Mohammadhossein Firouznia

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Research Interests

Soft matter, biophysics, cellular mechanics, fluid mechanics, computational biology, physics of soft interfaces, numerical methods

Employment

Research Associate *Fall 2026 – present*

Department of Molecular and Cellular Biology, Harvard University, Cambridge, MA

- Advisor: Daniel J. Needleman

Flatiron Research Fellow *Fall 2023 – Fall 2026*

Center for Computational Biology, Flatiron Institute, New York, NY

- Advisor: Michael J. Shelley

Education

Ph.D. in Mechanical Engineering *Fall 2018 – Summer 2023*

University of California San Diego, Jacobs School of Engineering, La Jolla, CA

- Thesis: *Interfacially driven flows: from electrohydrodynamics to active interfaces*
- Advisor: David Saintillan

M.S. in Mechanical Engineering *Fall 2014 – Summer 2017*

Ohio University, Russ College of Engineering and Technology, Athens, OH

- Thesis: *The hydrodynamic interaction of two small freely-moving particles in a Couette flow of a yield stress fluid*
- Advisor: Sarah Hormozi

B.S. in Mechanical Engineering *Fall 2008 – Summer 2012*

Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran

Publications

In Preparation

1. Mohammadhossein Firouznia, Christopher J. Edelmaier, Bryce Palmer & Michael J. Shelley, *A fast platform for simulating Zimm polymer dynamics applied to chromatin motion*.

2. Mohammadhossein Firouznia, Christopher J. Edelmaier, Bryce Palmer, Zhicheng Pan, Olga Troyanskaya & Michael J. Shelley, *Hydrodynamics of the genome: distinct collective dynamics under two active models*.

3. Mohammadhossein Firouznia, Tae Yeon Yoo, Stylianos Varchanis, David B. Stein, Daniel J. Needleman & Michael J. Shelley, *Cellular nuclear dynamics in response to envelope rupture*.

Under Review

4. Mohammadhossein Firouznia, Wen Lu, Margot Lakonishok, Reza Farhadifar, Vladimir I. Gelfand & Michael J. Shelley, (2026). *Polarization of the* Drosophila *oocyte by active cortical exchange*, arXiv:2610.10916.

5. Adam R. Lamson, Mohammadhossein Firouznia & Michael J. Shelley, (2025). *Condensation dynamics of sticky and anchored flexible biopolymers*, arXiv:2512.17745.

Peer-Reviewed Journal Articles

6. Diptendu Sen*, Mohammadhossein Firouznia*, Jeremy A. Koch, David Saintillan & Petia M. Vlahovska, (2025). *Electrohydrodynamic drift of a drop away from an insulating wall*, Physical Review Fluids, 10(7), 073601.

7. Mohammadhossein Firouznia & David Saintillan, (2025). *Self-organized dynamics of a viscous drop with interfacial nematic activity*, Physical Review Research, 7(1), L012054.

8. Mohammadhossein Firouznia, Spencer H. Bryngelson & David Saintillan, (2023). *A spectral boundary integral method for simulating electrohydrodynamic flows in viscous drops*, Journal of Computational Physics, 489, 112248.

9. Mohammadhossein Firouznia, Michael J. Miksis, Petia M. Vlahovska & David Saintillan, (2022). *Instability of a planar fluid interface under a tangential electric field in a stagnation point flow*, Journal of Fluid Mechanics, 931, A25.

10. Mohammadhossein Firouznia & David Saintillan, (2021). *Electrohydrodynamic instabilities in freely suspended viscous films under normal electric fields*, Physical Review Fluids, 6(10), 103703.

11. Ahmadreza Rashedi, Mohammad Sarabian, Mohammadhossein Firouznia, Dallas Roberts, Guillaume Ovarlez & Sarah Hormozi, (2020). *Shear-induced migration and axial development of particles in channel flows of non-Brownian suspensions*, AIChE Journal, 66(12), e17100.

12. Mohammad Sarabian, Mohammadhossein Firouznia, Bloen Metzger & Sarah Hormozi, (2019). *Fully developed and transient concentration profiles of particulate suspensions sheared in a cylindrical Couette cell*, Journal of Fluid Mechanics, 862, 659–671.

13. Mohammadhossein Firouznia, Bloen Metzger, Guillaume Ovarlez & Sarah Hormozi, (2018). *The interaction of two spherical particles in simple-shear flows of yield stress fluids*, Journal of Non-Newtonian Fluid Mechanics, 255, 19–38.

** Co-authors with equal contributions.*

Presentations

Invited

M. Firouznia, W. Lu, M. Lakonishok, R. Farhadifar, V. I. Gelfand, M. J. Shelley, *Polarization of the Drosophila oocyte by active cortical exchange*, CCBx Annual Meeting, July 2026, Flatiron Institute, New York, USA.

M. Firouznia, D. Saintillan, S. Chakraborty, S. Weady, *Self-organization in active nematic surfaces*, APS Global Physics Summit, March 2026, Denver, USA.

M. Firouznia, *Nuclear envelope rupture: modeling leakage dynamics and recovery*, CCBx Annual Meeting, July 2024, Flatiron Institute, New York, USA.

Contributed

M. Firouznia, C. J. Edelmaier, B. Palmer, M. J. Shelley, *Hydrodynamics of the genome: distinct collective dynamics under two active models*, APS DFD, November 2026 (upcoming), Orlando, USA.

M. Firouznia, T. Y. Yoo, S. Varchanis, D. B. Stein, D. J. Needleman, M. J. Shelley, *Cellular nuclear dynamics in response to envelope rupture*, APS DFD, November 2025, Houston, USA.

Y. N. Young, B. Quaife, H. L. Gunasekara, D. Saintillan, M. Firouznia, *Nemato-hydrodynamics of a viscous drop under shear flow*, APS DFD, November 2025, Houston, USA.

M. Firouznia, D. Sen, P. M. Vlahovska, D. Saintillan, *Numerical and asymptotic analysis of the three-dimensional electrohydrodynamic interactions of a drop and a nearby planar boundary*, APS DFD, November 2024, Salt Lake City, USA.

M. Firouznia, D. Saintillan, *Self-organized dynamics of viscous drops with surface nematic activity*, APS March Meeting, March 2024, Minneapolis, USA.

M. Firouznia, D. Saintillan, *Self-organized dynamics of a viscous drop with interfacial nematic activity*, SoCal Fluids XVI, April 2023, San Diego, USA.

M. Firouznia, S. H. Bryngelson, D. Saintillan, *A spectral boundary integral method for simulating electrohydrodynamic flows in liquid droplets*, APS DFD, November 2022, Indianapolis, USA.

M. Firouznia, M. J. Miksis, P. M. Vlahovska, D. Saintillan, *Electrohydrodynamic interfacial instability at the stagnation point of a converging flow*, US National Congress on Theoretical and Applied Mechanics, June 2022, Austin, USA.

M. Firouznia, D. Saintillan, *Electrohydrodynamic instabilities in viscous films under perpendicular electric fields*, SoCal Fluids XV, April 2022, Los Angeles, USA.

M. Firouznia, M. J. Miksis, P. M. Vlahovska, D. Saintillan, *Electrohydrodynamic interfacial instability at a stagnation point*, APS DFD, November 2021, Phoenix, USA.

M. Firouznia, M. J. Miksis, P. M. Vlahovska, D. Saintillan, *Instability of a planar interface under a tangential electric field in a stagnation point flow*, SoCal Fluids XIV, April 2021 (online).

M. Firouznia, D. Saintillan, *Interfacial instabilities in electrified liquid films*, APS DFD, November 2020 (online).

M. Firouznia, D. Saintillan, *Electrohydrodynamic instability of a suspended liquid film*, APS DFD, November 2019, Seattle, USA.

A. Rashedi, M. Sarabian, M. Firouznia, G. Ovarlez, S. Hormozi, *An experimental study on fracturing flows of Newtonian fluids*, APS DFD, November 2018, Atlanta, USA.

M. Firouznia, R. Mehrani, B. Metzger, G. Ovarlez, S. Hormozi, *Experiments of a sphere settling in simple shear flows of yield stress fluids*, APS DFD, November 2018, Atlanta, USA.

M. Firouznia, B. Metzger, G. Ovarlez, S. Hormozi, *The interaction of two spheres in a simple-shear flow of complex fluids*, APS DFD, November 2017, Denver, USA.

M. Sarabian, M. Firouznia, B. Metzger, S. Hormozi, *Dispersion and layering of solid particles in cylindrical Couette flows*, APS DFD, November 2017, Denver, USA.

M. Firouznia, B. Metzger, G. Ovarlez, S. Hormozi, *The hydrodynamic interaction of two small freely-moving particles in a Couette flow of a yield stress fluid*, APS DFD, November 2016, Portland, USA.

Presenter underlined.

Honors & Awards

USNC/TAM 5-Minute Thesis (5MT) Competition in Mechanics: 3rd Place & People's Choice Award, U.S. National Committee for Theoretical and Applied Mechanics, National Academies *2024*

Powell/Kunzel Fellowship: Jacobs School of Engineering, University of California San Diego *2018*

Departmental Scholarship: Mechanical Engineering, Ohio University *2014*

Outstanding Student Award: Top senior, merit-based admission to M.S. program, Tehran Polytechnic *2012*

Honor Scholar & Double Major Award: Recognized by the Office of Brilliant Talents and Olympiads; granted selection of two bachelor's programs, Tehran Polytechnic *2010*

Teaching

UCSD

- Fluid Mechanics I (Graduate, MAE 210A), Teaching Assistant, Fall 2022.
- Fluid Mechanics II (Graduate, MAE 210B), Teaching Assistant, Winter 2021.
- Introduction to Mathematical Physics (Undergraduate, MAE 105), Teaching Assistant, Spring 2020 and 2021.
- Mechanics of Fluids (Graduate, MAE 201), Teaching Assistant, Fall 2020.

Tehran Polytechnic

- Heat Transfer I (Undergraduate), Teaching Assistant, Fall 2012.

Service, Mentoring & Outreach

- **Manuscript Reviewer:** Journal of Fluid Mechanics, European Journal of Mechanics – B/Fluids, Journal of Applied Mechanics.
- **Post-PhD Career Panel:** Invited panelist for a virtual discussion on academic and non-academic career pathways for STEM PhD students, organized by the Graduate Student Government, the Association for Women in Science, and the Association for Women in Mathematics, University of Notre Dame, January 2026.
- **Flatiron's Summer Internship:** Mentored a Ph.D. student on a research project during the Flatiron Institute Summer Internship Program, Summer 2025.
- **Student Committee for Faculty Recruitment:** Served on two student committees for faculty recruitment in the Department of Mechanical and Aerospace Engineering and at Scripps Institution of Oceanography, UCSD, Spring 2022 and 2023.
- **MAE Mentorship Program:** Mentored undergraduate students in the Department of Mechanical and Aerospace Engineering on career and professional development, UCSD, Spring 2023.
- **ENLACE Program:** Mentored two engineering students in a summer research program, UCSD, Summer 2022.
- **Undergraduate Research Supervision:** Supervised two engineering students in research, Ohio University, 2015–2017.
- **Tech Savvy:** Co-organized a STEM career workshop for girls (grades 6–9), Ohio University, Summer 2017.
- **Technology Camp for High School Girls:** Co-organized a workshop on engineering and technology career opportunities for female high school students, Ohio University, Summer 2016.