

Vahid Jebraeeli

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Summary

A highly motivated final-year Ph.D. researcher with demonstrated expertise in machine learning and deep learning, specializing in large-scale generative models and foundational vision systems. Proven track record of leading end-to-end research, from theoretical innovation to model implementation and evaluation, underscored by publications in leading conferences. Possesses over 8 years of experience designing and optimizing scalable AI systems for applications in multimodal content generation and efficient learning.

Education

Ph.D. in Electrical Engineering (with Minor in Mathematics) at North Carolina State University, Raleigh, NC, United States *2022 – (Sep. 2025)*

Thesis Title: “Balanced Scalability for Sustainable ML: Novel Data Synthesis and Transformer Dynamics for Efficient AI Systems”

Honors: Recipient of the Graduate Merit Award from the College of Engineering (2022 & 2024).

Supervisor: [Dr. Hamid Krim](#)

M.Sc. in Electrical Engineering at Sharif University of Technology, Tehran, Iran

2018 - 2021

Thesis Title: “Human identity recognition through gait and body motions analysis”

Honors: Graduated with Distinction (19.75/20 Thesis Grade); Ranked 3rd among all students in Secure Communications & Cryptography.

Supervisor: [Dr. Shahrokh Ghaemmaghami](#)

B.Sc. in Electrical Engineering at Amirkabir University of Technology, Tehran, Iran

2014 - 2018

Thesis Title: “Human Identity recognition through Iris analysis by keypoint-based feature extraction method under variable image quality conditions”

Honors: Ranked in the top 0.3% (491 out of 223,000+) in the National University Entrance Exam.

Supervisor: [Dr. Hamidreza Amindavar](#)

Research Interests

Machine Learning • Computer Vision • vLLM • Agentic AI • MCP • Transformers • Diffusion Models • Auto-Encoders • Generative Models • Deep Learning • Image and Video Analysis • Efficient AI Systems • 3D Computer Vision • Multimodal Learning • MLOps • Responsible AI • LLMs

Skills

- **Programming platforms:** Python (Advanced) • MATLAB (Advanced) • C++ (Moderate) • Git • Jupyter • VS Code • Pycharm • Anaconda
- **Computer Vision & DL:** PyTorch (Lightning) • TensorFlow/Keras • MMDetection/Detectron2 • Ultralytics YOLOv5/v8 • Vision Transformers (ViT/Swin) • DETR/Deformable DETR • Segment Anything (SAM) • diffusion models (Stable Diffusion, ControlNet) • NeRF & 3D Gaussian Splatting • CLIP/BLIP-2/LLaVA • Autoencoders • Optimal Transport
- **Classical CV & Geometry:** SIFT/SURF • Multi-view Geometry • SLAM • COLMAP • Open3D
- **Optimization & Deployment:** TensorRT • ONNX Runtime • OpenVINO • INT8/FP16 Quantization • Pruning • Distillation • TFLite/CoreML
- **MLOps & DataOps:** MLflow • Weights & Biases • Docker • GitHub Actions • Vertex AI; Dataset Tooling • Data Versioning & Monitoring

Recent Research Projects

Synergizing Volterra Filters and Vision Transformers (2025-Present)

- Proposed a novel architecture that integrates Volterra filters with Vision Transformers to improve context-based learning by capturing both local non-linear features and global contextual relationships.
- Developed a "Volterra-Conditioned Attention" mechanism where a global Volterra operator generates prior tokens that condition the standard attention process.
- Investigating a continuous-time, ODE-based formulation for attention dynamics, replacing discrete Transformer blocks with a structured polynomial vector field for enhanced interpretability and stability.

ViT-based Class-conditioned Autoencoder (ViTCAE) (2025-Present)

- Designed and implemented a novel hierarchical Vision Transformer-based autoencoder that re-purposes the class token into a generative linchpin for improved controllable image synthesis.
- Developed a dynamic, convergence-aware attention temperature scheduler and a head-freezing mechanism to significantly reduce computational overhead (FLOPs) without compromising model fidelity.
- Established a hierarchical dependency where global semantics, captured by the class token's latent variable, directly inform the synthesis of local patch-level details.

- **Optimization of Vision Transformer (ViT) Dynamics (2024-2025)**

- Investigated the evolution of attention mechanisms in Vision Transformers during training to understand and enhance model convergence and architectural efficiency.
- Developed novel optimization strategies for ViT training by leveraging the Earth Mover's Distance (EMD) of attention heatmaps across iterations.
- Implemented control mechanisms to guide the optimal training of ViTs through parameter evolution analysis.

- **Expansive Synthesis for Data-Efficient Learning (2023-2024)**

- Created an "Expansive Synthesis" model to generate large-scale, information-rich datasets from minimal samples
- Utilized expander graph mappings and feature interpolation to preserve data distribution and feature relationships
- Developed a framework leveraging neural networks' non-linear latent space and Koopman operator theory
- Validated the model by comparing classifiers trained on generated data to those trained on original datasets
- Presented findings in the paper "Generative Expansion of Small Datasets: An Expansive Graph Approach" (published in ICASSP 2025)

- **Dataset Condensation using Koopman Operator Theory (2022-2023)**

- Developed an Autoencoder-based Dataset Condensation Model (Koopcon) utilizing Optimal Transport theory and Wasserstein distance
- Synthesized large datasets into compact, information-rich representations while maintaining essential features and label distributions
- Demonstrated that classifiers trained on condensed data exhibited comparable performance to those trained on original datasets
- Presented findings in the paper "Koopcon: A new approach towards smarter and less complex learning" (published in ICIP 2024)

Remarkable Work & Research Experiences

- **Research Assistant (at [VISSTAL Lab](#), NCSU)** as Computer Vision and Deep Learning Researcher supervised by Dr. Hamid Krim (2022-present)

- Led the design of novel generative architectures (ViTCAE) and conducted foundational research into the dynamics of Vision Transformers to improve efficiency and performance.
- Created an "Expansive Synthesis" framework leveraging expander graph mappings and neural latent spaces to generate large-scale, information-rich datasets from minimal samples, advancing data-efficient learning paradigms. Research published in ICASSP 2025.
- Developed "Koopcon" a novel dataset condensation framework utilizing Koopman Operator Theory and Optimal Transport, efficiently synthesizing large datasets into compact, information-rich representations while preserving essential features. Research published in ICIP 2024.

- **AI & CV Intern at USDA (US Department of Agriculture)** as a Machine Learning engineer supervised by Dr. Ebraheim Babiker (Summer 2023)

- Designed and trained a Deep Neural Network based in Yolo-V8 for detecting and segmenting Blueberries out of bush
- Performed a ML-based Colour Calibration for analyzing the maturity of Blueberries
- Measured the diameter of blueberries in order to estimate the genotype of the mother plant

- **Senior ML Engineer (at AI-bridge Company, Stuttgart, Germany)** as R&D Computer Vision & Deep Learning Engineer (2021-2022)

- Utilized style transfer approaches in order to transfer features in Generative networks Like Fashion, Makeup transfer, etc.
- Developed a robust neural network architecture for precisely removing background from the salient object
- Established text-to-image diffusion models for generating higher resolution images and videos

- **Senior Machine Learning Engineer (at Sharif Technology Services Complex)** as Algorithmic Trading Researcher (2020-2021)

- Designed and implemented an algorithm based on XGboost framework for Bitcoin price prediction
- Designed and implemented a genetic algorithm based cross validation scheme for tuning XGboost

- **Research Assistant (at Electronic Research Institute, Sharif Univ.)** as ML Researcher supervised by Dr. Shahrokh Ghaemmaghami (2018-2021)

- Analyzed gait and body motions as a unique biometric feature for identity recognition
- Designed a Deep Neural Network for reaching state of the art accuracy in human identity recognition
- Designed and implemented an algorithm for disentangling the identity-unrelated factors (e.g., camera viewpoint, illumination conditions)

- **Research Assistant (at Digital Com. Lab, Amirkabir Univ.)** as DSP Researcher supervised by Dr. Hamidreza Amindavar (2014-2018)

- Designed an algorithm for Iris segmentation from images with different quality conditions
- Feature Extraction from Iris images for doing identity recognition task
- Developed a data fusion scheme for merging recognition scores from different methods

Awards & Honors

- Awarded a Fully Funded Ph.D. Research Assistantship covering all tuition and health insurance by North Carolina State University. (2022 – 2025)
- Recipient of the Graduate Merit Award (GMA) from the College of Engineering at NC State University (2022 & 2024)
- Defended my M.Sc. & B.Sc. theses with 19.75 grade (out of 20) and best possible grade respectively (2021 & 2018)
- Ranked 3rd among all students of Secure Communications & Cryptography in EE department (2020)
- Ranked 107 among 31,000 participants (top 0.4%) in the National Iranian Universities' Entrance Exam for Electrical Engineering M.Sc. Degree (2018)
- Ranked 491 among 223,000 participants (top 0.3%) in the National Iranian Universities' Entrance Exam for B.Sc. Degree (2014)
- Member of National Organization for Development of Exceptional Talents (NODET), Tabriz, Iran (2010)

Remarkable Teaching Experiences

- Teaching assistant for **Image Processing** Course by Dr. Shahrokh Ghaemmaghami at **Sharif University**. (Summer 2020)
- Teaching assistant (Head TA) for **Communication Systems** Course by Dr. Hamid Behrouzi at **Sharif University**. (Spring 2020)
- Teaching assistant (Head TA) for **Digital Communication Systems** Course by Dr. Hamidreza Amindavar at **Amirkabir University**. (Spring 2020)
- Teaching assistant (Head TA) for **Digital Communication Systems** Course by Dr. Fereydoun Behnia at **Sharif University**. (Winter 2019)

Remarkable Academic Courses

Deep Learning • Advanced Machine Learning • Digital Image Processing • Linear Algebra • Manifold Theory • Speech Processing • Random Processes
Optimization and Algorithms • Digital Communication Systems • Advanced Digital Signal Processing • Data Structure • Queuing Systems • Cryptography

Professional Services

- **Standard Track Conference Papers Peer Reviewer, IEEE ICIP**: Evaluated conference papers in broad image processing and AI topics.
- **OJSP Track Peer Journal Papers Peer Reviewer, IEEE: Assessed** Open Journal of Signal Processing-track submissions in broad Signal processing and Machine Learning topics.

Publications

- Vahid Jebraeeli, Bo Jiang, Derya Cansever, and Hamid Krim. "Koopcon: A new approach towards smarter and less complex learning," 2024 IEEE International Conference on Image Processing (ICIP), Abu Dhabi, United Arab Emirates, 2024, pp. 880-886, doi: 10.1109/ICIP51287.2024.10647948. (6 Citations)
- Vahid Jebraeeli, Bo Jiang, Derya Cansever, and Hamid Krim. "Generative Expansion of Small Datasets: An Expansive Graph Approach", accepted in 2025 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP). IEEE, 2025. (4 Citations)
- Vahid Jebraeeli, Hamid Krim, and Derya Cansever. "ViTCAE: ViT-based Class-conditioned Autoencoder", submitted to 2026 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP).
- Vahid Jebraeeli, Haoyu Yun and Hamid Krim. "Volterra-Conditioned Attention in Vision Transformers for Enhanced Contextual Learning". In preparation.