HAOTIAN HANG

May, 2025

Contact Information

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Education

2020 - 2025	**University of Southern California**, Los Angeles, CA
	Ph.D. Candidate, Mechanical Engineering, (2025/3/14 defended)
	Master of Science, Computer Science (High Performance Computing track), Dec 2023
2015 - 2019	**Shanghai Jiao Tong University**, Shanghai, China
	B.S. Aeronautics and Astronautics Engineering, June 2019 (Average Score: 89.22/100)

Employment

2020 - 2025	**Research Assistant**, Bio-Inspired Motion Lab at USC, PI: *Prof. Eva Kanso*
2023/6 - 8	**Quantitative Analyst Intern**, Corporate Model Risk, Wells Fargo, Manager: *Dr. Nengfeng Zhou, Dr. Harry Zhang*
	Evaluate robustness of machine learning models
	Discover the contribution of each input feature on robustness metrics and overfitting
	Compare different perturbation schemes in robustness testing
	Develop nonlinear variance inflation factor (VIF) to evaluate the nonlinear correlation in dataset
2019/9 - 12	**Intern Algorithmic Engineer**, Shanghai Hongpu Information Technology Co., Ltd.
	Conduct flaw detection on images of photovoltaic cell using Faster R-CNN and yolov3
2016 - 2019	**Research Assistant**, J.C.Wu Center for Aerodynamics, PI: *Prof. Hong Liu*

Publications

2025	12. **Hang, H.**, Huang, C., Barnett, A., & Kanso, E.* (in preparation) Chaotic Mixing in Large Schools of Fish
	11. Cheng, H., **Hang, H.**, Huang, C., Barnett, A., & Kanso, E.* (in preparation) Collective transitions in bi-chamber domain
	10. Linot, A.*, **Hang, H.**, Kanso, E., Taira, K. (under review) *Hierarchical equivariant graph neural networks for forecasting collective motion in vortex clusters and microswimmers*
	9. **Hang, H.**, Huang, C., Barnett, A., & Kanso, E.* (under review) Self-reorganization and Information Transfer in Massive Schools of Fish
	8. **Hang, H.**, Jiao, Y., Merel, J. & Kanso, E.* (under review). *Flow Currents Support Simple and Versatile Trail-Tracking Strategies*
	7. Jiao, Y.#, **Hang, H.**#, Merel, J., & Kanso, E.* (2025). Sensing flow gradients is necessary for learning autonomous underwater navigation. Nature Communications, 16(1), 3044.
2024	6. Heydari, S.#, **Hang, H.**#, & Kanso, E.* (2024). *Mapping spatial patterns to energetic benefits in groups of flow-coupled swimmers.* Elife, 13, RP96129.
	5. **Hang, H.**, Heydari, S. & Kanso, E.* (2024). *Feedback control of uncoordinated flapping swimmers to maintain school cohesion.* American Control Conference (ACC)
2023	4. Qin, S., **Hang, H.**, Xiang, Y.* & Liu, H. (2023). *Reynolds-number scaling analysis on lift generation of a flapping and passive rotating wing with an inhomogeneous mass distribution.* Chinese Journal of Aeronautics, 37(2), 259-269
2022	3. **Hang, H.**, Heydari, S., Costello, J., & Kanso, E.* (2022). *Active tail flexion in concert with passive hydrodynamic forces improves swimming speed and efficiency.* Journal of Fluid Mechanics, 932, A35.
2021	2. Xiang, Y., **Hang, H.**, Qin, S.*, & Liu, H. (2021). *Scaling analysis of the circulation growth of leading-edge vortex in flapping flight.* Acta Mech. Sin, 37(10), 1530-1543.
2020	1. **Hang, H.**, Yu, B., Xiang, Y., Zhang, B.*, & Liu, H. (2020). *An objective-adaptive refinement criterion based on modified ridge extraction method for finite-time Lyapunov exponent (FTLE) calculation.* Journal of Visualization, 23(1), 81-95.
	# - equal contribution, * - corresponding author

Patents

2018	Single-wing aircraft with rotor wing mode and fixed wing flight mode and mode switching method ZL.201811222322.5

Talks/Presentations

2025	**APS March Meeting**, Fish schooling at extreme scales
	Dynamics Day, Fish schooling at extreme scales
2024	**APS Division of Fluid Dynamics Meeting**, Fish schooling at extreme scales
	APS March Meeting, Learning to track flows
2023	**APS Division of Fluid Dynamics Meeting**, Flow-coupled swimmers self-organize into energetically cooperative or greedy spatial patterns
	So Cal Fluids XVI, Active tail flexion in concert with passive hydrodynamic forces improves swimming speed and efficiency
2022	**APS Division of Fluid Dynamics Meeting**, Learning to blindly follow hydrodynamic trails
	So Cal Fluids XV, Learning to blindly follow hydrodynamic trails
2021	**APS Division of Fluid Dynamics Meeting**, Active tail flexion in concert with passive hydrodynamic forces improves swimming speed and efficiency
2020	**APS Division of Fluid Dynamics Meeting**, Flowtaxis in the wakes of oscillating airfoils
2018	**APS Division of Fluid Dynamics Meeting**, Passive rotation of a flapping wing with an inhomogeneous mass distribution

Research Interests/Experience

2023 -	**Collective locomotion in complex geometry**, supervised by *Prof. Eva Kanso*, *Prof. Alex Barnett*
	Employ Boundary Element method (BEM) to model the hydrodynamic interaction between fish school and arbitrary geometry
	Study the transition of fish school in a bi-chamber domain
	Analyze large-scale agent-based simulation at the order of 10^4 using continuum description
2021 -	**School cohesion and energetic benefits of fish school**, supervised by *Prof. Eva Kanso*, *Prof. Matt McHenry*
	Develop efficient parallelized code using fast multipole method (FMM) to simulate emergent formation of hydordynamically-coupled siwmmers
	Evaluate the energetic benefit and stability of fish schools of different different spatial patterns
	Design control laws to stabilize fish schools that are passively unstable
	Study the dynamically-changing real fish schools using graph neural network
2020 -	**Underwater navigation using deep reinforcement learning**, supervised by *Prof. Eva Kanso*, *Dr. Josh Merel*
	Employ reinforcement learning to track vortical wakes based on local flow sensory and to navigate through unsteady adversarial background flow
	Find the importance of the wake's periodicity and traveling wave characteristic in both tasks
	Analyze the wake-trac king policy in a simplified signal field and prove that stability of the controller depends on the location of sensor
	Explain neural-network-based policy in observation space, and link it to the generalizability of the policy
2020 -	**Fluid-structure interaction of biologically-inspired flexible propulsor**, supervised by *Prof. Eva Kanso*, *Prof. John H. Costello*
	Analyze the role of active and passive flexion on swimming speed and efficiency of a self-propelling pitching plate using vortex sheet method
	Parametric study on effects of flexion phase, flexion angle and flexion ratio on swimming performance
	Find overlap between biological data and the region we proposed to have hydrodynamic benefits in parameter space
2016 - 2019	**High lift generation mechanisms of insects' flight**, supervised by *Prof. Hong Liu*, *Prof. Yang Xiang* and *Dr. Suyang Qin*
	Conduct experimental study using robotic flapping wing models in glycerin with Reynolds number similar to insects
	Measure flow field using particle image velocimetry (PIV) and measure force and torque using 6-axis force sensor, analogue filter and NI data acquisition system
	Study formation of leading edge vortex(LEV) for different kinematic modes, and find advanced rotation can generate a lager LEV because of wake capture
	Find a scaling law between passive rotation and active translation in flapping wing model

2016 - 2019	**AMR for FTLE calculation**, supervised by *Prof. Hong Liu*, *Prof. Bin Zhang*, *Bin Yu* and *Prof. Yang Xiang* Develop a physics-based adaptive refinement method for finite-time Lyapunov exponent calculation
2015 - 2016	**VTOL pitch-changed quadrotor** , supported by National Students' Platform for Innovation and Entrepreneurship Training , supervised by *Prof. Junqi Wu* Lead a team to make a quadrotor and implement pitch-changed technique and VTOL technique in terms of both mechanical and control

Teaching Experience

	at University of Southern California
2021 Spring	**Teaching Assistant**, AME-526, Introduction to mathematical methods in engineering II, *Prof. Niema Pahlevan*
2020 Fall	**Teaching Assistant**, AME-404, Computational Solutions to Engineering Problems, *Prof. Takahiro Sakai*

Open Source Projects

2023-	Field-Oriented Control (FOC) on STM32 ⌀ Github Link
2021-	Inferring unknown parameters of partially-observable system using Physics-informed-DeepONet ⌀ Github Link
2021 - 2022	Parallel C++ Implementation of Proximal Policy Optimization (PPO) ⌀ Github Link

Student Mentees

	at University of Southern California
2023 - 2024	Ziyan Zhu, M.S. student Ali Khokhar, M.S. student
2023	Donghun (Calvin) Moon, undergraduate at Columbia University

Service

2025	Reviewer, ICLR-AI4Mat 2025, Physics of Fluids
2024	Reviewer, Physics of Fluids, PNAS Nexus, NeurIPS-AI4Mat 2024 Judge, Undergraduate Symposium for Scholarly and Creative Work Session Chair, APS March Meeting DFD IX session
2023	Reviewer, American Control Conference (ACC) 2024 Judge, Undergraduate Symposium for Scholarly and Creative Work
2022	AME 441 project mentor, Robotic fish with artificial lateral line Judge, Undergraduate Symposium for Scholarly and Creative Work

Honor/Awards

2025	The William F. Ballhaus Jr. Prize for Excellence in Graduate Engineering Research (Viterbi School 2025 Best Dissertation Award) Dynamics Days US 2025 travel grant
2022	USC Three Minute Thesis (3MT) competition Finalist Link
2020	USC Viterbi fellowship
2017-2018	Hui-Chun Chin and Tsung-Dao Lee Chinese Undergraduate Research Endowment of SJTU
2016	Honeywell Star Project **Second Place** , Parts of the National College Students Physics Competition **Third Place** , Chinese College Students' Mathematics Competition
2014	**First Place**, Chinese Chemistry Olympiad **First Place**, Shanghai Adolescents Science and Technology Innovation Contest

Professional Society Memberships

- American Physical Society (APS)
- Institute of Electrical and Electronics Engineers (IEEE)

Graduate Coursework

	at University of Southern California
2024	AME-530b, Dynamics of Incompressible Fluids, *Prof. Mitul Luhar*
2023	CSCI-575, Quantum Computing and Quantum Cryptography, *Prof. Ming-Deh Huang*
	CSCI-599, An Introduction to Programming Languages, *Prof. Mukund Raghothaman*
2022	EE-587, Nonlinear Control Systems, *Prof. Mihailo Jovanovic*
	CSCI-561, Foundations of Artificial Intelligence, *Prof. Wei-Min Shen*
	CSCI-567, Machine Learning, *Prof. Victor Adamchik*
	CSCI-653, High Performance Computing and Simulations, *Prof. Aiichiro Nakano*
2021	PHYS-516, Methods of Computational Physics, *Prof. Aiichiro Nakano*
	EE-556, Stochastic Systems and Reinforcement Learning, *Prof. Rahul Jain*
	CSCI-570, Analysis of Algorithms, *Prof. Victor Adamchik*
	AME-508, Machine Learning and Computational Physics, *Prof. Assad Oberai*
	CSCI-596, Scientific Computing and Visualization, *Prof. Aiichiro Nakano*
2020	AME-525, Engineering Analysis, *Prof. Eva Kanso*
	AME-526, Introduction to Mathematical Methods in Engineering II, *Prof. Niema Pahlevan*
	AME-511, Compressible Gas Dynamics, *Prof. Iván Bermejo-Moreno*
	PHYS-760, Selected Topics in Computational Physics, *Prof. Satish Kumar Thittamaranahalli*
	AME-451, Linear Control Systems I, *Prof. Henryk Flashner*
	AME-541, Linear Control Systems II, *Prof. Néstor O. Pérez-Arancibia*
	AME-535A, Introduction to Computational Fluid Mechanics, *Prof. Alejandra Uranga*
	AME-530A, Dynamics of Incompressible Fluids, *Prof. Carlos Pantano*

Online Coursework

2024	Minds and Machines, MITx Online
2022	C++ Nanodegree, Udacity
	Qiskit Global Summer School 2022, IBM
2021	Build a Modern Computer from First Principles: From Nand to Tetris (Project-Centered Course), Coursera
2019	**Specialization**, DeepLearning.AI TensorFlow Developer , Coursera (containing 4 courses)
	Specialization, Deep Learning, Coursera (containing 5 courses)
	Machine Learning, Coursera
2014	General Chemistry, Coursera

Technical Skills

Programming Language:	Python, C/C++, Matlab, Fortran
Machine learning framework:	Pytorch, Tensorflow
Micro controller:	Arduino, Raspberry Pi, Pixhawk, stm32
Other softwares/ tools:	Solidworks, Fusion 360, ROS/ROS2, Gazebo, GitHub, LaTeX, Docker, Ansys Fluent, Linux, MPI, OpenMP, cuda