FENG LING

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PERSONAL INFO

Birth Year: 1992
Citizenship: China, People's Republic of
E-mail: feng.ling@helmholtz-munich.de
ORCID: 0000-0002-1766-073X
Address: Lerchenauerstraße 4, D-80809 München
Mobile: +49 1515 597 4990
Webpage: http://gofling.me/
Google Scholar: link to profile page

EMPLOYMENT

2022 - **Postdoc**, Helmholtz Pioneer Campus, Helmholtz Zentrum Müchen (HMGU), PI: *Dr. Janna Nawroth*
2017 - 2022 **Research Assistant / Resource Worker**, Bio-Inspired Motion Lab at USC, PI: *Prof. Eva Kanso*
2021 **Teaching Assistant**, Computational Solutions to Engineering Problems (AME 404), *Dr. Takahiro Sakai*
2016 **Teaching Assistant**, Engineering Thermodynamics (AME 310), *Prof. J. Domaradzki and A. Penkova*
2013 - 2015 **Research Assistant**, Center for Space Research at UT Austin, PI: *Prof. Srinivas Bettadpur*

EDUCATION

2016 - 2022 **University of Southern California**, Los Angeles, CA
Ph.D., Mechanical Engineering, Defense on Feb. 18, 2022; Degree conferred May. 13, 2022
Title: Multiscale Modeling of Cilia Mechanics and Functions
Committee: *Prof. Eva Kanso, Prof. P. Newton, Prof. I. Bermejo-Moreno, Prof. A. Oberai, Prof. C. Haselwandter*

2010 - 2015 **The University of Texas at Austin**, Austin, TX
B.S. Pure Mathematics, December 2015
B.S. Aerospace Engineering (Astronautics), December 2015
Computational Science and Engineering Certificate Program, May 2015 (*Rene Hiemstra, Prof. T. J.R. Hughes*)
Halliburton Business Foundations Summer Institute, July 2012

PUBLICATIONS

12. **F. Ling**, Y. Man, and E. Kanso*, *Flagellar Wave Reversal via Molecular Motor Asymmetry*, **(in prep)**
11. **F. Ling**, A.T. Sahin, B. Miller-Naranjo, S. Aime, D. Roth, N. Tepho, A.S. Vendrame, E. Emken, M. Kiechle, Y. Tesfaigzi, O. Lieleg, and J.C. Nawroth*, *High-throughput Mucus Microrheology for Donor and Disease Phenotyping*, **(preprint)**
10. D. Roth[#], A.T. Sahin[#], **F. Ling**, C.N. Senger, E.J. Quiroz, B.A. Calvert, A. van der Does, T.G. Güney, N. Tepho, S. Glasl, A. van Schadewijk, L. von Schledorn, R. Olmer, Eva Kanso*, J.C. Nawroth* and A.L. Ryan*, *Structure-function Relationships of Mucociliary Clearance in Human Airways*, **(accepted Nat. Comm.)**

2024
9. C. Huang, **F. Ling**, and E. Kanso*, *Collective Phase Transitions in Confined Fish Schools*, **PNAS**
8. **F. Ling**, T. Essock-Burns, M. McFall-Ngai, K. Katija, J.C. Nawroth* and E. Kanso*, *Flow Physics Guides Morphology of Ciliated Organs,* **Nature Physics**
7. H. Hang, Y. Jiao, S. Heydari, **F. Ling**, J. Merel, and E. Kanso*, *Interpretable and Generalizable Strategies for Stably Following Hydrodynamic Trails*, **Biorxiv**
6. Y. Jiao[#], **F. Ling**[#], S. Heydari[#], N. Heess, J. Merel, and E. Kanso*, *Deep Dive into Model-free Reinforcement Learning for Biological and Robotic Systems: Theory and Practice*, **arXiv**

2022
5. A.V. Kanale[#], **F. Ling**[#], H. Guo, S.F. Fürthauer, E. Kanso*, *Spontaneous Phase Coordination and Fluid Pumping in Model Ciliary Carpets*, **PNAS**

2021
4. Y. Jiao[#], **F. Ling**[#], S. Heydari[#], N. Heess, J. Merel, and E. Kanso*, *Learning to Swim in Potential Flow,* **Phys. Rev. Fluids.**
3. **F. Ling** and E. Kanso*, *Octopus-Inspired Arm Movements,* **Bioinspired Sensing, Actuation, and Control in Underwater Soft Robotic Systems** [chapter link]

2019
2. Y. Man[#], **F. Ling**[#], and E. Kanso*, *Cilia Oscillations,* **Phil. Trans. R. S. B**

2018
1. **F. Ling**, H. Guo, and E. Kanso*, *Instability-driven Oscillations of Elastic Microfilaments*, **J. R. S. Interface**

# - equal contribution, * - corresponding author

RESEARCH INTERESTS (*) and EXPERIENCES

2022 - * **Role of Mucus Rheology and Cilia Beat Kinematics in Human Airway Barrier Function**,
with *Dr. Janna Nawroth, Ayşe Tuğçe Şahin, Prof. Oliver Lieleg, Bernardo Miller-Naranjo, Prof. Stefano Aime*
Streamline DDM for high-throughput mucus microrheology, and develop physics-based quantitative models with machine learning techniques to dissect different factors that impair muco-ciliary clearance in *in vitro* human airway models of chronic airway diseases (*e.g.*, COPD, Asthma)

2017 - * **Driving Mechanics and Multi-scale Coordination of Cilia Motion**,
with *Prof. Eva Kanso, Dr. Yi Man, Anup Kanale, Dr. Janna Nawroth*
Using a consortium of models that deal with mechanics of molecular motors driving cilia oscillations, treat ciliary carpets and ducts as phased oscillators and active porous media to understand the *structure-to-function* relationship for individual cilium motion to ciliated organs

2019 - * **Embodied AI / RL and Emergence of Collective Behaviors**,
with *Prof. Eva Kanso, Yusheng Jiao, Chenchen Huang, Sina Heydari, Dr. Josh Merel*
Using reduced-order models and reinforcement learning techniques to study the formation of locomotion gaits and gait transitions in fish and seastar and emergence of collective motion in schools of fish

2018 **Trade-offs in Rapid Plant Movements (MSRI-Janelia)**,
joint with *Prof. Orit Peleg, Dr. Mattia Serra, Samantha Hill, Nina Ning*
Mathematical analysis of drag reduction due to branch folding in *Mimosa Pudica*

2016 **Discrete Inverse Spectral Problem**, supervised by *Prof. Etienne Vouga* and *Prof. Keenan Crane*
Reconstruction of discrete genus-0 surfaces using only its Laplace-Beltrami spectrum

2013 - 2015 **At Center for Space Research**, supervised by *Prof. Srinivas Bettadpur*
Parametric modeling of spacecraft accelerometer and center-of-mass misalignment
Correlation analysis among accelerometer read-outs, thruster firing pattern, and star camera anomalies
Studied geographical significance of GRACE on-board SNR w.r.t. gravity model post-fit residue

AWARDS

2023 **First Place Poster** on ciliated duct morphologies for EMBO Workshop: Physics of living systems.
2022 **Jenny Wang Excellence in Teaching Award,** coursework coordination for USC AME404 (*Dr. T. Sakai*).
2021 **Second Place Winner,** AES Student MATLAB Plugin Competition Entry, Synchronized Sythesis: A music synthesizer enabled by the synchronization of many ($\geq \mathcal{O}(10^3)$) coupled phased oscillators.
2015 **Meritorious Winner** Team Lead, COMAP Mathematical Contest In Modeling,
Problem B: Searching a lost aeroplane in open water, locally organized by *Dr. Andrew Spann*
2011 **Member**, ΣΓΤ Aerospace Honor Society UT Austin Chapter
2010 **Finalist**, Intel International Science and Engineering Fair

PRESENTATIONS

2024 **European Respiratory Society (ERS) Congress**, Poster: High-throughput Mucus Microrheology for Donor and Disease Phenotyping
2023 **Les Houches School of Physics: Bio-Inspired Aerial and Aquatic Locomotion**, From swimmers to the lung: Understanding the link between cilia ultrastructure and ciliary beat patterns
American Physical Society (APS) March Meeting, Flow Physics Explains Morphological Diversity of Ciliated Organs, PP08.8
Gordon Research Conference (GRC): Cilia, Mucus and Mucociliary Interactions, Poster: Flow Physics Explains Morphological Diversity of Ciliated Organs
2022 **APS March Meeting**, Cilia Coordination (substitute presentation for *Prof. Eva Kanso*'s invited talk M07:5)
2021 **APS Division of Fluid Dynamics Meeting (DFD)**, Asymmetric driving forces and spatial heterogeneity enhance metachronal order in ciliary carpets
Janelia 4D Cellular Physiology Workshops, Sponatenous coordination of ciliary carpets remastered version
2020 **Course lecture**, Mechanics of morphogenesis: surface growth and patterns
2019 - 2020 **APS DFD**, Proximal-to-distal molecular motor asymmetry controls flagellar wave reversals
SHINE USC (for HS students), Experiments on the fantastic strangeness of viscosity and elasticity
2018 **APS DFD**, Ciliary pumps
APS March Meeting, Instability-driven oscillations of active microfilament
2017 **APS DFD**, Dynamics of active microfilaments
2016 **Mathematics Undergraduate Student Talks** (at UT Austin), LS category and its cousins
2015 **Introduce a Girl to Engineering Day** (with demonstrations for K-12 audience),
Ballon rockets and iterative engineering design

	Directed Reading Program (DRP), (Co)fiber sequences and $\pi_3(S^2)$, mentor: *Ernest Fontes*
	DRP, What is persistent homology, mentor: *Ahmad Issa*
2014	**DRP**, Čech cohomology of projective spaces, mentor: *Yuecheng Zhu*
	DRP, Classification of du-val singularities, mentor: *Yuecheng Zhu*
2013	**DRP**, How to blow-up double points in a plane, mentor: *Hendrik Orem*

ELECTIVE GRADUATE COURSEWORK

	at University of Southern California
2020	Physics of Emergent Phenomena, *Prof. Christoph Haselwandter*
	Computational Differential Geometry, *Prof. Anand Joshi*
2018	Transition to Chaos in Dynamical Systems, *Prof. Paul Newton*
	Mechanics of Locomotion in Air, Water, and on Land, *Prof. Eva Kanso*
2017	Thermodynamics and Statistical Mechanics, *Prof. Christoph Haselwandter*
	Incompressible Fluids and Turbulence, *Prof. Mitul Luhar*
2016	Fokas method (audit), *Prof. Athanassios Fokas*
	at the University of Texas at Austin
	Kac-Moody Algebras and Groups (audit), *Prof. Daniel Allcock*
	Algebraic Geometry (audit), *Prof. David Ben-Zvi*
	Riemann Surfaces (audit), *Prof. Tim Perutz*
	Moduli of Higgs Bundle (audit), *Prof. Andrew Neitzke*
2015	Algebra, *Prof. Felipe Voloch*
	K-theory as it appears in geometry, *Prof. Dan Freed*
	Topics in algebraic topology (individual instruction), *Prof. Andrew Blumberg*
	4-Manifold Topology (audit), *Prof. Robert Gompf*
	Rational Homotopy Theory (audit), *Dr. Jonathan Campbell*
	Differential Topology, *Prof. Andrew Neitzke*
	D-modules (audit), *Dr. Sam Gunningham*
	Ergodic Theory and Dynamics (audit), *Prof. Lewis Bowen*
2014	Real Analysis, *Prof. Lewis Bowen*
	Algebraic Topology, *Prof. Michael Starbird*
	Homotopy Type Theory (audit), *Prof. Andrew Blumberg*
	Complex Analysis, *Prof. Thomas Chen*
	Stochastic Detection and Estimation, *Prof. Todd Humphreys*
2013	Finite Elements Methods, *Prof. Mary Wheeler*
	GPS Signal Processing, *Prof. Todd E. Humphreys*

MISC. ASSOCIATIONS

COVID	Yet another bouldering fanatic in the making and can now officially juggle and play with DAWs
2019 - 2022	Judging for USC Undergraduate Symposium for Scholarly and Creative Work (Physical Sciences II)
2018 - 2020	Designated pot washer for Good Karma Cafe at USC (volunteer → part of the family)
2017	USC Wrigley Marine Science Institute Spring Break Program on Sustainability
2016 - 2020	DTLA Weightlifting (defeated by strange back issues and distracted by bouldering)
2016	Volunteering in SXSW comedy and planning operations crew
2014 - 2016	Participation in Texas Undergraduate Topology and Geometry conference
2013 - 2016	Active member of Math Club at UT Austin (should've bought a shirt to show off)
2013	Researched WAAS literature for UT Radionavigation Lab over the summer
2011 - 2020	Numerous experiences in MOOC learning on Cryptography, Software Testing, Machine Learning, Database Management, AI, Automata Theory, Epigenetics, Origins of Life...
2011 - 2014	Longhorn Rocket Association (model rockets and software ground station work for a L2 rocket)
2014	LeaderShape Institute participant
2010 - 2011	Member of Engineering for a Sustainable World, IEEE Robotics and Automation Society; Explore UT Guide; Austin Habitat for Humanity (helped roofed and fenced a house)
2007 - 2009	Volunteer work at Houston Methodist Hospital and Bellaire City Library