

HANLIANG GUO

Postdoctoral Scholar

Aerospace and Mechanical Engineering
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RESEARCH INTERESTS & SKILLS

- Physical Simulations, Fluid-Structure Interactions, Bio-medical Flows.
- Mathematical Modeling, Numerical Methods for Fluid-structure Interactions in Viscosity-dominant Flows (regularized Stokeslet methods, immersed boundary methods, finite difference methods, etc.), Various Programming Languages (MATLAB, C/C++, FORTRAN, etc.), High Performance Computing (Fast Multipole Methods, MPI, OpenMP, etc.).

EDUCATION

- **Ph.D.** in Mechanical Engineering, 05/2017
University of Southern California, Los Angeles, CA
- **M.S.** in Computer Science, 05/2016
University of Southern California, Los Angeles, CA
- **M.S.** in Mechanical Engineering, 05/2012
University of Southern California, Los Angeles, CA
- **B.E.** in Engineering Mechanics and Aerospace Engineering, 07/2010
Tsinghua University, Beijing, China

RESEARCH EXPERIENCES

- **Postdoctoral Scholar**, AME, University of Southern California 2017 –
project: *Synchronizations and Stabilities for Ciliary Dynamics*
advisor: Eva Kanso
- **Research Assistant**, AME, University of Southern California 2012 – 2017
project: *Physics-based Models of Ciliary Flows*
advisor: Eva Kanso
- **Visiting Scholar**, SICE, Beijing Univ. of Posts and Telecomm., China 2010 – 2014
project: *Affinity Measures for Complex Networks*
advisor: Jun Guo
- **Research Assistant**, CE, University of Southern California 2011 – 2012
project: *Coarse Graining Algorithm of Atomistic Mechanics Computation*
advisor: Landon C. Wellford
- **Research Assistant**, SA, Tsinghua University, China 2008 – 2010
project: *Size Effects of Fatigue on Aerospace Structural Materials*
advisor: Huiji Shi

AWARDS

- **Postdoctoral Training & Travel Award** 2018
University of Southern California
- **AME Best Research Assistant Award** 2017
University of Southern California
- **Outstanding Self-Financed Student Abroad Award** 2016
China Scholarship Council
- **“Runner-up” of *Math Matters, Apply it!* Contest** 2016
Society of Industrial and Applied Mathematics (SIAM)
- **Graduate Student Government Travel Grant** 2015, 2016
University of Southern California
- **AME Teaching Assistant Fellowship** 2013 – 2014
University of Southern California
- **2nd Place in the Annual Poster Competition of AME** 2013
University of Southern California

STUDENTS MENTORED

- **Feng Ling** (Ph.D. student) Since Spring 2017
project: *Physical model for cilia’s activation mechanism*
- **Anup Kanale** (Masters Student, Ph.D. student since Fall 2016) Since Spring 2016
project: *Micro-rotors as an abstract model for cilia*
- **Anthony Medrano** (USC Undergraduate Student) Fall 2014
project: *A continuum model of numerical simulations for ciliated organelles*

TEACHING EXPERIENCES

- Two Guest Lectures in **AME 525 Engineering Analysis** Fall 2014
- Teaching Assistant of **AME 525 Engineering Analysis** Fall 2013, Spring 2014
- Grader of **AME 403 Stress Analysis** Spring 2012
- Grader of **AME 404 Mechanical Engineering Problems** Fall 2011

PROFESSIONAL SOCIETY MEMBERSHIPS

- **American Physical Society**
- **Society of Industrial and Applied Mathematics**
- **Association for Computing Machinery**

EDITORIAL DUTIES

- **Referee** *Open Physics* (previously *Central European Journal of Physics*)

JOURNAL PAPERS IN PREPARATION

1. **H. Guo**, K. Wan, J. Nawroth, E. Kanso, “Synchronization modes of basally-coupled microfilaments”, *in preparation*.
2. F. Ling, **H. Guo**, E. Kanso, “Instability-triggered 3D and 2D oscillations of axially-actuated microfilaments”, *in preparation*.
3. A. Kanale, **H. Guo**, E. Kanso, “Synchronizations of a carpet of hydrodynamically-coupled microrotors”, *in preparation*.

REFEREED JOURNAL PUBLICATIONS

4. **H. Guo**, L. Fauci, M. Shelley, E. Kanso, “Bistable synchronization modes of hydrodynamically-coupled microfilaments”, *Journal of Fluid Mechanics* **836** pp. 304-323 (2018).
5. J. Nawroth[†], **H. Guo**[†], E. Koch, E. Heath-Heckman, J.C. Hermanson, E. Ruby, J. Dabiri, E. Kanso[‡], M. McFall-Ngai[‡], “Motile cilia create fluid-mechanical microhabitats for the active recruitment of the host microbiome”, *Proceedings of the National Academy of Sciences USA* **114.36** (2017) ([†] equal contributions, [‡] equal contributions).
Featured by PNAS In This Issue: <http://www.pnas.org/content/114/36/9487.full>
LabAnimal: <http://www.labanimal.com/labanimal/v46/n11/pdf/labanimal.1374.pdf>
USC News: <https://viterbischool.usc.edu/news/2017/09/cilia-bouncer-bacteria-filtering-enhancing-chemical-communication/>
BPoD (Biomedical Picture of the Day): <http://bpod.mrc.ac.uk/archive/2017/10/5>
6. **H. Guo**, E. Kanso, “A Computational Study of Mucociliary Transport in Healthy and Diseased Environments”, *European Journal of Computational Mechanics*, **26**:1-2, (2017).
7. **H. Guo**, E. Kanso, “Evaluating Efficiency and Robustness in Cilia Design”, *Physical Review E*, **93.3** (2016).
8. **H. Guo**, J. Nawroth, Y. Ding, E. Kanso, “Cilia Beating Patterns are not Hydrodynamically Optimal”. *Physics of Fluids* **26.9** (2014): 091901. (*Among the top 5 most read papers of the month. Featured in Research Highlights by the Journal.*)

AIP | Physics of Fluids

MOST READ THIS MONTH

Post-breakup solutions of Navier-Stokes and Stokes threads

Streak generation in wind tunnels

Turbulence and skin friction modification in channel flow with streamwise-aligned superhydrophobic surface texture

Cilia beating patterns are not hydrodynamically optimal

Large-eddy simulation of turbulent cavitating flow in a micro channel

— LESS

AIP | Physics of Fluids

Research Highlights

The papers listed below are research highlights from *Physics of Fluids*. These papers have been made free to download for a limited time.

A model for the linear stability of the interface between aqueous humor and vitreous substitutes after vitreoretinal surgery
Krystyna Isakova, Jan O. Prallits, Rodolfo Repetto, Mario R. Romano
Phys. Fluids **26**, 124101 (2014)

Dynamic mode decomposition for large and streaming datasets
Maziar S. Hemati, Matthew O. Williams, Clarence W. Rowley
Phys. Fluids **26**, 111701 (2014)

Shock structure and temperature overshoot in macroscopic multi-temperature model of mixtures
Dimitar Madzarević, Tommaso Ruggeri, Srđoljub Simić
Phys. Fluids **26**, 108102 (2014)

Undulatory microswimming near solid boundaries
R. D. Schulman, M. Backholm, W. S. Ryu, K. Dalnoki-Veress
Phys. Fluids **26**, 101902 (2014)

Comparison of two- and three-dimensional simulations of miscible Richtmyer-Meshkov instability with multimode initial conditions
Britton J. Olson, Jeffrey A. Greenough
Phys. Fluids **26**, 101702 (2014)

Fluid mechanical responses to nutrient depletion in fungi and biofilms
Michael P. Brenner
Phys. Fluids **26**, 101306 (2014)

Cilia beating patterns are not hydrodynamically optimal
Hanliang Guo, Janna Nawroth, Yang Ding, Eva Kanso
Phys. Fluids **26**, 091901 (2014)

Thermo-optical pressure difference in one-component gas
I. V. Chernykhov, V. G. Chernykh
Phys. Fluids **26**, 092001 (2014)

9. J. Guo, **H. Guo**, Z. Wang, “Inferring the Temporal Order of Cancer Gene Mutations in Individual Tumor Samples”. *PLOS ONE*, **9.2** (2014): e89244.
10. J. Guo, **H. Guo**, Z. Wang, “An Activation Force-based Affinity Measure for Analyzing Complex Networks”. *Scientific Reports*, **1** (2011).
11. Z. Wang, F. Xue, G. Shu, H. Shi, P. Shi, **H. Guo**, “Thermal Aging Effect on the PWR Primary Pipe Steel with Nano-indentation Tests”. *Journal of Mechanical Strength*, **33.1**, 45-49 (in Chinese).
12. **H. Guo**, B. Qu, Z. Wang, P. Shi, F. Xue, H. Shi, “Small Punch Test Method in Hydrogen Embrittlement Characteristics in 65Mn Metallic Structures”. *Proceedings of 13th Conference of Mechanics in Northern China* (in Chinese).

INVITED PRESENTATIONS

- **Southern University of Science and Technology, China** 01/2018
Bistability in the synchronization of actuated micro filaments as a result of hydrodynamical coupling
- **Institute of Mechanics, Chinese Academy of Sciences, China** 08/2017
Ciliary flows actively recruit bacteria
- **Beijing Computational Science Research Center, China** 07/2015
Ciliary fluid transport enhanced by viscoelastic fluid
- **Beijing University of Posts and Telecommunications, China** 07/2014
Cilia beating patterns are not hydrodynamically optimal

CONTRIBUTED PRESENTATIONS

- **APS DFD 70th Annual Meeting, Denver, CO** 11/2017
Bistable synchronization modes in hydrodynamically coupled micro-rotors
- **Squid-Vibrio Fest XXIX, USC ISI, Marina Del Rey, CA** 05/2017
Ciliary flows actively recruit bacteria
- **So Cal Fluids XI, University of California, San Diego, CA** 04/2017
Multiple synchronization modes of elastic micro-filaments
- **APS DFD 69th Annual Meeting, Portland, OR** 11/2016
Emergence of multiple synchronization modes in hydrodynamically-coupled cilia
- **So Cal Fluids X, University of California, Irvine, CA** 04/2016
Evaluating efficiency and robustness in cilia design
- **APS DFD 68th Annual Meeting, Boston, MA** 11/2015
Effects of Viscoelastic Layers on Ciliary Transport
- **So Cal Fluids IX, San Diego State University, San Diego, CA** 04/2015
Leaning into the fluid

- **SIAM Conference on Comp. Science & Engineering**, Salt Lake City, UT 03/2015
Ciliary fluid transport enhanced by viscoelastic fluid
- **2015 Sendai Workshop on Computer, Communications and Their Interdisciplinary Perspective**, Tohoku University, Sendai, Japan 01/2015
What if you are tiny – a numerical study of ciliary flow
- **Microscale Ocean Biophysics**, Aspen Center for Physics, Aspen, CO 01/2015
Cilia beating patterns are not hydrodynamically optimal (poster)
- **APS DFD 67th Annual Meeting**, San Francisco, CA 11/2014
Cilia beating patterns are not hydrodynamically optimal
- **So Cal Fluids VIII**, University of California, Los Angeles, CA 04/2014
Cilia beat kinematics are not hydrodynamically optimal
- **APS DFD 66th Annual Meeting**, Pittsburg, PA 11/2013
Swimming of a ciliated microorganism
- **So Cal Fluids VII**, California Institute of Technology, Pasadena, CA 04/2013
Swimming of a ciliated microorganism model

OUTREACH

- **STEM Spotlight on AME Open House** 10/2017
Open House to over 100 high-school students.
Hands on experiments with high-speed camera, fidget spinner, & viscous fluids.
Featured by USC News:
<http://news.usc.edu/130497/high-school-students-get-a-firsthand-feel-for-what-its-like-to-be-an-engineer/>
<https://viterbischool.usc.edu/news/2017/10/high-school-students-attend-ame-stem-spotlight/>
- **RET program of USC Viterbi** 7/2017
Hosted two high school teachers for research experience in lab.
Designed hands on projects for high school teachers/students with phone-camera, image processing software (Fiji/ImageJ), and coding (Python).
- **STEM Spotlight on AME Open House** 10/2014
Open House to over 370 elementary to high-school students.
Hands on experiments with high-speed camera, viscous & non-Newtonian fluids.
- **USC MESA College Day** 10/2013
Workshop for local high-school students.
Hands on experiments with viscous & non-Newtonian fluids.