

JINGYI LIU

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I am interested in **integrating physics into machine learning** architectures to achieve more efficient, faster computation, and to improve physics awareness of current ML architectures. Ultimately, I want to help improve tool-developing ML research to benefit both scientific research and future robotics research.

EDUCATION

University of Southern California	Los Angeles, CA, U.S.
Ph.D., Mechanical Engineering - <i>Fluid Dynamics, Dynamics and Vibrations</i>	05.2025, 05. 2023
M.S., Applied Physics - <i>Electromagnetic Wave Propagation and Scattering, and Mechanics of Fluid and Solid Media</i>	
M.S., Mechanical Engineering	05. 2019
Xi'an University of Technology	Xi'an, China
B.S., Mechanical Engineering	2017

RELEVANT PROJECTS

Physics-guided ML design for learning collective dynamical system	2026-present
<ul style="list-style-type: none">Design ML architecture by mirroring active matter physics onto ML frameworks for learning collective dynamical system in biological data. (undergoing)	
Generative model for learning chaotic system	2025-present
<ul style="list-style-type: none">Examined diffusion model for learning chaotic dynamical system. linkDesigning physics-constraint architectures for high-dimensional chaotic dynamical systems. (undergoing)	
GAN-PINN for solving partial differential equations	2023
<ul style="list-style-type: none">Built physics-informed neural networks(PINN) and Generative adversarial networks(GAN) for solving 1D Allen-Cahn equation with 0.5% observations with unknown parameters. link	
Images recognition/classification	2023
<ul style="list-style-type: none">Constructed and trained deep convolutional neural networks for recognizing images, Tensorflow. link	

SKILLS/INTEREST

- Technical skills:** Mathematical Modeling, Complex physical simulation design, Numerical scheme selecting Integrating Physics into ML architectures,
- Tools:** Python(pytorch, tensorflow, pandas), C++, Matlab

WORK EXPERIENCE

Theory Fellow	Janelia Research Institute, HHMI, Ashburn, VA, 2025-present
<ul style="list-style-type: none">Independently led research question for learning a complex dynamical system with developing forward physics-based simulation and inverse physics-guided machine learning architecture for scientific discovery.Provided services for researchers interview process, workshops, and conferences.	
Research assistant	USC, Los Angeles, CA, 2022-2025
<ul style="list-style-type: none">Instructing and guiding junior Ph.D. students with projects.Constructed and planned summer lab projects for master students and high school students.Performed scientific presentations and held posters sessions on professional conferences and workshops.Gave guest lectures to class with 300 students on topic: <i>Swimming in low Re numbers</i>.	
Teaching assistant (AME 341 a,b Mechoptronics Laboratory)	USC, Los Angeles, CA, 2019-2022
<ul style="list-style-type: none">Led labs for junior undergraduate experimental courses, taught and facilitated hands-on experiments, including digital image correlation, signal processing and acoustic wave testing, taught quantitative analysis skills, like FFT, spectral analysis.Served on junior project review committees, provided guidance and evaluation on final reports and presentations.	
Student research team leader (under water vehicle research group)	XUT, Xi'an, China, 2016-2017
<ul style="list-style-type: none">Directed a project through full timeline, guided a multidisciplinary team through every stage from concept to completion, allocated tasks among team members.	

SELECTIVE PUBLICATIONS

- J.Liu**, Y. Man, J. Costello and E. Kanso. [Optimal Feeding of Swimming and Attached Ciliates](#). *Journal of Fluid Mechanics*, 1003, A26.
- J.Liu**, Y. Man, J. Costello and E. Kanso. [Feeding Rates of Sessile and Motile Ciliates are Hydrodynamically Equivalent](#). *eLife*, 13.
- J.Liu**, J. Costello and E. Kanso. [Flow Physics of Nutrient Transport Drives Functional Design of Ciliates](#). *Nat Commun* **16**, 4154 (2025).
- J.Liu**, Y. Man and E. Kanso. (2025) [Nutrient Transport in Concentration Gradients](#). *Physical Review Fluids*, 10(9), 093104.

CONFERENCES/WORKSHOPS

- **J.Liu**, E. Kalso. (2025) Self-organized Intracellular Stirrers Drive Coherent Cell-wide Flows, *Physics in Cytoplasm, Princeton University, NJ*.
- **J.Liu**, E. Kalso. (2025) Emergence of Cilia Synchronization and Circulating Flows in Spherical Cavities, *American Physical Society (Division of Fluid Dynamics), Huston, TX*.
- J. Costello, **J.Liu**, R Lopes, JR STRICKLER, SP Colin, and E. Kalso. (2025) The Peclet innovation and its lasting imprint on metazoan evolution, *American Physical Society (Division of Fluid Dynamics), Huston, TX*.
- KN Banoth, **J.Liu** and E. Kalso. (2025) Spontaneous Oscillations and Phase Locking in Flow-Coupled Force Singularities, *American Physical Society (Division of Fluid Dynamics), Huston, TX*.
- **J.Liu**, J. Costello and E. Kalso. (2025) Flow physics of nutrient transport drives functional design in ciliates, *American Physical Society, March Meeting, Anaheim, CA*.
- **J.Liu**, J. Costello and E. Kalso. (2024) Enhanced feeding with structural coordination of ciliary band and oral apparatus, *American Physical Society (Division of Fluid Dynamics), 77th Annual meeting, Salt Lake City, Utah*.
- KN Banoth, **J.Liu** and E. Kalso. (2024) Synchronization and Fluid Transport in Heterogeneous Ciliary Carpets, *American Physical Society (Division of Fluid Dynamics), 77th Annual meeting, Salt Lake City, Utah*.
- **J.Liu** (2024) Evaluating Feeding Strategies in Marine Ciliates. *Computational Tools for PDEs with Complicated Geometries and Interfaces. Flatiron Institute, Simons Foundation, New York*.
- **J.Liu**, Y. Man, J. Costello and E. Kalso. (2023) Feeding Rate of motile and sessile ciliates are asymptotically equivalent, *American Physical Society (Division of Fluid Dynamics), 76th Annual meeting, Washington, DC*.
- **J.Liu** (2023) Modeling flow physics and nutrient acquisition in microorganisms. *Janelia Theoretical Biophysics Workshop, Virginia*.
- **J.Liu**, Y. Man, J. Costello and E. Kalso. (2023) Optimal feeding of motile and sessile ciliates are asymptotically equivalent, *SoCal Fluids XVI conference, SDSU, CA*.
- **J.Liu**, Y. Man, J. Costello and E. Kalso. (2022) Feeding of sessile ciliates in uniform and nonuniform nutrient concentrations. *American Physical Society (Division of Fluid Dynamics), 75th Annual meeting, Indianapolis, IN*.
- **J.Liu**, Y. Man, J. Costello and E. Kalso. (2022) Nutrient uptake enhancement of sessile in concentration gradients, *SoCal Fluids XV conference, UCLA, CA*.
- **J.Liu**, Y. Man, and E. Kalso. (2021) Nutrients uptake enhancement of fixed ciliated microorganisms in concentration gradients. *American Physical Society (Division of Fluid Dynamics), 74th Annual meeting, Phoenix, AZ*.
- **J.Liu** and E. Kalso. (2020) Optimal feeding of ciliated microorganisms in concentration gradients. *American Physical Society (Division of Fluid Dynamics), 73rd Annual meeting, Virtual*.
- **J.Liu** and E. Kalso. (2019) Nutrients uptake and locomotion of ciliated microorganisms, *SoCal Fluids XIII conference, USCB, CA*.

HONORS/AWARDS

- Jenny Wang Excellence in Teaching Award, Viterbi School of Engineering, USC.
- 3rd prize, China University Robot Contest (National).
- 1st prize, Contemporary Undergraduate Mathematical Contest in Modeling (Province).
- Pacemaker to Merit Student in academic, XUT.
- 1st price in Extracurricular and Academic Contest, XUT.
- Excellence Award, Xi'an Conservatory of Music Piano Competition.

EARLIER RESEARCH

Optical wave propagation simulations

2022, USC

- Simulated wave scattering and propagation, applying in 2D metasurface and communication fibers design.
- Numerically solving Nonlinear Schrödinger equation by finite difference and Split-step Fourier method.

Remotely Operated Vehicle design (Prof. Xiaohui Zhang)

2016-2017, XUT

- Designed the ROV framework and analyzed its working deformation under the water.
- Designed the propulsion system; designed the seal structure by applying the spring-piston pressure auto-balancing structure.