

# 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 3<sup>rd</sup> 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. (7 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. (5 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.