MORTEZA MARDANI

NVIDIA Research
URL: Personal Website
Tel: (612) 501-8126 (Mobile)
Email: mormardani@gmail.com

OBJECTIVE

Advancing **generative AI** by bridging theory and practice through **diffusion models** and **foundation models for generative physical AI**, driving the next generation of **AI technology**.

SKILL SET

- **Expertise**: Generative learning, machine learning, statistical learning, optimization.
- **Leadership**: Led a **20-person** research team at NVIDIA to develop **diffusion foundation models** for weather sciences, **productized and deployed by multiple customers, including The Weather Channel**.
- **Product Development**: Designed and deployed **CorrDiff and AFNO Transformer**, **core components of NVIDIA Earth Digital Twin**, adopted by multiple customers.
- **Programming**: Expert in **large-scale distributed training** on GPU clusters with **Python, PyTorch, Linux, and Unix**.
- **Mentorship**: **Supervised 10+ interns, 10 PhD students, and 2 research scientists**, shaping the next generation of AI researchers.
- **Public Speaking**: Delivered numerous **keynote and invited talks**, conference presentations, and participated in high-profile panels.
- **Professional Service**: **IEEE Distinguished Industry Speaker**, Technical Committee Member for **IEEE Computational Imaging**, Area Chair for **ICLR & AISTATS**.

WORK & PROFESSIONAL EXPERIENCE

NVIDIA Research — Santa Clara, California
Principal (Lead) Research Scientist — Jan 2020 - Present
Fundamental Generative AI Research (GenAIR)

Stanford University — Stanford, California
Visiting Researcher — Jan 2020 - Present
Research Staff — Jan 2017 - Jan 2020
Postdoctoral Fellow — Jun 2015 - Jan 2017
Information Systems Lab (ISL), Electrical Engineering

UC Berkeley — Berkeley, California
Visiting Scholar — Jan 2015 - Jun 2015
RISE Lab, EECS

EDUCATION

University of Minnesota — Twin Cities, Minnesota
Ph.D., Electrical Engineering — Sep 2009 - May 2015
Ph.D. Minor, Mathematics

University of Tehran — Tehran, Iran
B.Sc., Electrical Engineering — Sep 2006 - Jul 2009

NOTABLE AWARDS

- **IEEE Signal Processing Society Young Author Best Paper Award** (2017) Recognized for *dimensionality reduction of streaming data.*
- **Best Student Paper Award, IEEE SPAWC** (2012) Awarded for contributions to *distributed data matrix completion.*

- **IEEE Distinguished Industry Speaker Award** (2024) Selected as an IEEE Distinguished Industry Speaker for contributions to generative AI.
- **Postdoctoral Fellowship Award** (2017) Awarded for postdoctoral research at Stanford University.
- **Doctoral Dissertation Fellowship Award** (2014) Recognized for outstanding Ph.D. research at the University of Minnesota.
- **ADC Fellowship, Digital Technology Center, University of Minnesota** (2009 & 2010) Awarded for excellence in research and digital technology innovation.
- **Silver Medal, Iranian Nationwide Olympiad in Electrical Engineering** (2006) Ranked among the top nationwide competitors.

NOTABLE PROJECTS (Core Investigator)

- **Generative Models and Diffusion Techniques**
  - **Heavy-Tailed Diffusion Models**
    - Introduced *heavy-tailed* diffusion models based on Student-t distributions for extreme event modeling.
    - Developed **t-EDM and t-DDPM**, maintaining Gaussian diffusion compatibility.
    - Integrated into **NVIDIA Modulus**.
  - **Corrective Diffusion for Physical Sciences (CorrDiff)**
    - Developed **CorrDiff** for super-resolving weather forecasts **(25km → 2km)**.
    - Introduced a two-stage learning framework inspired by *Loyd decomposition* in fluid mechanics.
    - **Published in Nature**, featured in **Jensen Huang GTC 2024 keynote**, **productized**, and adopted by **The Weather Channel**.
  - **Reinforcement Learning for Diffusion Models**
    - Designed RL-based checkpoint mixing for diffusion models, enhancing sample quality via human feedback.
    - Generalized autoguidance for arbitrary checkpoint selection, achieving state-of-the-art FID on **ImageNet and Stable Diffusion**.
  - **Steering Diffusion Models with Variational Inference**
    - Developed **RED-diff**, an optimization-based variational sampler for inverse problems and text-to-image/3D generation.
    - Introduced **RLSD** for diversity enhancement using repulsive forces and latent inversion via distribution augmentation.
    - Integrated into **NVIDIA MONAI**.
  - **LLMs for Compositional Diffusion Models**
    - Enabled *compositional* text-to-2D/3D/video generation via LLM-driven visual layout understanding.
    - Developed **BlobGen and BlobGen3D** for structured text-to-2D/3D scene generation.
- **Transformers and Representation Learning**
  - **Scalable Transformers for High-Resolution Data**
    - Invented **Adaptive Fourier Neural Operator (AFNO)**, a function-space scalable attention mechanism.
    - Core of **FourCastNet**, NVIDIA weather forecasting foundation model, achieving $1\mathbf{M}\times$ **speedup over PDE solvers**.
    - Featured in Jensen Huang **GTC 2022 keynote**, productized, and adopted by multiple customers.
  - **Self-Supervised Vision Transformers**
    - Designed self-supervised ViT models for few-shot learning.
    - Developed **BERT-style inpainting** as a pretraining task, significantly improving context learning.

- Scaled to 10B ViTs using **NVIDIA Megatron** across 1024+ GPUs.
- Deployed in **NVIDIA DRIVE Hyperion** as a labeling engine for AV data creation.

- **GANs and Inverse Problems**
  - **GANs for Compressed Sensing/Imaging**
    - Designed GANs for amortized compressed sensing, enabling perceptual-quality MAP estimation without paired data.
    - Adopted in **MRI scanners at Stanford Children Hospital**.
  - **Uncertainty Quantification for Neural Image Reconstruction**
    - Developed pixel-wise uncertainty estimators using **Stein Unbiased Risk Estimator (SURE)**.
    - Deployed for **MRI reconstruction** with GE scanner data.
  - **Neural Proximal Learning for Inverse Imaging**
    - Designed unrolled networks based on proximal gradient descent for fast, high-fidelity inverse imaging.
    - Deployed for **MRI reconstruction at Stanford Children Hospital**.

- **Interpretable Neural Networks**
  - **Understanding Neural Networks via Convex Duality**
    - Applied convex duality to analyze the inductive bias of CNN denoising, Wasserstein GANs, vision transformers, and batch normalization.
    - Enabled layer-wise training using convex solvers, improving interpretability.

RESEARCH

Publications Book chapters: 3, journals: 20+, conferences: 100+, h-index: 33

Selected Papers

- **M. Mardani**, N. Brenowitz, Y. Cohen, J. Pathak, C.Y. Chen, C.C. Liu, A. Vahdat, K. Kashinath, J. Kautz, M. Pritchard, "*Generative Residual Diffusion Modeling for km-scale Atmospheric Downscaling*," *Nature Communications*, Nov. 2024.
- K. Pandey, J. Pathak, Y. Xu, M. Pritchard, A. Vahdat, **M. Mardani**, "*Heavy-Tailed Diffusion Models*," *ICLR*, 2025.
- S. Fotiadis, N. Brenowitz, T. Geffner, Y. Cohen, M. Pritchard, A. Vahdat, **M. Mardani**, "*Stochastic Flow Matching for Resolving Small-Scale Physics*," *ICML*, 2025.
- G. Daras, W. Nie, K. Kreis, A. Dimakis, **M. Mardani**, N. Kovachki, A. Vahdat, "*Warped Diffusion: Solving Video Inverse Problems with Image Diffusion Models*," *NeurIPS*, 2024.
- N. Zilberstein, **M. Mardani***, S. Segarra*, "*Repulsive Score Distillation for Diverse Sampling of Diffusion Models*," *ICLR*, 2024.
- Ch. Liu, W. Nie, S. Liu, **M. Mardani**, B. Eckart, A. Vahdat, "*BlobGEN-3D: Compositional 3D-Consistent Freeview Image Generation with 3D Blobs*," *SIGGRAPH Asia*, 2024.
- W. Nie, S. Liu, **M. Mardani**, Ch. Liu, B. Eckart, A. Vahdat, "*Compositional Text-to-Image Generation with Dense Blob Representations*," *ICML*, 2024.
- D. Xu, Y. Yuan, **M. Mardani**, S. Liu, J. Song, Z. Wang, A. Vahdat, "*AGG: Amortized Generative 3D Gaussians for Single Image to 3D*," *ICML*, 2024.
- J. Song, Q. Zhang, H. Yin, **M. Mardani**, M.Y. Liu, J. Kautz, Y. Chen, A. Vahdat, "*Loss-Guided Diffusion Models for Plug-and-Play Controllable Generation*," *ICML*, 2023.
- **M. Mardani**, J. Song, J. Kautz, A. Vahdat, "*A Variational Perspective on Solving Inverse Problems with Diffusion Models*," *ICLR*, 2022.

- J. Song, A. Vahdat, **M. Mardani**, J. Kautz, "*Pseudoinverse-Guided Diffusion Models for Inverse Problems*," *ICLR*, 2022.
- J. Guibas**, **M. Mardani****, Z. Li, A. Tao, A. Anandkumar, B. Catanzaro, "*Efficient Token Mixing for Transformers via Adaptive Fourier Neural Operators*," *ICLR*, 2021.
- A. Sahiner, T. Ergen, B. Ozturkler, J. Pauly, **M. Mardani***, M. Pilanci*, "*Unraveling Attention via Convex Duality: Analysis and Interpretations of Vision Transformers*," *ICLR*, 2022.
- A. Sahiner, T. Ergen, B. Ozturkler, B. Bartan, J. M. Pauly, **M. Mardani***, M. Pilanci*, "*Hidden Convexity of Wasserstein GANs: Interpretable Generative Models with Closed-Form Solutions*," *ICLR*, 2021.
- A. Sahiner, T. Ergen, B. Ozturkler, J. Pauly, **M. Mardani***, M. Pilanci*, "*Scaling Convex Neural Networks with Burer-Monteiro Factorization*," *ICLR*, 2023.
- T. Ergen, A. Sahiner, B. Ozturkler, J. Pauly, **M. Mardani***, M. Pilanci*, "*Demystifying Batch Normalization in ReLU Networks: Equivalent Convex Optimization Models and Implicit Regularization*," *NeurIPS*, 2021.
- **M. Mardani**, G. Liu, A. Dundar, S. Liu, A. Tao, B. Catanzaro, "*Neural FFTs for Universal Texture Image Synthesis*," *NeurIPS*, 2020.
- **M. Mardani**, Q. Sun, S. Vasanawala, V. Papyan, H. Monajemi, J. Pauly, D. Donoho, "*Neural Proximal Gradient Descent for Compressive Imaging*," *NeurIPS*, 2018.
- C. Alkan, **M. Mardani**, S.S. Vasanawala, J. Pauly, "*AutoSamp: Autoencoding MRI Sampling via Variational Information Maximization*," *IEEE Trans. Medical Imaging*, Nov. 2023.
- K. Lei, **M. Mardani**, J.M. Pauly, S. Vasanawala, "*Wasserstein GANs for MR Imaging: from Paired to Unpaired Training*," *IEEE Trans. Medical Imaging*, vol. 4, Jan. 2021.
- V. Edupuganti, **M. Mardani**, S. Vasanawala, J. Pauly, "*Uncertainty Quantification for Deep MRI Reconstruction*," *IEEE Trans. Medical Imaging*, vol. 4, Jan. 2021.
- **M. Mardani**, E. Gong, J.Y. Cheng, S. Vasanawala, G. Zaharchuk, L. Xing, J.M. Pauly, "*Deep Generative Adversarial Neural Networks for Compressed Sensing (GANCS) MRI*," *IEEE Trans. Medical Imaging*, vol. 38, no. 1, pp. 167-179, Jan. 2019.
- **M. Mardani**, G. Mateos, G. Giannakis, "*Big Data*," *Cooperative and Graph Signal Processing: Principles and Applications*, Elsevier, 2018.

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Selected Patents

- A. Vahdat, **M. Mardani**, K. Keris, "*Alias-Free Diffusion Models*," filed Oct. 2023.
- **M. Mardani**, J. Song, J. Kautz, A. Vahdat, "*RED-diff: A Variational Method for Solving Inverse Problems with Diffusion Models*," filed Feb. 2023.
- **M. Mardani**, N. Brenowitz, Y. Cohen, J. Pathak, C. Chen, A. Vahdat, K. Kashinath, J. Kautz, M. Pritchard, "*CorrDiff: Corrector Diffusion Modeling for km-Scale Atmospheric Downscaling*," filed Oct. 2023.
- J. Song, A. Vahdat, **M. Mardani**, J. Kautz, "*PGDM: Pseudo-Inverse Guided Diffusion Models for Inverse Problems*," filed July 2022.
- W. Nie, S. Liu, **M. Mardani**, C. Liu, B. Eckart, A. Vahdat, "*Compositional Text-to-Image Generation with Dense Blob Representations*," filed March 2024.
- B. Otzuker, C. Liu, B. Eckart, **M. Mardani**, J. Song, J. Kautz, "*SMRD: SURE-Based Robust MRI Reconstruction with Diffusion Models*," filed Aug. 2023.

[1] *Equal first authors, **Equal senior authors.

- J. Song, Q. Zhang, H. Yin, **M. Mardani**, M. Liu, J. Kautz, Y. Chen, A. Vahdat, "*Loss-Guided Diffusion Models for Plug-and-Play Controllable Generation*," filed Feb. 2023.
- D. Xu, Y. Yuan, **M. Mardani**, S. Liu, J. Song, Z. Wang, A. Vahdat, "*AGG: Amortized Generative 3D Gaussians for Single Image to 3D*," filed Nov. 2023.
- **M. Mardani**, G. Liu, A. Dundar, E. Liu, A. Tao, B. Catanzaro, "*Neural FFTs for Universal Texture Synthesis*," filed Sep. 2020.
- **M. Mardani**, E. Gong, G. Zaharchuk, J. Pauly, "*MRI Reconstruction Using Deep Learning, Generative Adversarial Network, and Acquisition Signal Model*," filed May 2019.

MENTORING EXPERIENCE

Mentoring **NVIDIA Research**

- **Interns and Research Scientists** Mentored and collaborated with multiple interns and researchers: *Kushagra Pandey*, *Peiyu Yu*, *Stathis Fotiadis*, *Salva Cachay*, *Giannis Daras*, *Hyungjin Chen*, *Tao Ge*, *Dejia Xu*, *Batu Ozturkler*, *John Guibas*.

Supervision **Stanford University**

- **Co-Supervised Ph.D. Students** *Cagan Alkan*, *Arda Sahiner*, *Batu Ozturkler*, *Beliz Gunel*, *Lisa Li*, *Vineet V. Edupuganti*.
- **Supervised REU Students** *Scott W. Blankenberg*, *Jordan Harrod*, *Tejpal Virdi*, *John Guibas*.
- **Other Mentoring** - Guided a student team in the Data Science Hackathon (STATS285).

Ph.D. Mentorship **University of Minnesota, Twin Cities**

- Mentored Ph.D. students: *Yanning Shen*, *Fateme Sheikholeslami*.

SELECTED INVITED TALKS AND PANELS

- **University of Minnesota, Twin Cities** - Mar 6, 2025 *Steering Diffusion Models for Next-Gen AI*
- **Keynote at GTTI MMSP Meeting** - Jan 19, 2025 *Steering Diffusion Models for Next-Gen AI*
- **University of Rochester, NY** - Sep 13, 2024 *Steering Diffusion Models for Next-Gen AI*
- **C3.ai DTI Workshop, UIUC, IL** - Oct 25, 2023 *Sampling Diffusion Models in the Era of Generative AI*
- **Institute for Mathematics and its Applications (IMA), Minneapolis, MN** - Sep 22, 2023 *Sampling Diffusion Models in the Era of Generative AI*
- **Asilomar Conference, Pacific Grove, CA** - Nov 6, 2019 *Effectiveness of Unrolled Neural Networks for Inverse Problems and MRI*
- **Stanford AIMI, Dept. of Radiology** - Oct 23, 2019 *Interpretable and Reliable AI for Medical Imaging*
- **Johns Hopkins Univ., Biomedical Eng. Dept., Baltimore, MD** - Feb 28, 2019 *Deep Learning for Medical Imaging: Mapping Sensor Data to Decisions*
- **Univ. of Michigan, EECS, Ann Arbor, MI** - Feb 21, 2019 *Deep Learning for Medical Imaging: Mapping Sensor Data to Decisions*
- **UC Berkeley, EECS, Berkeley, CA** - Feb 15, 2019 *Deep Learning for Medical Imaging: Mapping Sensor Data to Decisions*
- **Sharif Univ. of Tech., Tehran, Iran** - Dec 26, 2019 *Recurrent GANs for Compressive Imaging*
- **ETH Zurich, CS Dept., Switzerland** - Jun 28, 2018 *Neural Proximal Gradient Descent Using GANs for Compressive Imaging*
- **Google Brain Research, Zurich, Switzerland** - Jun 26, 2018 *Neural Proximal Gradient Descent Using GANs*

- **Facebook AI Research, Menlo Park, CA** - May 7, 2018 *GANs for Medical Image Recovery*
- **NVIDIA GTC, San Jose, CA** - Mar 26-29, 2018 *Recurrent Generative Adversarial Neural Networks for Compressive Imaging*
- **Panelist, Intel @ UCSF** - Mar 22, 2018 *AI Barriers in Healthcare*

PROFESSIONAL AFFILIATIONS AND SERVICES

- **Leadership and Organization** *Area Chair* - AISTATS, ICLR, ICASSP *Guest Editor* - Special Issue on *"The Role of Signal Processing and Information Theory in Modern Machine Learning"*, *Entropy*, 2020 *Co-organizer* - 1st Bay Area Symposium on Computational Imaging with Deep Learning, Stanford University, March 2019
- **Editorial and Reviewing** Reviewer for *PNAS, Nature, JMLR, TMLR, IEEE Transactions on Signal Processing, Computational Imaging, Medical Imaging, Information Theory, Networking, Multimedia, Cybernetics* Regular reviewer for *NeurIPS, CVPR, ICML, ICLR, AISTATS, AAAI, KDD, ICASSP*
- **Professional Memberships** *IEEE Senior Member*, *IEEE Signal Processing Society Member Technical Committee Member* - Computational Imaging, IEEE Signal Processing Society *IEEE Distinguished Industry Speaker*

REFERENCES

Available upon request.