

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 / +1 713 666 2935
Webpage: <http://gofling.me/>
Google Scholar: [link to profile page](#)

EDUCATION

- 2016 - 2022 **University of Southern California**, Los Angeles, CA
Ph.D., Mechanical Engineering (*Defense on 02/18/2022, Degree conferred 05/13/2022*)
Title: Multiscale Modeling of Cilia Mechanics and Functions
Committee: *Prof. Eva Kanso, Prof. P. Newton, Prof. I. Bermejo-Moreno, Prof. A. Oberai, Prof. C. Hasehwandter*
- 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

EMPLOYMENT

- 2022 - **Postdoc**, Helmholtz Pioneer Campus, Helmholtz Zentrum München (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*

PUBLICATIONS

- 2023 8. **F. Ling**, B. Miller-Naranjo, A. T. Sahin, O. Lieleg, and J. Nawroth, **Image-based High-throughput Micro-rheology of Human Airway Mucus**, (*in preparation*)
7. **F. Ling**, Y. Man, J.C. Nawroth, and E. Kanso, **Flagellar Wave Reversal via Molecular Motor Asymmetry**, (*in preparation*)
6. J.C. Nawroth, **F. Ling**, K. Katija, D. Stein, M.S. Shelley, and E. Kanso, (joint first author), **Flow Physics Explains Morphological Diversity of Ciliated Ducts**, *Bio-arxiv*, [link]
- 2022 5. A.V. Kanale, **F. Ling**, H. Guo, S.F. Fürthauer, E. Kanso, (joint first author), **Spontaneous Phase Coordination and Fluid Pumping in Model Ciliary Carpets**, *PNAS* [link]
- 2021 4. Y. Jiao, **F. Ling**, S. Heydari, N. Heess, J. Merel, and E. Kanso, (joint first author), **Learning to Swim in Potential Flow**, *Phys. Rev. Fluids*. [link]
3. **F. Ling** and E. Kanso, **Octopus-Inspired Arm Movements**, *Bioinspired Sensing, Actuation, and Control in Underwater Soft Robotic Systems* [link]
- 2019 2. Y. Man, **F. Ling**, and E. Kanso, (equal contributions), **Cilia Oscillations**, *Phil. Trans. R. S. B*, [link]
- 2018 1. **F. Ling**, H. Guo, and E. Kanso, **Instability-driven Oscillations of Elastic Microfilaments**, *J. R. S. Interface*, [link]

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 Müller-Naranjo, Prof. Stefano Aime*
Leverage innovative microscopy-based micro-rheology methods, physics-based computational modeling, and machine learning techniques to dissect different factors that cause mucociliary clearance impairment in *in vitro* human airway cell 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. Oriit 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 Synthesis: 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**, $\Sigma\Gamma\Theta$ Aerospace Honor Society UT Austin Chapter
- 2010 **Finalist**, Intel International Science and Engineering Fair

PRESENTATIONS

- 2023 **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, Spontaneous 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: *Abmad 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*

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 \rightarrow 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 SXSU 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

ELECTIVE GRADUATE COURSEWORK

- at University of Southern California**
- 2020 Physics of Emergent Phenomena, *Prof. Christoph Hasehwandter*
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 Hasehwandter*
Incompressible Fluids and Turbulence, *Prof. Mitul Lubar*
- 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*