# Jaydeep Rade

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

515-451-3196 https://jaydeepradejd.github.io/ jrrade@iastate.edu LinkedIn GitHub Google Scholar

## Summary

Ph.D. candidate specializing in Deep Learning and 3D 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 – Aug 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**, Electronics Engineering, GPA: 7.50/10.00 — **Aug 2014 – May 2018**

## Technical Skills

**Programming Languages:** Python, C++, Matlab, LaTeX, **AI Frameworks:** PyTorch, Pytorch-Lightning, TensorFlow, Keras, Scikit-Learn, OpenCV, HuggingFace, **GenAI:** LangChain, LangGraph, **UI Frameworks:** Streamlit, Gradio.

## Publications

1. **J. Rade**, et al., "ProFusion: 3D Reconstruction of Protein Complex Structures from Multi-view AFM Images", **Nature Machine Intelligence** (Under review).
2. **J. Rade***, A. Biswas, et al., "Conversational LLM-Based Decision Support for Defect Classification in AFM Images", **IEEE Open Journal of Instrumentation and Measurement, 2025**.[article]
3. **J. Rade***, N. Masud, Md. H. Hasan, A. Krishnamurthy, A. Sarkar; "Machine learning approaches for improving atomic force microscopy instrumentation and data analytics", **Frontiers in Physics, 2024**. [article]
4. **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]
5. 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]
6. **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]
7. **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]
8. **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]
9. **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]
10. 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]
11. **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**.
12. **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]
13. **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**× 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** [Code]
   - 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 and Defect Detection in AFM Microscopic Images** [Cell Shape Detection], [Defect Detection LLM]
   - Created an **LLM**-powered user interface using **LancgChain, LangGraph and Streamlit** to guide users in identifying and resolving defects in AFM 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**× 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** [Code]
   - Designed a deep learning framework for end-to-end topology optimization using **PSP-U-Net** and **3D CNNs**.
   - Created a dataset of 60K **high-resolution 3D** structures and accelerated data generation with GNU Parallel.
   - Achieved a **5**× training speedup using distributed training across **multi-node, multi-GPU** infrastructure.

## Talks and Posters

1. "AI-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.