Miguel Liu-Schiaffini

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Google Scholar

mliuschi.github.io

Education

California Institute of Technology — Pasadena, CA

B.S. in Computer Science — *Sep. 2021 – Jun. 2025*

- **GPA:** 4.3
- **Notable coursework:** Mathematical Optimization, Machine learning, Learning Systems, Statistical Learning Theory, ML for Inverse Problems and Data Assimilation, LLM Reasoning, Markov Chains, Statistical Inference, Causality, Introduction to Control Theory, Probability Models, Network Science, Algorithms, Differential Equations, Computability and Complexity, Applied Linear Algebra, Computing Systems, Software Design, Data Structures, Abstract Algebra

Publications

* Equal contribution

[1] **Liu-Schiaffini, M.***, Berner, J.*, Bonev, B.*, Kurth, T., Azizzadenesheli, K., & Anandkumar, A. (2024). Neural Operators with Localized Integral and Differential Kernels. *International conference on machine learning (ICML 2024).*

- Spotlight at ICLR 2024 Workshop on AI4DifferentialEquations in Science

[2] Li, Z.*, **Liu-Schiaffini, M.***, Kovachki, N.B., Liu, B., Azizzadenesheli, K., Bhattacharya, K., Stuart, A., & Anandkumar, A. (2022). Learning Dissipative Dynamics in Chaotic Systems. *Advances in Neural Information Processing Systems (NeurIPS 2022).*

[3] **Liu-Schiaffini, M.**, Ng, G., Grima, C. & Young, D. (2022). Ice Thickness from Deep Learning and Conditional Random Fields: Application to Ice Penetrating Radar Data with Radiometric Validation. *IEEE Transactions on Geoscience and Remote Sensing.*

[4] **Liu-Schiaffini, M.**, Singer, C. E., Kovachki, N., Schneider, T., Azizzadenesheli, K., & Anandkumar, A. (2023). Tipping Point Forecasting in Non-Stationary Dynamics on Function Spaces. *arXiv preprint arXiv:2308.08794.*

[5] Azizzadenesheli, K., Kovachki, N., Li, Z. **Liu-Schiaffini, M.**, Kossaifi, J., & Anandkumar, A (2024). Neural Operators for Accelerating Scientific Simulations and Design. *Nature Reviews Physics.*

[6] Duruisseaux, V.*, **Liu-Schiaffini, M.***, Berner, J., & Anandkumar, A. (2024). Towards Enforcing Hard Physics Constraints in Operator Learning Frameworks. *AI for science workshop at ICML 2024.*

Research Experience

NVIDIA Research — Jun. 2024 – Present

Research Intern – Learning and Perception Research Group

- Developing operator learning methods for computer vision under Nikola Kovachki, Jean Kossaifi, and Jan Kautz.

Anima Anandkumar Lab (Caltech) — Sep. 2021 – Present

Undergraduate Researcher

- **Local neural operator:** Developed method to incorporate learnable finite-difference kernels and local convolutions into existing neural operator frameworks. By extension, this project provides a method for reformulating U-Net and other convolutional neural networks as neural operators mapping between function spaces.
- **Tipping point forecasting:** Designed novel method for predicting tipping points (i.e., drastic, abrupt nonlinear changes) in complex systems (e.g., cloud breakup) defined over function spaces. Also developed a novel recurrent neural operator architecture for learning in non-stationary dynamical systems defined on function spaces.
- **Probabilistic neural operator:** Designed and developed conditional generative adversarial neural operator model for learning solutions to stochastic partial differential equations or to forecasting noisy real-world spatiotemporal systems.

- **Markov neural operator:** Developed Markov neural operator framework for learning the dynamics of chaotic systems (e.g., turbulent fluid flows) from data. Also proposed a novel method to enforce dissipative dynamics and encourage stability for long autoregressive roll-outs.
- Awarded summer undergraduate research fellowships in 2022 and 2023.

University of Texas Institute for Geophysics Jun. 2020 – May 2023

Research Intern

- **Deep learning for accelerating ice thickness measurements:** Proposed and initiated project to automate generation of ice thickness measurements using radar data for ice sheets and glaciers. Designed a novel neural network/probabilistic graphical model framework, achieving several orders of magnitude speed-up over prior methods.
- **Mars surface characterization with radar data:** Led a team of interns using machine learning methods to analyze Martian terrain. Designed unsupervised graph neural network and clustering methods to characterize Mars surface radar returns, which will enable search for life on Mars and identification of future rover landing sites.

University of Texas Institute for Geophysics Jun. 2019 – Aug. 2019

Summer Intern

- Defined and analyzed ice-surface and ice-bedrock returns from laser and radar data over ice sheets/ice caps around the world. Investigated offset in ice surface elevation measurements derived from laser and radar-sounding instruments over Devon Ice Cap, Canadian Arctic.

Teaching

Head TA for Caltech ACM 104 (Applied Linear Algebra) Sep. 2023 – Dec. 2023

- Led team of 10 TAs for a 200-student class.

TA for Caltech IDS 157 (Graduate-level Statistical Inference) Apr. 2024 – Present

TA for Caltech ACM 216 (Graduate-level Markov Chains) Jan. 2024 – Mar. 2024

Lead Deans' Tutor for Caltech Ma1 (First-year Mathematics) Oct. 2022 – Jun. 2023

- Selected by Deans to lead weekly study sessions for first-year students.

Awards and Honors

- 2024 Barry Goldwater Scholar
- Henry Ford II Scholar Award (Caltech)
- Mellon Mays Undergraduate Fellowship (2023 – Present)
- 2021 UT Jackson School of Geosciences Student Research Symposium: First Place in High School category
- 2021 Applied Materials Foundation "Mathematics & Science" Scholarship recipient
- 2021 National Merit Battelle Scholarship Recipient

Reviewing

Conferences

- NeurIPS [2023, 2024]
- ICML [2024]
- ICLR [2024]

Journals

- Journal of Machine Learning Research
- IEEE Transactions on Geoscience and Remote Sensing
- IEEE Geoscience and Remote Sensing Letters
- The Cryosphere

Talks and Presentations

Invited Talks

- kAI Sabanci (Sabanci University), 2023. "Learning Chaotic and Non-Stationary Dynamics With Neural Operators."
- Caltech Xiaojing Fu Research Group, 2023. "Tipping Point Forecasting on Function Spaces."
- Austin Geological Society Poster Session, 2021. "Ice Thickness Estimates Using Deep Learning."

Presentations

- 52nd Lunar and Planetary Science Conference, 2021. "Machine Learning Classification of the Martian Surface: Application to Radar Reflectometry."
- American Geophysical Union Fall Meeting, 2020. "Application of Deep Learning Techniques to Ice Sheet Surface and Bed Interface Detection."
- American Geophysical Union Fall Meeting, 2019. "Investigating Ice Surface Elevations Derived from Laser and Radar-sounding Measurements Over Devon Ice Cap, Canadian Arctic."

Code Contributions

- Markov Neural Operator GitHub Repository (https://github.com/neuraloperator/markov_neural_operator)
- Neural Operator PyTorch Library (https://github.com/neuraloperator/neuraloperator)

Skills and Languages

Languages: English (native), Spanish (native), Chinese (native)
Programming: Python, MATLAB, Java, C/C++, R
Libraries: PyTorch, TensorFlow, Keras, NumPy, SciPy