

Yoichiro Mori

CONTACT INFORMATION	Department of Mathematics Department of Biology School of Arts and Sciences University of Pennsylvania	y1mori@sas.upenn.edu
RESEARCH INTERESTS	Mathematical physiology and biophysics, applied and numerical analysis.	
POSITIONS	Department of Mathematics, Department of Biology, University of Pennsylvania Philadelphia, PA, USA Calabi-Simons Professor in Mathematics and Biology 2019-present. School of Mathematics, University of Minnesota Minneapolis, MN, USA Professor, 2018-2020. Associate Professor, 2013-2018. Assistant Professor, 2008-2013. Department of Mathematics, University of British Columbia Vancouver, BC, Canada Postdoctoral Fellow, August 2006-July 2008.	
EDUCATION	Courant Institute of Mathematical Sciences, New York University New York, NY, USA Ph.D. Mathematics, September 2006. <ul style="list-style-type: none">• Dissertation Title: “Three Dimensional Model of Cellular Electrophysiology”• Advisor: Charles S. Peskin University of Tokyo Tokyo, Japan M.D. Medicine, March 2002.	
AWARDS	2010-2012 2009-2011 2007 2007 2006	McKnight Land Grant Professorship Alfred P. Sloan Foundation Fellow Leslie Fox Prize in Numerical Analysis (First Prize) Kurt O. Friedrichs Prize for Outstanding Dissertation Moses A. Greenfield Research Award for Interdisciplinary Research
FELLOWSHIPS	2005-2006 2002-2004	New York University Graduate School of Arts and Sciences Dean’s Dissertation Fellow New York University Graduate School of Arts and Sciences Henry McCracken Fellow
PUBLICATIONS	Hyunjoong Kim, Yoichiro Mori and Joshua B. Plotkin, <i>Optimality of intercellular signaling: direct transport versus diffusion</i> , in revision. Hiroshi Matano, Yoichiro Mori and Mitsunori Nara, <i>Stability of Front Solutions of the Bidomain Allen-Cahn Equation on an Infinite Strip</i> , in revision.	

- Alex McAvoy, Yoichiro Mori and Joshua B. Plotkin *Selfish optimization and collective learning in populations*, Physica D, accepted.
- D. B. Cooney and Y. Mori, *Long-Time Behavior of a PDE Replicator Equation for Multilevel Selection in Group-Structured Populations*, Journal of Mathematical Biology, in press.
- E. Garcia-Juarez, Y. Mori and R. Strain *The Peskin Problem with Viscosity Contrast*, Analysis and PDE, in press.
- Maria Jesus Munoz Lopez, Hyunjoong Kim and Yoichiro Mori, *A Reduced 1D Stochastic Model of Bleb-driven Cell Migration*, Biophysical Journal, 121(10), 1881-1896, 2022.
- Hiroshi Matano, Yoichiro Mori, Mitsunori Nara and Koya Sakakibara, *Asymptotic behavior of fronts and pulses of the bidomain model*, SIAM Journal of Applied Dynamical Systems, 21(1), 616-649, 2022.
- Q. Su, A. McAvoy, Y. Mori and J. B. Plotkin *Evolution of prosocial behavior in multilayer populations*, Nature Human Behaviour, 6, 338-348, 2022.
- William H Mitchell, Henry G Bell, Laurel Ohm, Yoichiro Mori and Daniel Spirn *A single-layer based numerical method for the slender body boundary value problem*, Journal of Computational Physics, 450, 110865, 2021.
- Y. Mori and L. Ohm *Accuracy of slender body theory in approximating force exerted by thin fiber on viscous fluid*, Studies in Applied Mathematics, 147, 127-179, 2021.
- J. Ma, M. Do, M. A. Le Gros, C. S. Peskin, C. A. Larabell, Y. Mori, and S. A. Isaacson, *Strong Intracellular Signal Inactivation Produces Sharper and more Robust Signaling from Cell Membrane to Nucleus*, PLOS Computational Biology, 16(11): e1008356, 2020.
- Y. Mori and L. Ohm *An error bound for the slender body approximation of a thin, rigid fiber sedimenting in Stokes flow*, Research in Mathematical Sciences, 7(8), 2020.
- Y. Li, K. Konstantopoulos, R. Zhao, Y. Mori and S.X. Sun, *The importance of water and hydraulic pressure in cell dynamics*, Journal of Cell Science, 133(20), 2020.
- Y. Li, L. Yao, Y. Mori and S.X. Sun *On the energy efficiency of cell migration in diverse physical environments*, Proceedings of the National Academy of Sciences, 116 (48) 23894-23900, 2019.
- A. Tuttle, J. Riera-Diaz and Y. Mori *A computational study on the role of glutamate and NMDA receptors on cortical spreading depression using a multidomain electrodiffusion model*, PLOS Computational Biology, 15 (12):e1007455, 2019.
- Y. Mori, L. Ohm and D. Spirn, *Theoretical Justification and Error Analysis for Slender Body Theory with Free Ends*, Archive for Rational Mechanics and Analysis, 235 (3), 1905-1978, 2019.
- Y. Mori, L. Ohm and D. Spirn, *Theoretical justification and error analysis for slender body theory* Communications on Pure and Applied Mathematics, published online, 2019.

- Y.N. Young, Y. Mori and M. Miksis, *Slightly deformable Darcy drop in linear flows*, Physical Reviews Fluids, 4, 063601, 2019.
- A. Moshkforoush, P.A. Valdes-Hernandez, D.E. Rivera, Y. Mori and J. Riera-Diaz, *waveCSD: A method for estimating transmembrane currents originated from propagating neuronal activity in the neocortex: Application to study cortical spreading depression*, Journal of Neuroscience Methods 307, 106–124, 2018.
- Y. Mori and Y.N. Young, *From Electrodiffusion Theory to the Electrohydrodynamics of Leaky Dielectrics through the Weak Electrolyte Limit*, Journal of Fluid Mechanics, 855, 67-130, 2018.
- M. Nara, Y. Mori and H. Matano, *Asymptotic behavior of spreading fronts in the anisotropic Allen-Cahn equations on \mathbb{R}^n* , Annales de l’Institut Henri Poincaré, 36, 585-626, 2019.
- Y. Mori, A. Rodenberg and D. Spirn, *Well-posedness and global behavior of the Peskin problem of an immersed elastic filament in Stokes flow*, Communications on Pure and Applied Mathematics, 72, 5, 887-980, 2018.
- L. Yao and Y. Mori, *A numerical method for osmotic water flow and solute diffusion with deformable membrane boundaries in two spatial dimension*, Journal of Computational Physics, 350, 728-746, 2017.
- L. Yao, M.C. Calderer, Y. Mori and R. Siegel, *Rhythmogenic Drug Delivery: Modeling, Analysis and Numerical Simulation*, SIAM Journal of Applied Mathematics, 77(2), 565-592, 2017.
- R. O’Connell and Y. Mori, *Effects of Glia in a Triphasic Continuum Model of Cortical Spreading Depression*, Bulletin of Mathematical Biology, 78 (10), 1943-1967, 2016.
- N. Wei, Y. Mori and E.G. Talkacheva, *The dual effect of ephaptic coupling on cardiac conduction with heterogeneous expression of connexin 43*, Journal of Theoretical Biology, 397, 103-114, 2016.
- Y. Mori and H. Matano, *Stability of Planar Fronts of the Bidomain Equation* Communications in Pure and Applied Mathematics, 69(12), 2364-2426, 2016.
- A. Stinchcombe, Y. Mori and C.S. Peskin, *Well-Posed Treatment of Space-Charge Layers in the Electroneutral Limit of Electrodiffusion*, Communications on Pure and Applied Mathematics, 69(12), 2221-2249, 2016.
- Y. Li, Y. Mori and S. Sun, *Flow-driven cell migration under external electric fields*, Physical Review Letters, 115(26), 268101, 2015.
- Y. Mori, *A multidomain model for ionic electrodiffusion and osmosis with an application to cortical spreading depression*, Physica D, Nonlinear Phenomena, 308, 94-108, 2015.
- N. Wei, Y. Mori, and E.G. Talkacheva, *The role of short term memory and conduction velocity restitution in alternans formation*, Journal of Theoretical Biology, 367, 21-28, 2015.
- T. Fai, B Griffith, Y. Mori and C.S. Peskin, *Immersed Boundary Method for Vari-*

able Viscosity and Variable Density Problems Using Fast Constant-Coefficient Linear Solvers II: Theory, SIAM. J. Sci. Comput., 36, B589-B621, 2014.

H. Chen, M.C. Calderer and Y. Mori, *Analysis and Simulation of a model of polyelectrolyte gel in one spatial dimension*, Nonlinearity, 27, 1241-1285, 2014.

Stephen D. McIntyre, Virendra Kakade, Yoichiro Mori, Elena G. Tolkacheva, *Heart rate variability and alternans formation in the heart: the role of feedback in cardiac dynamics*, Journal of Theoretical Biology, 350, 90-97, 2014.

Y. Liu and Y. Mori, *L^p convergence of the Immersed Boundary Method*, SIAM. J. Num. Anal., 52, 1, 496-514, 2014.

T. Fai, B Griffith, Y. Mori and C.S. Peskin, *Immersed Boundary Method for Variable Viscosity and Variable Density Problems Using Fast Constant-Coefficient Linear Solvers I: Numerical Method and Results*, SIAM. J. Sci. Comput., 35, B1132-B1161, 2013.

Y. Mori, H. Chen, C. Micek, and M.C. Calderer, *A Dynamic Model of Polyelectrolyte Gels*, SIAM Journal of Applied Mathematics, 73, 104-133, 2013.

Y. Liu and Y. Mori, *Properties of Discrete Delta Functions and Local Convergence of the Immersed Boundary Method*, SIAM J. Num. Anal., 50, 2986-3015, 2012.

Y. Mori, *Mathematical Properties of Pump-Leak Models of Cell Volume Control and Electrolyte Balance*, Journal of Mathematical Biology, Vol. 64, No. 5, p873-916, 2012, *Erratum*, *ibid.*

Y. Mori, C. Liu and R.S. Eisenberg, *A Model of Electrodifffusion and Osmotic Water Flow and its Energetic Structure*, Physica D: Nonlinear phenomena, 240, 1835-1852, 2011.

Y. Mori, A. Jilkine and L. Edelstein-Keshet, *Asymptotic and bifurcation analysis of wave-pinning in a reaction-diffusion model of cell polarization*, SIAM J. Appl. Math. 71, 1401-1420, 2011.

H. Matano and Y. Mori, *Global existence and uniqueness of a three-dimensional model of cellular electrophysiology*, Discrete and Continuous Dynamical Systems (DCDS-A), Vol. 29, No. 4, 1573-1636, 2011.

M. Brera, J.W. Jerome, Y. Mori and R. Sacco, *A Conservative and monotone mixed-hybridized finite element approximation of transport problems in heterogeneous domains*, Computer Methods in Applied Mechanics and Engineering, Vol. 199, 2709-2720, 2010.

Y. Mori and C.S. Peskin, *A Numerical Method for Cellular Electrophysiology based on the Electrodifffusion Equations with Internal Boundary Conditions at the Membrane*, Communications in Applied Mathematics and Computational Sciences, Vol. 4, No.1, 85-134, 2009.

Y. Mori and C.S. Peskin, *A Universal Programmable Fiber Architecture for the Representation of a General Incompressible Linearly Elastic Material as a Fiber-Reinforced Fluid*, Advances in Applied Mathematics, Vol. 43, No. 1, 75-100, July 2009.

- Y. Mori, G.I. Fishman and C.S. Peskin, *Ephaptic conduction in a cardiac strand model with 3D electrodiffusion*, Proc. Natl. Acad. Sci., Vol. 105, no. 17, pp. 6463-6468, 2008.
- Y. Mori, A. Jilkin and L. Edelstein-Keshet, *Wave-pinning and Cell Polarity From a Bistable Reaction-diffusion System*, Biophysical Journal, Vol. 94, pp.3684-3697, 2008.
- Y. Mori, *Convergence Proof of the Velocity Field for a Stokes Flow Immersed Boundary Method*, Communications on Pure and Applied Mathematics, 2008, Vol. 61, no. 9, pp. 1213-1263.
- Y. Mori and C.S. Peskin, *Implicit Second Order Immersed Boundary Methods with Boundary Mass*, Computational Methods in Applied Mechanics and Engineering, Vol. 197, pp. 2049-2067, Apr. 2008.
- Y. Mori, J.W. Jerome and C.S. Peskin, *A Three-Dimensional Model of Cellular Electrical Activity*, Bulletin of the Institute of Mathematics, Academia Sinica, Volume 2, No.2. pp. 367-390, Jun. 2007.
- Y. Mori and M. Nakazawa, *A New Simple Etiological Model of Human Death*, Jinkougaku Kenkyuu (The Journal of Population Studies) (33) Nov. 2003.

INVITED TALKS

- University of Delaware (Mar. 2022).
- PDEA seminar, (sponsored by Springer) (Jun. 2021).
- Rochester Institute of Technology (Apr. 2021).
- Temple University, Applied Math Seminar (Mar. 2021).
- Illinois Institute of Technology, Applied Math Seminar (Dec. 2020).
- University of California, Riverside, Applied Math Seminar (Nov. 2020).
- Pacific Rim Conference in Mathematics, MSRI (Aug. 2020).
- McGill University, Mathematical Biology Seminar (May 2020).
- Mathematical Biosciences Institute, Ohio State University (May 2020).
- University of California, Irvine, Applied Mathematics Seminar (Feb. 2020).
- University of Pennsylvania, PICS colloquium, (Jan. 2020).
- Drexel University, Mathematics Colloquium, (Jan. 2020).
- Meiji Institute of Mathematical Sciences, Tokyo, Japan (Sept. 2019).
- Courant Institute, New York University, Mathematical Biology Seminar, Applied Math Seminar (May 2019).
- 83rd Midwest PDE seminar, Indiana University, Bloomington, plenary speaker (Mar. 2019)
- University of Pennsylvania (Jan. 2019)
- Meiji Institute of Mathematical Sciences, MIMS workshop, Tokyo, Japan (Dec. 2018)
- Flatiron Institute, New York, NY (Oct. 2018)
- Scuola Normale Superiore, Pisa, Italy (Oct. 2018)
- Meiji Institute of Mathematical Sciences, MIMS/CMMA lecture, Tokyo, Japan (Sept. 2018)
- Banff International Research Station, Oaxaca, Mexico (Aug. 2018)

- New Jersey Institute of Technology (May 2018)
- Midwest Numerical Analysis Day, University of Kansas, plenary speaker (Apr. 2018)
- Meiji Institute of Mathematical Sciences, Tokyo, Japan (Mar. 2018)
- University of Tokyo (Dec. 2017)
- Creighton University (Nov. 2017)
- Fields Institute (Aug. 2017)
- New Jersey Institute of Technology (May 2017)
- National Chiao-Tung University, Hsinchu, Taiwan (Apr. 2017)
- National Taiwan University, Tapei, Taiwan (Apr. 2017)
- Hokkaido University, Sapporo, Japan (Mar. 2017)
- Meiji Institute of Mathematical Sciences, Tokyo, Japan (Jan. 2016)
- Newton Institute, Cambridge, UK (Jul. 2015)
- Riken Center for Developmental Biology, Kobe, Japan (Jun. 2015)
- University of California, Irvine (Mar. 2015)
- National Institutes of Health, Bethesda MD (Dec. 2014)
- Pennsylvania State University (Oct. 2014)
- Florida International University (Sept. 2014)
- Fields Institute, Toronto (Jul. 2014).
- Suzhou University, Suzhou, China (Jun. 2014).
- University of Wisconsin, Madison (Nov. 2013).
- Pennsylvania State University (Oct. 2013).
- IMA workshop, lecturer (Jul. 2013).
- University of Tokyo (Jun. 2013).
- New Jersey Institute of Technology (Nov. 2012)
- Institut des Hautes Études Scientifiques, Paris (Jun. 2012)
- Courant Institute, New York University (Dec. 2011).
- University of Tokyo (Nov. 2011).
- University of Tokyo, Graduate School of Mathematical Sciences (1.5 hour lecture)(Jan. 2011)
- International Conference on Nonlinear PDE and Related Analysis/Applications, Northwestern University, plenary speaker (Mar. 2010).
- University of Tokyo, Graduate School of Mathematical Sciences (two 2 hour lectures)(Jul. 2010)
- University of Wisconsin, Eau Claire, Andrew J. Balas Lecture (Apr. 2009)
- Rush Medical College (Mar. 2009)
- Duke University, Applied Mathematics Seminar. (Feb. 2009)
- University of Tokyo, Graduate School of Mathematical Sciences (three 1.5 hour lectures)(Jan. 2009),
- University of Tokyo, Institute for Industrial Science (Jan. 2009)
- University of Minnesota, Applied Mathematics Seminar (Sept. 2008)
- Politecnico di Milano, Scientific Computing seminar (Jul. 2008)

- University of Tokyo, Applied Analysis seminar (May 2008)
- Massachusetts Institute of Technology, Physical Applied Mathematics seminar (Feb. 2008)
- University of British Columbia, Scientific Computing seminar. (Jan. 2008)
- University of Minnesota, Scientific Computing seminar (Dec. 2007)
- University of Utah, Mathematical Biology seminar. (Oct. 2007)
- Courant Institute, Mathematical Biology seminar. (May 2007)
- Northwestern University, PDE seminar. (May 2007)
- University of Utah, Mathematical Biology seminar. (Jan. 2006)
- University of British Columbia, Mathematical Biology seminar. (Jan. 2006)
- Northwestern University, PDE seminar. (Nov. 2005)
- University of British Columbia, Mathematical Biology seminar. (Oct. 2006)

SERVICES

- Applied Mathematics and Computational Science Program of the University of Pennsylvania, Graduate Chair, 2022-present.
- Data Driven Discovery Initiative (School of Arts Sciences, University of Pennsylvania), Advisory Board, 2021-present.
- Lecture Notes on Mathematical Modelling in the Life Sciences, Springer, Editor in Chief, 2021-present.
- SIAM Journal of Applied Mathematics, Editorial Board, 2021-present.
- Studies in Applied Mathematics, Editorial Board 2020-present.
- Co-Director, Center for Mathematical Biology at the University of Pennsylvania, 2019-present.
- Served on DOVE fellowship committee (U of M university-wide graduate fellowship), 2019.
- Reviewer of SIAM Journal of Applied Mathematics, SIAM Journal of Numerical Analysis, SIAM Journal of Mathematical Analysis, Computer Methods in Applied Mechanics and Engineering, Bulletin of Mathematical Biology, Communications in Computational Physics, Journal of Computational Physics, Mathematics of Computation, Proceedings of the National Academy of Sciences, Journal of Fluid Mechanics, Physical Biology, Journal of Mathematical Biology, Journal of Computational Neuroscience, Journal of Theoretical Biology, Physica D, Gels, etc.
- NSF review panel, 2014, 2015, 2017, 2018.
- SIAM Life Sciences Meeting, 2020, Organizing Committee.
- Organization of IMA workshop "Electrohydrodynamics and Electrodiffusion in Material Sciences and Biology", Mar. 2018.
- Organization of IMA workshop "Mathematical Modeling of Cortical Spreading Depression (SD) and Related Phenomena", Feb. 2018.
- Organization of IMA workshop "Mathematics of Biological Charge Transport: Molecules and Beyond", Summer, 2015.
- Organization of GAFOS (German American Frontiers of Science Symposium) in 2009, 2010.
- Organization of minisymposia at SIAM conferences.

TEACHING
EXPERIENCE

Fall	2022	Lecturer, BIOL 3310 (Principles of Human Physiology)
Spring	2022	Lecturer, AMCS 603 (Numerical Methods)
Fall	2021	Lecturer, BIOL 215 (Human Physiology)
Spring	2021	Lecturer, AMCS 568 (Mathematical Biology)
Fall	2020	Lecturer, AMCS 602 (Numerical Linear Algebra)
Spring	2019	Lecturer, MATH 4428 (Introduction to Applied Mathematics)
Spring	2018	Lecturer, MATH 8402 (Methods of Applied Mathematics II)
Fall	2017	Lecturer, MATH 8401 (Methods of Applied Mathematics I)
Fall	2016	Lecturer, MATH 2373 (CSE Calculus IV)
Fall	2016	Lecturer, MATH 8540 (Topics in Mathematical Biology)
Spring	2016	Lecturer, MATH 8402 (Methods of Applied Mathematics II)
Fall	2015	Lecturer, MATH 8401 (Methods of Applied Mathematics I)
Spring	2015	Lecturer, MATH 8540 (Topics in Mathematical Biology)
Spring	2015	Lecturer, MATH 2373 (CSE Calculus IV)
Spring	2014	Lecturer, MATH 2373 (CSE Calculus IV)
Spring	2014	Lecturer, MATH 8402 (Methods of Applied Mathematics, II)
Fall	2013	Lecturer, MATH 8401 (Methods of Applied Mathematics I)
Spring	2013	Lecturer, MATH 2574 (Honors Calculus IV)
Fall	2012	Lecturer, MATH 8540 (Topics in Mathematical Biology)
Spring	2011	Lecturer, MATH 8402 (Methods of Applied Mathematics II)
Fall	2010	Lecturer, MATH 8401 (Methods of Applied Mathematics I)
Spring	2009	Lecturer, MATH 1272 (Calculus II)
Fall	2008	Lecturer, MATH 8401 (Methods of Applied Mathematics I)
Spring	2008	Lecturer, MATH 103 (Integral Calculus)
Spring	2007	Lecturer, MATH 103 (Integral Calculus)
Summer	2005	Teaching Assistant in Mathematical Biology, Park City Mathematics Institute, Utah
Spring	2005	Lecturer, Written Exam Workshop (Graduate)
Summer	2004	Lecturer, Calculus I
Spring	2004	Lecturer, Written Exam Workshop (Graduate)
Fall	2003	Teaching Assistant, Quantitative Reasoning
Spring	2003	Teaching Assistant, Business Calculus

ADVISING

Current Postdoctoral Fellows:

- Daniel Gomez 2021-present
- Hyunjoong Kim 2020-present
- Daniel Cooney, 2020-present
- Qi Su, 2020-present
- Alex McAvoy, 2021-present

Postdoctoral Fellows advised:

- Lingxing Yao, 2011-2013

Current Ph.D. Students:

- Jae Ho Choi, 2021-present.
- Po-Chun Kuo, 2019-present.

Ph.D. Students advised:

- María Jesús Muñoz-López, 2016-2021.
- Laurel Ohm, 2015-2020.
- Austin Tuttle, 2015-2019.

- Yang Liu, 2009-2011.
- Analise Rodenberg, 2013-2018.
- Rosemary O'Connell, 2013-2016.
- Ning Wei, 2011-2016.
- Stephen McIntyre 2009-2014.
- Minsu Kim 2011-2014.
- Haoran Chen 2010-2013.

Current Masters Students:

- Ya Gao, 2022-present.

Master Students advised:

- Cordelia McGehee, 2018-2022

UNDERGRADUATE
SENIOR THESES

Kelly Catlin (Spring 2018), Akshay Bhardwaj (Spring 2016), Meghan Chau (Fall 2015), Jiachen Wang (Spring 2013), Euibin Cheon (Spring 2013), Kristen Steenvoorden (Fall 2011).

FUNDING

- Simons Foundation, Math+X Chair Fund, 2019-2024.
- NSF DMS-1907583/DMS-2042144 (PI) *Collaborative Research: Analysis and Computation of Dynamics of Elastic Structures in Stokes Flow*, \$320,000, 2019-2022.
- NSF DMS 1620316 (PI) *Collaborative Research: Algorithm and Theory for Interface Computations*, \$149,998, 2016-2019.
- NSF DMS 1516978 (PI) *Collaborative Research: Cortical Spreading Depression and Ionic Electrodifffusion in the Brain*, \$195,000, 2015-2019.
- NSF DMS 1412371 (co-PI) *Collaborative Research: Cortical Spreading Depression: Initiation, Propagation and Recovery*, 2014, recommended for funding but returned to NSF due to illness of collaborator.
- NSF DMS 0914963 (PI) *A Theoretical and Algorithmic Study of the Immersed Boundary Method*, \$315,059, 2009-2013.
- McKnight Foundation Fellowship, 2010-2012.
- Alfred P. Sloan Foundation Fellowship, 2009-2011.

QUALIFICATIONS

Medical Board Examination, Japan, April 2002
Certified to practice medicine in Japan.