- Contribute to open-source research software released through NASA ACCESS and Earth science data programs.
- Collaborate in interdisciplinary teams spanning AI, atmospheric science, and physics.
- Mentor undergraduate and K–12 students in AI research projects.

Research Assistant*University of Hawaii at Manoa*

Aug 2021-Dec 2021

Honolulu, HI

- Developed meta-learning models for medical image denoising under limited labeled data.

Research Intern*Universidad Autonoma de Madrid, Video Processing and Understanding Lab*

Feb 2021 – Jul 2021

Madrid, Spain

- Built a self-supervised learning framework for classifying medical imaging data (skin cancer).
- Designed explainable AI methods to interpret CNN representations and decision patterns.

Lecturer (Full-Time Faculty)*Military Institute of Science and Technology, (MIST)*

Jan 2017– Aug 2019

Dhaka, Bangladesh

- Taught undergraduate lectures and laboratory courses in Electrical and Computer Engineering.
- Courses included Signals and Systems, Electronic Engineering, Electrical Machines, Digital Signal Processing Lab, Communication Systems Lab, and Digital Electronics Lab.
- Mentored undergraduate research projects and supervised laboratory instruction.

PUBLICATIONS

1. **Zahid Hassan Tushar**, and Sanjay Purushotham, “HyperFM: An Efficient Hyperspectral Foundation Model with Spectral Grouping”. Accepted for presentation (findings track) at The IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2026.
2. **Zahid Hassan Tushar**, and Sanjay Purushotham, “Foundation Ai Models for Aerosol Optical Depth Estimation From Pace Satellite Data”. Accepted for presentation at the 2026 IEEE International Geoscience and Remote Sensing Symposium (IGARSS).
3. **Zahid Hassan Tushar**, Adeleke Ademakinwa, Jianwu Wang, Zhibo Zhang, and Sanjay Purushotham. “Cloud Optical Thickness Retrievals Using Angle Invariant Attention Based Deep Learning Models”, 2025 IEEE International Conference on Image Processing (ICIP), Sep 2025.
4. **Zahid Hassan Tushar**, Adeleke Ademakinwa, Jianwu Wang, Zhibo Zhang, and Sanjay Purushotham. “Joint cloud optical thickness and cloud effective radius property retrievals using attention-based deep learning models”. IEEE International Geoscience and Remote Sensing Symposium (IGARSS), Aug 2025.
5. Adeleke Ademakinwa, Zhibo Zhang, Daniel Miller, Kerry Meyer, Steven Platnick, **Zahid H. Tushar**, Sanjay Purushotham, and Jianwu Wang. “Impacts of the Three-dimensional Radiative Effects on Cloud Droplet Number Concentration Retrieval and Aerosol Cloud Interaction Analysis”. *EGU sphere*, 2025, pp.1-55.
6. **Zahid Hassan Tushar**, Adeleke Ademakinwa, Jianwu Wang, Zhibo Zhang and Sanjay Purushotham, “CloudUNet: Adapting UNet for Retrieving Cloud Properties”, 2024 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), July 2024, page 8170–8174.
7. Ademakinwa, Adeleke S., **Zahid Hassan Tushar**, Jianyu Zheng, Chenxi Wang, Sanjay Purushotham, Jianwu Wang, Kerry G. Meyer, Tamas Várnai, and Zhibo Zhang. "Influence of cloud retrieval errors due to three-dimensional radiative effects on calculations of broadband shortwave cloud radiative effect." *Atmospheric Chemistry and Physics* 24, no. 5 (2024): 3093-3114.
8. **Zahid Hassan Tushar*** and M. M. Islam*, "Interpreting and Comparing Convolutional Neural Networks: A Quantitative Approach," 2021 5th International Conference on Electrical Engineering and Information Communication Technology (ICEEICT), 2021, pp. 1-6, doi: 10.1109/ICEEICT53905.2021.9667854.

9. Shabnam, Musharrat, Imtiaz Hasan Chowdhury, **Zahid Hassan Tushar**, Sunjida Sultana, and Md Hossam-E-Haider. "Performance evaluation of GNSS receiver in multi-constellation system." International Conference on Electrical, Computer and Communication Engineering (ECCE), pp. 610-614. IEEE, 2017.

POSTERS & PRESENTATION

1. **Zahid Hassan Tushar**, and Sanjay Purushotham, "Security of Biomedical Large Language Models: Threats, Defenses, and Open Challenges". Accepted for Poster Presentation at the Hot Topics in the Science of Security Symposium (HotSoS) 2026.
2. **Zahid Hassan Tushar** and Sanjay Purushotham, "View-Invariant Cloud-Attention Network for Retrieval of Atmospheric Cloud Microphysical Properties", CV4Science, **CVPR** Workshop 2025.
3. **Zahid Hassan Tushar**, Adeleke Ademakinwa, Zhibo Zhang and Sanjay Purushotham, "Enhancing Aerosol and Cloud Retrievals Based on Hyperspectral Observations with Deep Learning: A Case Study with PACE-OCI", presented at UMBC COEIT Research Day 2025, and UMBC Annual Research Symposium 2025.
4. **Zahid Hassan Tushar**, Adeleke Ademakinwa, Jianwu Wang, Zhibo Zhang, and Sanjay Purushotham. "Joint cloud optical thickness and cloud effective radius property retrievals using attention-based deep learning models". Presented at **AGU** Annual Meeting. American Geophysical Union (AGU), 2024. and UMBC COEIT Research Day 2025.
5. Adeleke Ademakinwa, Daniel J Miller, **Zahid Hassan Tushar**, Sanjay Purushotham, Jianwu Wang, Kerry Meyer, Steven E Platnick, Zhibo Zhang, "Influence of the Three-dimensional Radiative Effects on Cloud Droplet Number Concentration Retrievals and Their Response to Cloud Susceptibility". Presented at **AGU** Annual Meeting. American Geophysical Union (AGU), 2024.
6. Adeleke Segun Ademakinwa, **Zahid H. Tushar**, Jianyu Zheng, Chenxi Wang, Sanjay Purushotham, Jianwu Wang, Kerry Meyer, Tamas Varnai, Zhibo Zhang, "Radiative Closure Studies of How Cloud Property Retrieval Errors due to three-dimensional radiative effects Influence Our Understanding of Broadband Cloud Radiative Effects". In 104th Annual AMS Meeting 2024 (Vol. 104, p. 437889).
7. **Zahid Hassan Tushar**, Adeleke Ademakinwa, Jianwu Wang, Zhibo Zhang and Sanjay Purushotham, "CloudUNet: Adapting UNet for Retrieving Cloud Properties", COEIT Research Day 2024, April 2024.
8. **Zahid Hassan Tushar** and Sanjay Purushotham, "A Study of Federated Adversarial Learning for Automatic Speech Recognition", presented at IS Symposium 2022, Department of Information System, UMBC, April 2022. Also presented at the Annual Review Meeting of Army Research Laboratory, University of Maryland College Park, May 2022.

RESEARCH PROJECTS

Parameter-Efficient Foundation Models for Hyperspectral Earth Observation

Funded project, Jan 2025~ Present

Supervisor: Professor Sanjay Purushotham, UMBC|| Professor Zhibo Zhang, UMBC

- Developing compact foundation models for hyperspectral satellite data from NASA's PACE mission.
- Designing spectral grouping and representation compression for scalable foundation modeling.
- Focus on generalization, efficiency, and physical consistency.

Cloud Properties Retrievals using Deep Learning Techniques

NASA funded project, June 2022~ Present

Supervisor: Professor Sanjay Purushotham, UMBC|| Professor Zhibo Zhang, UMBC

- Designed attention-based and generative architectures for atmospheric inverse problems.
- Studied robustness under multi-angle observation geometry and 3D radiative effects.

Adversarial Federated Learning for Speech Recognition

Independent Study, January 2022~ July 2022

Supervisor: Professor Sanjay Purushotham, UMBC

- Investigated robustness of federated learning under adversarial attacks.
- Studied privacy and security risks in distributed model training.

OPEN-SOURCE & RESEARCH SOFTWARE

- Contributor to NASA-funded research software packages released through the NASA ACCESS program. Link: <https://software.nasa.gov/software/GSC-19108-1>
- Developed reusable training, evaluation, and data-processing modules supporting operational satellite analytics workflows.
- Experience packaging research code for reproducibility, public release, and long-term maintenance.

GRANTS AND AWARDS

- UMBC COEIT Summer Student Project award 2025[\$5000]
- Doctoral Poster Awards, UMBC COEIT Research Day, 2024 & 2025
- IGARSS Travel Grant, 2025
- UMBC Information Systems Travel Grants, 2024, 2025
- UMBC GSA Professional Development Grants, 2024, 2025
- Erasmus Mundus Joint Master's Scholarship (2019–2021)
- MIST Medal for Academic Excellence, 2016

TEACHING INTERESTS

Generative AI, Machine Learning, Data Science, Deep Learning, Data Visualization, Python Programming, AI for Scientific Discovery, Trustworthy AI, Federated Learning.

RESEARCH METHODS AND TECHNICAL SKILLS

Machine Learning & AI PyTorch, Generative AI, GANs, Diffusion Models, Transformers, CNNs, UNets, LLMs, Self-Supervised Learning, Foundation Models, Explainable AI

Statistical Learning Regression, Classification, Regularization, Model Selection, Bias-Variance Tradeoff, Evaluation Metrics

Scientific Computing High-Dimensional Data Modeling, Multimodal Data Fusion, Representation Learning

Systems & Infrastructure HPC clusters, Multi-GPU training, GitHub, Reproducible pipelines

PROFESSIONAL MEMBERSHIPS

- Institute of Electrical and Electronics Engineers (IEEE) - <https://www.ieee.org/>
- American Geophysical Union (AGU) - <https://www.agu.org/>

LEADERSHIP AND VOLUNTARY ACTIVITIES

- President, Bangladesh Student Association at University of Maryland, Baltimore County.[2024-25]
- Media Coordinator, Bangladesh Student Association at University of Maryland, Baltimore County.[2024-25]
- East-West Center (EWC) Student Affiliate Program, Hawaii, 2021.