

Jiayin Liu

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RESEARCH INTERESTS

Theory and methods for flow-based generative models, including guidance, reward-based fine-tuning, and sampling; stochastic processes on manifolds; generative modeling with physical and geometric structure.

EDUCATION

Tsinghua University Beijing, China
B.Sc. in Theoretical and Applied Mechanics 2023 – 2027
Minor in Mathematics | GPA **3.9/4.0**, rank **2/35**

Duke University Durham, NC
Visiting research assistant, with Prof. Xiang Cheng Fall 2026

Princeton University Princeton, NJ
Exchange student, Mechanical and Aerospace Engineering Spring 2025

PUBLICATIONS AND PREPRINTS

Discovering Phase Space Structure in Learned Hamiltonian Systems **NeurIPS 2026**
Yulong Yang*, **Jiayin Liu***, Vineet Bansal, Christine Allen-Blanchette [arXiv]

GuidanceNFT: NFT-Based Reward Fine-Tuning of Guided Diffusion Models **Under review**
Jiayin Liu, Zeyu Michael Li, Bingshuo Qian, Xiang Cheng [arXiv]

RESEARCH EXPERIENCE

Diffusion models and stochastic processes

GuidanceNFT: reward fine-tuning of guided diffusion models [project page]
Duke University, with Prof. Xiang Cheng Jul 2026 – Oct 2026

- Traced DiffusionNFT’s collapse under CFG to a mismatch between its reference velocity and the guided rollout distribution, and corrected it by learning the corresponding score as a reference.
- Extended NFT to operate directly on guided rollout distributions across image and text generation, improving reward scores on SD3.5M with enhanced prompt alignment, and increasing ELF’s on GSM8K.

Wasserstein CLT for geodesic random walks on manifolds

Duke University, with Prof. Xiang Cheng Oct 2026 – Present

- Investigating the convergence rate of geodesic random walks to Brownian motion on compact manifolds in Wasserstein-2 distance.

Generative models with physical and geometric structure

SPS-GAN: phase space structure in learned Hamiltonian systems [project page]
Princeton University, with Prof. Christine Allen-Blanchette Jan 2025 – Oct 2025

- Developed a GAN-based model for video and trajectory generation whose latent states are constrained to evolve under learned port-Hamiltonian dynamics.
- Improved trajectory accuracy and video consistency over baselines, and recovered the degrees of freedom and canonical coordinates of the underlying system from both trajectory and video observations.

Inverse origami design for trajectory following

Tsinghua University IIIS, with Prof. Tao Du

[project page]

Oct 2025 – Jun 2026

- Developed an autoregressive diffusion framework that writes a crease pattern one rigid vertex unit at a time; over 70% of its samples are rigidly foldable, versus 10% for a prior VAE-based generator.
- Conditioned generation on a target 3D trajectory, producing designs whose folding follows it directly in about 20 s per target, instead of a 2.7 h latent-space genetic-algorithm search.
- Scored on par with that search on complex benchmark curves such as helices, spherical curves, and triangles; designs vary smoothly as the target is scaled or rotated.

MATHEMATICAL COURSEWORK

Algebra and geometry

Smooth Manifolds [A], Algebraic Topology [A–], Abstract Algebra [A], Representation Theory[†] [audit]

Analysis and probability

Real Analysis* [A–], Complex Analysis* [A+], Probability [A+], Stochastic Processes* [A–]

Applied mathematics and mechanics

Optimization* [A], Continuum Mechanics [A–], Fluid Mechanics* [A–]

*Taken at Princeton University. [†] Audited at Duke University, Fall 2026.

HONORS AND AWARDS

First Prize, National “Challenge Cup”, fluid simulation software track	2024
Comprehensive Excellence Scholarship, Tsinghua University	2024, 2025
Research and Innovation Excellence Scholarship, Tsinghua University	2025
Academic Excellence Scholarship, Tsinghua University	2024