Shijie Xiao

Atlanta, GA ● sjxiao@gatech.edu● (470) 312-4526 ● LinkedIn:shijie-xiao ●shijie-xiao.github.io

Computer Science Ph.D. student at Georgia Tech developing **physics-informed machine learning** for **spatiotemporal forecasting**, probabilistic prediction, and extreme-event evaluation. Research spans **differentiable dynamical models, neural operators, and structured sequence learning.** Seeking a Summer 2027 research internship.

EDUCATION

Georgia Institute of Technology, Atlanta, GA — Expected Aug 2030
Ph.D. student in CS, School of Interactive Computing **Advisors: Josiah Hester and Ali Sarhadi**

Georgia Institute of Technology, Atlanta, GA — May 2026
M.S in ECE, School of Electrical and Computer Engineering **GPA 4.0/4.0**
Thesis: A Computational Framework for Multi-Agent Behavior Analysis: Integrating Geometric Vision Extraction and Social Attention Inference **Thesis Advisor: Anqi Wu**

Huazhong University of Science and Technology (HUST), Wuhan, China — June 2024
B.S. in AI, School of Artificial Intelligence and Automation **GPA 3.95/4.0**
Thesis: Generative Diffusion Models for Segmentation with Noisy Labels **Thesis Advisor: Yincong Chen**

RESEARCH

Graduate Research Assistant with **Ali Sarhadi** Sponsored by **Sandia National Laboratories** — May 2025–Present
Topic: Hybrid Physics–Machine Learning for Tropical Cyclone Intensity Forecasting (FAST-ML) Paper | Code
First author; *submitted to* ***Journal of Advances in Modeling Earth Systems (JAMES).***

- **Differentiable Physics / UDE Modeling:** Developed a UDE-style hybrid framework embedding dual-stream CNN parameterizations within the FAST thermodynamic ODE. Combined physics-guided pretraining with end-to-end differentiation through the numerical solver, learning environmental controls from intensity observations while retaining the governing physical structure.
- **Large-Scale Meteorological Data Engineering:** Built pipelines spanning ERA5 reanalysis and GEFS/ECMWF forecast fields from TB–PB-scale historical archives. Harmonized storm-centered inputs to hourly, 0.25° resolution, aligning multilevel atmospheric fields, surface variables, and forecast lead times with IBTrACS observations.
- **Forecast Accuracy & Extreme Events:** Reduced mean per-storm RMSE by 30.1% on 12 held-out 2024 North Atlantic storms under ERA5-driven evaluation. Reduced 60-hour ensemble CRPS by ~31% and rapid-intensification false-alarm ratio by 45% relative to FAST while maintaining detection probability.
- **AI Benchmarking & Generalization:** Demonstrated advantages over Google DeepMind's FNV3 on selected storm-level metrics: for Beryl, ensemble-mean peak-intensity error was 26 kt versus 49 kt in an ERA5-driven comparison. Evaluated GEFS-driven forecasting, zero-shot Eastern Pacific transfer, architectural ablations, and gradient-based physical attribution.
- **Efficient Ensemble Computation:** Evaluated 1,000-member GEFS-driven ensembles and implemented an efficient neural–physical inference workflow. A separate 200-simulation benchmark completed in under three minutes on one 32-core/A100 node, with neural inference adding approximately 2% to per-member runtime.

Topic: Physics-based Generative AI for Probabilistic Compound Flood Forecasting
First author; *manuscript in preparation for submission to* ***Nature Machine Intelligence.***

- **Sequence-to-Field Operator Learning:** Developed a Transformer–FNO emulator mapping low-dimensional hurricane trajectories to 1024 × 1024 flood-depth fields, learning the nonlinear response of coupled surge–rainfall–riverine flooding from physical simulations.
- **Simulation-Based Learning & Architecture Selection:** Addressed sparse historical observations using ~13,000 synthetic hurricane scenarios and coupled hydrodynamic simulations. Compared 10 operator-learning and generative configurations, including FNO, U-Net, diffusion, GAN, and VAE models; achieved 0.0771 m domain-wide RMSE on held-out simulated flood fields.
- **Uncertainty Propagation & Hazard Forecasting:** Converted ECMWF ensemble trajectories into flood-depth distributions, inundation probabilities, and threshold-exceedance maps. Generated fields in seconds per member versus hours for physical simulations, with retrospective evaluation at 1–7-day lead times and SHAP-based analysis of storm-forcing sensitivity.

Topic: Physics-Guided Tropical Cyclone Genesis Prediction and Localization (TCG) | Code
Co-first author; *under review at* ***JGR: Machine Learning and Computation.***

- **Spatiotemporal Learning:** Developed a TimeSformer–U-Net framework combining factorized spatial–temporal attention with regional localization, using 14-day sequences of nine atmospheric and oceanic predictors.
- **Temporal Validation & Model Diagnostics**: Implemented chronological training/calibration/validation/test partitions and lead-time evaluation. Achieved F1 = 0.722 versus 0.402 for Random Forest under a 48-hour precursor-matching criterion; used SHAP, Integrated Gradients, and climate-regime stratification to investigate predictive drivers and failure conditions.

SELECTED PUBLICATIONS

FAST-ML: A Hybrid Physics–Machine Learning Framework for Tropical Cyclone Intensity Forecasting
Shijie Xiao, Jonathan Lin, Thomas Ehrmann, and Ali Sarhadi.
arXiv preprint, arXiv:2609.25505, 2026. Submitted to *Journal of Advances in Modeling Earth Systems* (JAMES).

Physics-Guided Machine Learning for Tropical Cyclone Genesis Prediction, Localization, and Interpretation in North Atlantic
Aren Russ†, **Shijie Xiao†**, Thomas Ehrmann, and Ali Sarhadi.
Manuscript under review at *Journal of Geophysical Research: Machine Learning and Computation*, 2026.
† These authors contributed equally.

A Computational Framework for Multi-Agent Behavior Analysis: Geometric Vision Extraction and Social Attention Inference
Shijie Xiao M.S. thesis, Georgia Institute of Technology, 2025. Advisor: **Anqi Wu**

EXPERIENCE

Graduate Researcher (Master's Thesis) with **Anqi Wu** BRAINML Lab Jan– Dec 2025
Topic: Structured Multi-Agent Dynamics and Probabilistic Trajectory Forecasting **Code**

- **Structured Sequence Modeling:** Developed a spatiotemporal graph model with separate intra-agent and inter-agent attention, representing body geometry and social interactions to predict the joint motion of interacting agents.
- **Probabilistic Forecasting:** Implemented autoregressive Gaussian trajectory prediction with geometry-aware distance regularization and activity-dependent loss weighting, evaluated through multi-step rollouts without future observations.
- **Comparative Evaluation:** Extended the research with matched comparisons against SRNN, EqMotion, PCHGCN, and ViTE, analyzing how keypoint representations affect displacement error, sampled prediction quality, and joint trajectory consistency.
- **Ongoing Method Development:** Investigating geometry-constrained latent dynamics and learned skeletal decoders to preserve anatomical structure, alongside experiments testing how individual pose and partner interactions contribute predictive information beyond center-point trajectories.

Master's thesis completed in 2025; ongoing research extension targeting ICML 2027.

Research Assistant in Hong Kong University of Science and Technology with **Yincong Chen** Jan–Jun 2024
Topic: Diffusion-Based Visual Generation with Noisy Supervision

- Investigated diffusion-based methods for 2D image segmentation under noisy supervision, using noisy-labeled and unlabeled images to improve learning from imperfect annotations.
- Developed data preprocessing, model training, and evaluation pipelines to study segmentation robustness under label noise and limited supervision.

Research Assistant in The Chinese University of Hong Kong with **Wu Yuan** Dec 2022–Mar 2023
Topic: Diffusion-Based Reconstruction of Noisy OCT Images

- Developed a DDPM-based denoising approach for multiplicative speckle noise, combining noise modeling with learned image reconstruction.
- Built comparative evaluation pipelines against DnCNN, U-Net, BM3D, and TCFL-OCT using PSNR, SSIM, and GCMSE to assess reconstruction fidelity.

Undergraduate Research Assistant in **HUST** Sep–Dec 2022
Topic: Musical Notation Detection and Recognition with Xiang Bai
Built and annotated a musical-notation dataset; implemented and evaluated DBNet, DBNet++, and PANet within MMOCR for detection and extraction of notation elements.

Topic: eSports Gaze Estimation | CNNs, Temporal Modeling, Few-Shot Learning with Yang Xiao Feb 2022–Apr 2023
Developed a video-based gaze estimation system combining CNN features and temporal alignment, with few-shot user adaptation to reduce calibration requirements and support real-time inference.

SELECTED PROJECTS

Multi-Object Tracking CVPR 2023 BDD100K Challenge May–Jun 2023
Built detection-and-tracking pipelines combining YOLO/DINO detectors with ByteTrack and BoT-SORT, addressing temporal association, occlusion, and identity continuity in driving videos.

EEG Sequence Classification NC State Winter School Dec 2022–Feb 2023
Developed EALNet, combining EEGNet feature extraction, LSTM temporal modeling, and Transformer attention for motor-imagery classification; evaluated sequence representations on BCI Competition datasets.

TECHNICAL SKILLS

Programming: Python, C/C++, SQL, Bash, MATLAB
Frameworks & Tools: PyTorch, TensorFlow, OpenCV, Git, Linux, Slurm
Machine Learning: Spatiotemporal Transformers, Graph Neural Networks, Diffusion Models, Probabilistic Forecasting
Scientific Computing: Differentiable ODE Models, Numerical Optimization, Ensemble Evaluation