

JENNY LIU

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Skilled in mathematical modeling, numerical and analytical analysis for statistics and differential equations. Experienced in physics involved optimization problem built up. Experienced in deep learning for time series data forecast with multiple neural network constructions. Always being curious.

EDUCATION

University of Southern California	Los Angeles, CA, U.S.
Ph.D., Mechanical Engineering-fluid dynamics (Excellence in Teaching Award, Viterbi School of Engineering)	05.2025
M.S., Applied Physics, and M.S., Mechanical Engineering	2023, 2019
Xi'an University of Technology	Xi'an, China
B.S., Mechanical Design and Manufacturing Automation (1st price in Mathematical Contest in Modeling, 3rd prize in China University Robot Contest)	2017

TECHNICAL SKILLS

- **Technical skills:** optimization, probability analysis, PCA analysis, time series forecast, supervised/unsupervised learning, deep learning, physics-informed neural network, CNN, RNN, LSTM, GAN, parallel computing
- **Tools:** Python (Pandas, Numpy, Tensorflow, PyTorch, Keras, Sklearn, OpenCV), Matlab, C++, GitHub, SQL, CUDA, OpenMp, MPI

WORK EXPERIENCE

Research assistant	Los Angeles, CA, USC, 2021-present
<ul style="list-style-type: none">• Constructed and planned summer lab projects for master students, including PIV analysis on image sequence and videos.• Performed presentations and held posters sessions on professional conferences and workshops.• Gave two guest lectures to class with 300 students on topic: <i>Swimming in low Re numbers</i>.	
Teaching assistant	Los Angeles, CA, USC, 2019-2021
<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)	Xi'an, China, XUT, 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.	

RELEVANT PROJECTS

JPMorgan Chase & Co. Quantitative Research Virtual Experience Program on Forge	May, 2024
<ul style="list-style-type: none">• Forecast gas price for one year by using monthly 4-year data, ARIMA.• Analyzed a book of loans with 10000 data to estimate a customer's probability of default, sklearn.• Used dynamic programming to convert FICO scores into categorical data to predict defaults.	
Machine learning: Partial differential equation solver by PINN	2023
<ul style="list-style-type: none">• Built physics-informed neural networks(PINN) and Generative adversarial networks(GAN) for solving Allen-Cahn equation with 0.5% observations with unknown parameters.• Performed parallel computing, and GPU usage for large data.	
Machine learning: Images recognition/classification	2023
<ul style="list-style-type: none">• Constructed and trained deep convolutional neural networks for recognizing images, Tensorflow.	

RESEARCH PROJECTS

Oceanic Microbial Nutrient Transport forecast, Fluid Dynamics Modeling, Optimization	2019-2023
<ul style="list-style-type: none">• Developed mathematical models and numerical schemes for solving PDE (partial differential equations) to simulate particles transport, aiming at forecasting the oceanic particles transport; built algorithm with reduced spatial computational complexity by one order; provided both of numerical and asymptotical analysis for model validation.• Formulated a PDE-constraint optimization problem and solved by adjoint-based method based on functional analysis and gradient descent, identifying the optimal metachronal wave generated by microorganisms' appendages.• Collected and analyzed biological data of organisms and identified correlation of size and fluid data.	
Symmetry-Breaking by flow feedback control in stochastic system	2022-present
<ul style="list-style-type: none">• Formulated a mathematical model for fluid dynamics within a spherical confinement driven by random forces obeying a Poisson process and simulated time evolution for fluid by Monte Carlo simulations.• Probabilistic analysis for stochastic physical system.	

PUBLICATIONS

- **J.Liu**, Y. Man, J. Costello and E. Kanso. (under review) Optimal Feeding of Swimming and Attached Ciliates. [archive](#)
- **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. (Submitted) Hydrodynamic origin of ciliary arrangements in unicellular eukaryotes.

- **J.Liu** and E. Kalso. (in preparation) Enhanced feeding of model ciliates in non-uniform nutrient fields.
- **J.Liu** and E. Kalso. (in preparation) Symmetry-Breaking by Feedback Flow Control in Stochastic Systems.

CONFERENCES/WORKSHOPS

- **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), 76rd 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), 75rd 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), 74rd 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, 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 PROJECTS

- Course project: Optical wave propagation simulations** 2023, 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.
- Course project: Stock price simulations** 2022, USC
 - Simulated stock price by solving a stochastic differential equation from the Black-Scholes model; Monte Carlo simulations.
 - Numerically solving Nonlinear Schrödinger equation by finite difference and Split-step Fourier method.
- Research project: Remotely Operated Vehicle design** (Prof. Xiaohui Zhang) 2016-2017, XUT
 - Designed the ROV framework and analyzed its working deformation under the water. Ansys (Workbench), Solidworks.
 - Designed the propulsion system; designed the seal structure by applying the spring-piston pressure auto-balancing structure.
 - Designed the propeller by using HydroComp ProExpert; made prototypes and adjusted the design parameter by testing the working performance of prototypes.
- Permanent Magnetic Coupling (PMC) design for a propulsion system** (Prof. Xiaohui Zhang) 2017, XUT
 - Designed the structure of a PMC, Solidworks.
 - Simulated the torque and tested that of a prototype, improving the structure design.
- Self-balance two-wheel Bicycle design** (Prof. Xiaohui Zhang) 2015-2016
 - Designed a self-balanced system by conservation of angular momentum theory.
 - Design the structure of a bicycle with applying a fly wheel for self-balance system; simulated working performance in ADAMS.
- Structure design of a Badminton Robot (body frame&arm)** (Prof. Xiaohui Zhang) 2015-2016
 - Participated in mechanical design in a multidisciplinary team.
 - Design the mechanical structure of overall frame and the arm of badminton robot, improving the structure design by collaborating with electronic teams.
- Application of Sunlight-LED three-dimensional intelligent lighting to greenhouse plant** (Prof. Yuanhe Tang) 2014, XUT
 - Collected and organized the data of different light wave band for different plants.
 - Report the results and analysis.