

## EDUCATION

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### California Institute of Technology

*B.S. in Computer Science*

- **GPA:** 4.3 / 4

Pasadena, CA

*Sept. 2021 – June 2025*

## RESEARCH EXPERIENCE

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### NVIDIA Research

June 2024 – Present

*Research Intern – Learning and Perception Research Group*

- **Function space diffusion models:** Developing function space diffusion models for efficient image generation at arbitrary resolutions using operator learning. Designing and validating neural operators for natural images.
- Supervisors: Nikola Kovachki, Jean Kossaifi, and Jan Kautz.

### Anima Anandkumar Lab (Caltech)

Sept. 2021 – Present

*Undergraduate Researcher*

- **Local neural operator:** Developed learnable finite-difference kernels and local convolutions into existing neural operator frameworks. Developed method for converting U-Net and other convolutional neural networks to neural operators mapping between function spaces.
- **Tipping point forecasting:** Designed novel method for predicting tipping points (drastic/abrupt changes) in complex systems defined over function spaces (e.g., rapid melting of ice caps). Proposed 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 and for 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. Proposed novel methods to enforce dissipative dynamics and encourage stability for long autoregressive roll-outs.
- **Neural operator reviews and other contributions:** Contributed to neural operator Perspective paper published in *Nature Reviews Physics*. Contributed several models to Neural Operator GitHub library.
- Supervised undergraduate student applying neural operators to fusion applications.

### University of Texas Institute for Geophysics

June – Aug. 2019 / June 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 with several orders of magnitude speed-up over prior methods.
- **Machine learning for Mars surface characterization:** Led a team of interns designing unsupervised graph neural networks and clustering methods for analyzing the Martian terrain.
- **Investigated ice surface elevation measurement error:** Hypothesized reason for offsets in surface elevation measurements derived from laser and radar-sounding instruments in the Arctic.

## PUBLICATIONS

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\* 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., 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.**, Kossai, 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*.

## AWARDS AND HONORS

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Barry Goldwater Scholar	2024
Henry Ford II Scholar Award (Caltech)	2024
Mellon Mays Undergraduate Fellowship	2023
Mellon Mays Summer Undergraduate Research Fellowship	2023
Stephen Adelman Memorial Summer Undergraduate Research Fellowship	2022
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	2021

## TEACHING

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<b>Head TA for Caltech ACM 104 (Applied Linear Algebra)</b>	Sept. 2023 – Dec. 2023
• Led team of 10 TAs for a 200-student class.	
<b>TA for Caltech IDS 157 (Graduate-level Statistical Inference)</b>	Apr. 2024 – June 2024
<b>TA for Caltech ACM 216 (Graduate-level Markov Chains)</b>	Jan. 2024 – Mar. 2024
<b>Lead Deans’ Tutor for Caltech Ma1 (First-year Mathematics)</b>	Oct. 2022 – June 2023
• Selected by Deans to lead weekly study sessions for first-year students.	

## TALKS AND PRESENTATIONS

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### 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.”

## REVIEWING

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### Conferences

- NeurIPS [2023, 2024]
- ICML [2024]
- ICLR [2024]
- AAAI [2025]

### Journals

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

## CODE CONTRIBUTIONS

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- Markov Neural Operator GitHub Repository ([https://github.com/neuraloperator/markov\\_neural\\_operator](https://github.com/neuraloperator/markov_neural_operator))
- Neural Operator PyTorch Library (<https://github.com/neuraloperator/neuraloperator>)

## SKILLS AND LANGUAGES

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**Languages:** English (native), Spanish (native), Chinese (native)

**Programming:** Python, MATLAB, Java, C/C++, R

**Libraries:** PyTorch, TensorFlow, Keras, NumPy, SciPy

**Hobbies:** Cello (orchestra and chamber music), football, chess