Jaydeep Rade

Ph.D. Student | Electrical Engineering | Iowa State University

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Summary

Ph.D. candidate specializing in Deep Learning and Computer Vision, with expertise in PyTorch, Transformers, NeRFs, and Diffusion Models. Strong publication record in top-tier venues and hands-on experience in applied AI through industry internships. Passionate about building real-world solutions using Vision, LLMs, and Agentic AI.

Education

Iowa State University — **Ames, Iowa**
Ph.D., Electrical Engineering **GPA: 3.85/4.00** — **Jan 2021 – May 2025**
Co-advised by Dr. Adarsh Krishnamurthy and Dr. Anwesha Sarkar
Honors: Graduate Research Excellence Award May 2024

Iowa State University — **Ames, Iowa**
MS (thesis)., Electrical Engineering **GPA: 3.70/4.00** — **Aug 2018 – May 2021**
Co-advised by Dr. Soumik Sarkar and Dr. Adarsh Krishnamurthy

Veermata Jijabai Technological Institute (VJTI) — **Mumbai, India**
Bachelor of Technology in Electronics Engineering **GPA: 7.50/10.00** — **Aug 2014 – May 2018**

Technical Skills

Programming: Python, Matlab, C++, C#, Unity, LaTeX

Deep Learning Frameworks: PyTorch, Pytorch-Lightning, TensorFlow, Keras, Scikit-Learn, OpenCV

Publications

1. N. Masud, **J. Rade**, Md. H. Hassan, A. Krishnamurthy, A. Sarkar; Machine learning approaches for improving atomic force microscopy instrumentation and data analytics, **Frontiers in Physics, 2024**. [article]
2. **J. Rade**, E. Herron, S. Sarkar, A. Sarkar, A. Krishnamurthy, "3D Reconstruction of Protein Structures from Multi-view AFM Images using Neural Radiance Fields (NeRFs)", Deep Learning for Geometric Computing (DLGC) Workshop, **CVPR 2024**. [article]
3. E. Herron, **J. Rade**, A. Jignasu, B. Ganapathysubramanian, A. Balu, S. Sarkar, A. Krishnamurthy, "Latent Diffusion Models for Structural Component Design", Computer-Aided Design 2024, **CAD 2024**. [article]
4. **J. Rade**, A. Jignasu, E. Herron, A. Corpuz, B. Ganapathysubramanian, S. Sarkar, A. Balu, A. Krishnamurthy, "Deep Learning-based 3D Multigrid Topology Optimization of Manufacturable Designs", **EAAI 2023**. [article]
5. **J. Rade**, S. Sarkar, A. Sarkar, A. Krishnamurthy, "3D Reconstruction of Protein Complex Structures Using Synthesized Multi-View AFM Images", Machine Learning for Structural Biology (MLSB) Workshop, **NeurIPS 2022**. [article]
6. **J. Rade**, J. Zhang, S. Sarkar, A. Krishnamurthy, J. Ren, A. Sarkar, "Deep Learning for Live Cell Shape Detection and Automated AFM Navigation", Volume 9, Article No. 522, **Bioengineering Journal 2022**. [article]
7. **J. Rade**, A. Balu, E. Herron, A. Jignasu, S. Botelho, S. Adavani, S. Sarkar, B. Ganapathysubramanian, A. Krishnamurthy, "Multigrid Distributed Deep CNNs for Structural Topology Optimization ", AI for Design and Manufacturing (ADAM) Workshop, **AAAI 2022**. [article]
8. E. Herron, A. Jignasu, **J. Rade**, X. Lee, A. Balu, A. Krishnamurthy, S. Sarkar, "Fast Unsupervised Generative Design for Structural Topology Optimization", AI for Design and Manufacturing (ADAM) Workshop, **AAAI 2022**. [article]
9. **J. Rade**, J. Zhang, S. Sarkar, A. Krishnamurthy, J. Ren, A. Sarkar, "AI Guided Measurement of Live Cells Using AFM", Modeling, Estimation and Control Conference, **MECC 2021**.
10. **J. Rade**, A. Balu, E. Herron, J. Pathak, R. Ranade, S. Sarkar, and A. Krishnamurthy, "Algorithmically-Consistent Deep Learning Frameworks for Structural Topology Optimization", Engineering Applications of Artificial Intelligence 106, 104483, **EAAI 2021**. [article]
11. **J. Rade**, "Deep Learning Frameworks for Structural Topology Optimization", Graduate Theses and Dissertations, Iowa State University, 18592, 2021. [thesis]

Work Experience

Computer Vision Intern at BAYER, Chesterfield, MO **May 2023 – Aug 2023**

- Achieved **92%** segmentation accuracy for insect detection using a **Transformer**-based **Neural Network**.
- Designed a **transfer learning** pipeline for accurate segmentation using as few as 50 unseen samples.
- Engineered a model monitoring framework for data drift detection in deployed models, ensuring stable performance.

Machine Learning Intern at ANSYS, Canonsburg, PA **Aug 2019 – Aug 2020**

- Accelerated Structural Topology Optimization by **39**$\times$ using **U-Net and U-SE-ResNet** architectures.
- Developed **CNN and CNN-LSTM** architectures for 2D and 3D geometries using **Keras** and **PyTorch**.
- Scaled the data generation by integrating **Python** with ANSYS Mechanical, enhancing automation and efficiency.
- Delivered the talk on the **Introduction to Machine Learning** as part of Learning Series at ANSYS.

Research Experience

Research Assistant, Iowa State University, Ames, IA **Jan 2019 – Present**

1. **AI-AFM Assisted Structure Prediction of Protein and Protein Complexes**
   - Developing novel view synthesis methods for **3D NeRF** reconstruction of protein structure using **Diffusion Models**.
   - Designed a **GPU-accelerated** Virtual AFM utilizing **volume rendering** for efficient synthetic data generation.
   - Generated a **large-scale synthetic dataset** of multi-view AFM images for over 550,000 3D protein structures.
2. **Cell Shape Detection in AFM Microscopic Images**
   - Analyzed zero-shot performance of **Vision-Language Models (VLMs)**, including **GPT-4o**, **Gemini**, and **LLaVA**, for cell shape classification.
   - Leveraged **transfer learning** to enhance **YOLOv3**-based **object detection** for cell shape detection in AFM images, achieving a **43%** accuracy improvement.
   - Achieved up to **60**$\times$ speed improvement in AFM scanning probe traversal using intelligent vision-based navigation over manual navigation.
3. **Deep Learning for High-resolution 3D Structural Topology Optimization**
   - Designed and implemented a **PSP-U-Net** architecture in **Keras** for Structural Topology Optimization.
   - Developed an efficient and scalable multigrid-style training for **high-resolution (**$128 \times 128 \times 128$**) 3D** structures.
   - Achieved **5**$\times$ training speedup at high-resolution by leveraging distributed training with multi-node, multi-GPU setup.
4. **Deep Learning for Structural Topology Optimization**
   - Designed a framework of multiple **3D CNNs** to perform end-to-end topology optimization.
   - Created a dataset of 60K high-resolution $(128 \times 128 \times 128)$ 3D voxelized structures and accelerated the generation pipeline using **GNU parallel**.

Talks and Posters

1. "AI and AFM Assisted Structure Prediction of Protein Complexes.", NVIDIA GPU Technology Conference, **NVIDIA GTC 2025**.
2. "Deep Learning for 3D Protein Structure Prediction from AFM Images." Biomedical Engineering Society, **BMES 2024**.
3. "Multigrid Deep Learning for 3D Structural Topology Optimization." 17th U.S. National Congress on Computational Mechanics, **USNCCM 2023**.
4. "Virtual AFM: Generating Synthetic 2D Multi-view Images from 3D Protein Structure." Biomedical Engineering Society, **BMES 2022**.
5. "Deep Learning Guided Navigation of Live Cells for AFM." Workshop on Scientific Machine Learning: Foundations and Applications at, **TrAC, Iowa State University 2022.**
6. "Deep Learning Accelerated Topology Optimization." NVIDIA GPU Technology Conference, **NVIDIA GTC 2021**.
7. "Physics Aware Machine Learning for Structural Topology Optimization." 16th U.S. National Congress on Computational Mechanics, **USNCCM 2021**.
8. "Deep learning frameworks for structural topology optimization." Mechanistic Machine Learning and Digital Twins for Computational Science, Engineering and Technology, **MMLDT 2021**.

Relevant Coursework

Deep Learning, Digital Signal Processing, Data Analytics, Machine Vision, GPU Computing, Computer Graphics

Leadership And Awards

1. Recipient of **Graduate Research Excellence Award** at Iowa State University May 2024.
2. **General Manager** at Technovanza'16 (Annual Technical Festival of VJTI).[website]
3. Awarded with **Foundation for Excellence (FFE) Scholarship** which covered four years of undergrad tuition fees.