

# Jaydeep Rade

Ph.D. Student | Electrical Engineering | Iowa State University | Ames, IA 50010

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## Summary

Ph.D. candidate with expertise in Deep Learning and Computer Vision. Proficient in Python and PyTorch, with hands-on experience in Transformer models, NeRFs, and Diffusion Models. Strong research background with publications in top conferences and journals and impactful industry internships. Seeking opportunities to apply AI in real-world applications, particularly in computer vision, LLMs, and multimodal learning.

## Education

### Iowa State University

Ph.D., Electrical Engineering **GPA: 3.85/4.00**

Co-advised by Dr. Adarsh Krishnamurthy and Dr. Anwesha Sarkar

**Honors:** Graduate Research Excellence Award May 2024

Ames, Iowa

Jan 2021 – May 2025

### Iowa State University

MS (thesis), Electrical Engineering **GPA: 3.70/4.00**

Co-advised by Dr. Soumik Sarkar and Dr. Adarsh Krishnamurthy

Ames, Iowa

Aug 2018 – May 2021

### Veermata Jijabai Technological Institute (VJTI)

Bachelor of Technology in Electronics Engineering **GPA: 7.50/10.00**

Mumbai, India

Aug 2014 – May 2018

## Technical Skills

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

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

## 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

- 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×** 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×** 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**.

## Publications

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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”, *AAAI-22 Workshop on AI for Design and Manufacturing (ADAM)*. [[article](#)]
8. E. Herron, A. Jignasu, **J. Rade**, X. Lee, A. Balu, A. Krishnamurthy, S. Sarkar, “Fast Unsupervised Generative Design for Structural Topology Optimization”, *AAAI-22 Workshop on AI for Design and Manufacturing (ADAM)*. [[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](#)]

## Relevant Coursework

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|-----------------------------|-----------------------|---------------------|
| • Deep Learning             | • Concurrent Systems  | • Machine Vision    |
| • Machine Learning          | • Convex Optimization | • GPU Computing     |
| • Digital Signal Processing | • Data Analytics      | • Computer Graphics |

## Talks

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

## Leadership And Awards

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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.