Jaydeep Rade

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INTEREST AREAS

Deep Learning, Computer Vision, 3D Reconstruction, Object Detection, Segmentation, Generative Models

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, TensorFlow, Keras, Scikit-Learn, OpenCV

PROFESSIONAL EXPERIENCE

Bayer **May 2023 – Aug 2023**
Computer Vision Intern, Crop Science Division Chesterfield, Missouri

- Enhanced segmentation performance through the implementation of a **transformer**-based neural network.
- Investigated Domain Adaptation techniques for **transformer-based segmentation** network.
- Evaluated data drift detection methods to effectively monitor segmentation performance in the presence of new and evolving data.

ANSYS, Inc. **Aug 2019 – Aug 2020**
Machine Learning Intern, ML Team, CTO Office Canonsburg, Pennsylvania

- Implemented **U-Net, U-SE-ResNet architectures** for Topology Optimization.
- Used **Keras, PyTorch** deep learning frameworks to develop **CNN and CNN-LSTM** based architectures for **2D and 3D geometries**.
- Integrated **python** with ANSYS Mechanical software for data generation pipeline.
- Delivered the talk on the **Introduction to Machine Learning** as part of Learning Series at ANSYS.

RESEARCH EXPERIENCE

Research Assistant, Iowa State University **Jan 2019 - Present**

1. **AI-AFM Assisted Structure Prediction of Protein Complexes**
   - Developing novel view synthesis methods for 3D **NeRF** reconstruction of protein structure using **diffusion models**.
   - Created Virtual AFM:gpu-accelerated computer graphics program and accelerated data generation using GNU Parallel.
   - Compiled an large dataset featuring multi-view virtual AFM images for over 550,000 voxelized 3D protein structures.
2. **Cell Shape Detection in AFM Microscopic Images**
   - Evaluated zero-shot performances of **VLMs** like **GPT-4o, Gemini and LLaVA** for cell shape classification.
   - Implemented **YOLO object detection** algorithm using **PyTorch** for cell shape detection in AFM images.
   - Incorporated intelligent vision-based navigation for traversing the AFM scanning probe.
3. **Deep Learning for High-resolution 3D Structural Topology Optimization**
   - Designed PSP-U-Net architecture in **Keras** for performing STO.
   - Leveraged multigrid-style training to train up to **high-resolution of** $128 \times 128 \times 128$ **3D** structures.
   - Achieved 5× speed up using distributed training across multiple GPUs.
4. **Deep Learning for Structural Topology Optimization**
   - Designed multiple neural networks model to perform end-to-end topology optimization consistent with **SIMP** algorithm using **3D CNNs**.
   - Built and accelerated the dataset generation pipeline using **GNU parallel** shell and created a dataset of 60K high-resolution of $128 \times 128 \times 128$ 3D voxelized structures.

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 ", **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

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

TALKS

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

LEADERSHIP AND AWARDS

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