CURRICULUM VITAE: CHRIS H. RYCROFT

Room 305, Pierce Hall
John A. Paulson School of Engineering and Applied Sciences
Harvard University
Cambridge, MA 02138

Tel. 510-207-0172
Fax. 617-495-9837
chr@seas.harvard.edu
http://seas.harvard.edu/~chr/

EDUCATION

Massachusetts Institute of Technology — 2002–2007
Ph. D. Mathematics
Advisor: Professor Martin Z. Bazant
Thesis title: *Multiscale Modeling in Granular Flow*

Pembroke College, University of Cambridge — 2001–2002
Certificate of Advanced Study in Mathematics, Grade of Distinction

Pembroke College, University of Cambridge — 1998–2001
Bachelor's in Mathematics, First Class Honours

POSITIONS

John A. Paulson School of Engineering and Applied Sciences, Harvard University — 2019–present
John L. Loeb Associate Professor of Engineering and Applied Sciences

Computational Research Division, Lawrence Berkeley Laboratory — 2010–present
Visiting Faculty Scientist

John A. Paulson School of Engineering and Applied Sciences, Harvard University — 2018–2019
Associate Professor of Applied Mathematics

John A. Paulson School of Engineering and Applied Sciences, Harvard University — 2014–2017
Assistant Professor of Applied Mathematics

Department of Mathematics, University of California, Berkeley — 2010–2013
Morrey Assistant Professor

Computational Research Division, Lawrence Berkeley Laboratory — 2007–2010
Visiting Postdoctoral Scholar

RESEARCH INTERESTS

Broadly: interdisciplinary mathematical modeling, mechanics of complex materials, numerical methods

Specifically: numerical methods for elasto-plasticity: bulk metallic glasses, fluid–structure interaction;
mechanical modeling of biological systems: biomaterials, simulation of multiple interfaces;
the Voronoi tessellation: computational techniques, analysis of particle systems;
material porosity: high-throughput screening, mathematical modeling of fluid flow;
dense granular materials: rheology, mixing, stochastic methods, industrial applications;
multigrid methods, spectral methods, conformal methods, adaptive grids, parallel computation

JOURNAL PUBLICATIONS

Direct undergraduate, graduate, and postdoctoral advisees are highlighted in red, purple, and blue, respectively. Co-first authors are marked with asterisks.

J. Andrejevic, L. M. Lee, S. M. Rubinstein, and C. H. Rycroft, *A model for fragmentation kinetics of crumpled thin sheets*, Nat. Commun., accepted (2020).

N. Derr,* D. C. Fronk,* C. A. Weber, A. Mahadevan, C. H. Rycroft, and L. Mahadevan *Flow-driven branching patterns in a porous medium*, Phys. Rev. Lett. **125**, 158002 (2020).

C. H. Rycroft, C.-H. Wu, Y. Yu, and K. Kamrin, *Reference map technique for incompressible fluid–structure interaction*, J. Fluid Mech. **898**, A9 (2020).

T. Kumar, C. H. Rycroft, and T. L. Jackson, *Eulerian Thermo-mechanical Simulations of Heterogeneous Solid Propellants using an Approximate Projection Method*, Combustion and Flame **219**, 198–211 (2020).

N. M. Boffi and C. H. Rycroft, *Parallel three-dimensional simulations of quasi-static elastoplastic solids*, Comput. Phys. Commun. **257**, 107254 (2020).

N. M. Boffi and C. H. Rycroft, *A coordinate transformation methodology for parallel three-dimensional simulations of quasi-static elastoplastic solids*, Phys. Rev. E **101**, 053304 (2020).

E. Medina, P. E. Farrell, K. Bertoldi, and C. H. Rycroft, *Navigating the landscape of nonlinear mechanical metamaterials for advanced programmability*, Phys. Rev. B **101**, 064101 (2020).

G. P. T. Choi, B. Chiu, and C. H. Rycroft, *Area-preserving mapping of 3D ultrasound carotid artery images using density-equalizing reference map*, IEEE T. Med. Imaging (2020). doi:10.1109/TBME.2019.2963783.

D. Fortunato, C. H. Rycroft, and R. I. Saye, *Efficient operator-coarsening multigrid schemes for local discontinuous Galerkin methods*, SIAM J. Sci. Comput. **41**, A3913–A3937 (2019).

J. Hoffmann,* Y. Bar-Sinai,* L. Lee, J. Andrejevic, S. Mishra, S. M. Rubinstein, and C. H. Rycroft, *Machine learning in a data-limited regime: Augmenting experiments with synthetic data uncovers order in crumpled sheets*, Science Advances **5**, eauu6792 (2019).

L. Gaucherand,* B. K. Porter,* R. E. Levene, S. K. Schmaling, E. L. Price, C. H. Rycroft, Y. Kevorkian, C. McCormick, D. Khaperskyy, and M. M. Gaglia, *The influenza A virus endoribonuclease PA-X usurps host mRNA processing machinery to limit host gene expression*, Cell Reports **27**, 776–792 (2019).

Y. Tang, L. Zhang, Q. Guo, B. Xia, Z. Yin, J. Cao, J. Tong, and C. H. Rycroft, *Analysis of the pebble burnup profile in a pebble-bed nuclear reactor*, Nucl. Eng. Design **345**, 233–251 (2019).

J. Hoffmann,* S. Donoughe,* K. Li, M. Salcedo, and C. H. Rycroft, *A simple developmental model recapitulates complex wing venation patterns*, Proc. Natl. Acad. Sci. **115**, 9905–9910 (2018).

O. Gottesman, J. Andrejevic, C. H. Rycroft, and S. M. Rubinstein, *A state variable for crumpled thin sheets*, Communications Physics **1**, 70 (2018).

C. A. Weber, C. H. Rycroft, and L. Mahadevan, *Differential Activity drives Instabilities in Biphasic Active Matter*, Phys. Rev. Lett. **120**, 248003 (2018).

G. P. T. Choi and C. H. Rycroft, *Density-equalizing maps for simply-connected open surfaces*, SIAM J. Imaging Sci. **11**, 1134–1178 (2018).

JOURNAL PUBLICATIONS (CONTINUED)

T. G. Fai and C. H. Rycroft, *Lubricated Immersed Boundary Method in Two Dimensions*, J. Comput. Phys. **356**, 319–339 (2018).

V. Gulizzi, C. H. Rycroft, and I. Benedetti, *Modelling intergranular and transgranular micro-cracking in polycrystalline materials*, Comput. Method Appl. M. **329**, 168–194 (2018).

T. G. Fai, R. Kusters, J. Harting, C. H. Rycroft, and L. Mahadevan, *Active elastohydrodynamics of vesicles in narrow, blind constrictions*, Phys. Rev. Fluids **2**, 113601 (2017).

A. R. Hinkle, C. H. Rycroft, M. D. Shields, and M. L. Falk, *Coarse-graining atomistic simulations of plastically deforming amorphous solids*, Phys. Rev. E **95**, 053001 (2017).

M. Vasoya, C. H. Rycroft, and E. Bouchbinder, *Notch fracture toughness of glasses: Rate, age and geometry dependence*, Phys. Rev. Applied **6**, 024008 (2016).

A. Lieb, C. H. Rycroft, and J. Wilkening, *Optimizing intermittent water supply*, SIAM J. Appl. Math. **76**, 1492–1514 (2016).

C. H. Rycroft and M. Z. Bazant, *Asymmetric collapse by dissolution or melting in a uniform flow*, Proc. Roy. Soc. A. **472**, 20150531 (2016).

M. M. Gaglia, C. H. Rycroft, and B. A. Glaunsinger, *Transcriptome-Wide Cleavage Site Mapping on Cellular mRNAs Reveals Features Underlying Sequence-Specific Cleavage by the Viral Ribonuclease SOX*, PLOS Pathog. **11**, e1005305 (2015).

C. H. Rycroft, Y. Sui, and E. Bouchbinder, *An Eulerian projection method for quasi-static elastoplasticity*, J. Comput. Phys. **300**, 136–166 (2015).

B. Valkov, C. H. Rycroft, and K. Kamrin, *Eulerian method for multiphase interactions of soft solid bodies in fluids*, J. Appl. Mech. **84**, 041011 (2015).

G. Venugopalan,* D. Camarillo,* K. D. Webster, C. D. Reber, J. A. Sethian, V. M. Weaver, D. A. Fletcher, and C. H. Rycroft, *Multicellular architecture of malignant breast epithelia influences mechanics*, PLOS ONE **9**, e101955 (2014).

C. M. Freeman, K. L. Boyle, M. Reagan, J. Johnson, C. H. Rycroft, and G. J. Moridis, *MeshVoro: A three-dimensional Voronoi mesh building tool for the TOUGH family of codes*, Computers & Geosciences **70**, 26–34 (2014).

Q. Shi,* R. P. Ghosh,* H. Engelke, C. H. Rycroft, L. Cassereau, J. A. Sethian, V. M. Weaver, and J. T. Liphardt, *Rapid disorganization of mechanically interacting systems of mammary acini*, Proc. Natl. Acad. Sci. **111**, 658–663 (2014).

G. I. Barenblatt, P. J. M. Monteiro, and C. H. Rycroft, *On a boundary layer problem related to the gas flow in shales*, J. Eng. Math. **84**, 11–18 (2014).

C. H. Rycroft, A. Dehbi, T. Lind, and S. Güntay, *Granular flow in pebble-bed nuclear reactors: scaling, dust generation, and stress*, Nucl. Eng. Design. **265**, 69–84 (2013).

C. H. Rycroft and J. Wilkening, *Computation of three-dimensional standing water waves*, J. Comput. Phys. **255**, 612–638 (2013).

M. Pinheiro, R. L. Martin, C. H. Rycroft, and M. Haranczyk, *High accuracy geometric analysis of crystalline porous materials*, CrystEngComm **37**, 7531–7538 (2013).

JOURNAL PUBLICATIONS (CONTINUED)

M. Pinheiro, R. L. Martin, C. H. Rycroft, A. Jones, E. Iglesia, and M. Haranczyk, *Characterization and comparison of pore landscapes in crystalline porous materials*, J. Mol. Graph. Model. **44**, 208–219 (2013).

M. Theillard, C. H. Rycroft, and F. Gibou, *A multigrid method on non-graded adaptive octree and quadtree Cartesian grids*, J. Sci. Comput. **55**, 1–15 (2013).

P. J. M. Monteiro, C. H. Rycroft, and G. I. Barenblatt, *A mathematical model of fluid and gas flow in nanoporous media*, Proc. Natl. Acad. Sci. **109**, 20309–20313 (2012).

C. H. Rycroft and E. Bouchbinder, *Fracture toughness of metallic glasses: annealing-induced embrittlement*, Phys. Rev. Lett. **109**, 194301 (2012).

K. Kamrin, C. H. Rycroft, J.-C. Nave, *Reference map technique for finite-strain elasticity and fluid–solid interaction*, J. Mech. Phys. Solids **60**, 1952–1969 (2012).

L.-C. Lin,* A. H. Berger,* R. L. Martin,* J. Kim,* J. A. Swisher, K. Jariwala, C. H. Rycroft, A. S. Bhown, M. W. Deem, M. Haranczyk, and B. Smit, *In silico screening of carbon capture materials*, Nature Materials **11**, 633–641 (2012).

C. H. Rycroft and F. Gibou, *Simulations of a stretching bar using a plasticity model from the shear transformation zone theory*, J. Comput. Phys. **231**, 2155–2179 (2012).

T. F. Willems, C. H. Rycroft, M. Kazi, J. C. Meza, and M. Haranczyk, *Algorithms and tools for high-throughput geometry-based analysis of crystalline porous materials*, Microporous and Mesoporous Materials **149**, 134–141 (2012).

C. H. Rycroft, Y. Wong, and M. Z. Bazant, *Fast spot-based multiscale simulations of granular flow*, Powder Technol. **200**, 1–11 (2010).

C. H. Rycroft, *Voro++: a three-dimensional Voronoi cell library in C++*, Chaos **19**, 041111 (2009).

C. H. Rycroft, A. V. Orpe, and A. Kudrolli, *Physical test of a particle simulation model in a sheared granular system*, Phys. Rev. E **80**, 031305 (2009).

C. H. Rycroft, K. Kamrin, and M. Z. Bazant, *Assessing continuum relationships in simulations of granular flow*, J. Mech. Phys. Solids **57**, 828–839 (2009).

K. Kamrin, C. H. Rycroft, and M. Z. Bazant, *The stochastic flow rule: a multi-scale model for granular plasticity*, Modelling Simul. Mater. Sci. Eng. **15**, S449–S464 (2007).

C. H. Rycroft, G. S. Grest, J. W. Landry, and M. Z. Bazant, *Analysis of granular flow in a pebble-bed nuclear reactor*, Phys. Rev. E **74**, 021306 (2006).

C. H. Rycroft, M. Z. Bazant, J. W. Landry, and G. S. Grest, *Dynamics of random packings in granular flow*, Phys. Rev. E **73**, 051306 (2006).

JOURNAL MANUSCRIPTS IN REVIEW & PREPRINTS

G. P. T. Choi and C. H. Rycroft, *Volumetric density-equalizing reference map with applications*, submitted to J. Sci. Comput. (2020).

N. Tanjeem, W. H. Wilkin, D. A. Beller, C. H. Rycroft, and V. N. Manoharan, *Crystallization on a cylinder*, preprint (2020).

Journal manuscripts in review & preprints (continued)

N. Andrejevic,* J. Andrejevic,* C. H. Rycroft, and M. Li, *Machine learning spectral indicators of topology*, preprint (2020). (arXiv:2003.00994)

H. Nesser, D. J. Jacob, J. D. Maasakkers, T. R. Scarpelli, M. P. Sulprizio, Y. Zhang, and C. H. Rycroft, *Reduced-cost construction of Jacobian matrices for high-resolution inversions of satellite observations of atmospheric composition*, in review at Atmos. Meas. Tech. (2020).

J. Lu, E. Lazar, and C. H. Rycroft, *A multithreaded extension of the Voro++ library*, preprint (2020).

Conference publications and technical reports

V. Gulizzi, C. H. Rycroft, I. Benedetti, *A Novel Micro-Mechanical Model for Polycrystalline Inter-Granular and Trans-Granular Fracture*, Key Engineering Materials **754**, 177–180 (2017).

C. H. Rycroft, T. Lind, S. Güntay, and A. Dehbi, *Granular flows in pebble bed reactors: dust generation and scaling*, proceedings of ICAPP 2012, Chicago.

T. Lind, S. Güntay, A. Dehbi, Y. Liao, and C. H. Rycroft, *PSI project on HTR dust generation and transport*, Proceedings of HTR 2010, Prague.

C. H. Rycroft, *Voro++: a three-dimensional Voronoi cell library in C++*, Lawrence Berkeley National Laboratory, Paper LBNL-1430E (2009).

Invited seminars and colloquia

Modeling the diverse geometry of insect wings, University of Arizona, Tucson, September 18, 2020.

The reference map technique for simulating complex materials and multi-body interactions, Weizmann Institute of Science, Israel, January 19, 2020.

The reference map technique for simulating complex materials and multi-body interactions, Hebrew University of Jerusalem, Israel, January 14, 2020.

Interfacial dynamics of dissolving objects in fluid flow, Bar-Ilan University, Israel, January 9, 2020.

The reference map technique for simulating complex materials and multi-body interactions, Worcester Polytechnic Institute, October 2, 2019.

The reference map technique for simulating complex materials and multi-body interactions, CMSA Colloquium, Harvard University, April 3, 2019.

Strain localization and fracture in metallic glasses, University of Massachusetts, Lowell, September 11, 2019.

Interfacial dynamics of dissolving objects in fluid flow, Department of Mathematics, University of Illinois, Chicago, December 3, 2018.

The reference map technique for simulating complex materials and multi-body interactions, University of California, Santa Barbara, October 15, 2018.

The reference map technique for simulating complex materials and multi-body interactions, University of California, Merced, April 6, 2018.

INVITED SEMINARS AND COLLOQUIA (CONTINUED)

Interfacial dynamics of dissolving objects in fluid flow, Widely Applied Mathematics Seminar, Harvard University, March 22, 2018.

The reference map technique for simulating complex materials and multi-body interactions, University of Southern California, Los Angeles, February 28, 2018.

The reference map technique for simulating complex materials and multi-body interactions, MICDE seminar, University of Michigan, November 10, 2017.

The reference map technique for simulating complex materials and multi-body interactions, Applied Mechanics Colloquium, Harvard University, October 4, 2017.

High-throughput screening of crystalline porous materials, Engineering Department, University of Massachusetts, Boston, April 24, 2017.

The reference map technique for simulating complex materials and multi-body interactions, Flatiron Institute, New York, April 19, 2017.

Interfacial dynamics of dissolving objects in fluid flow, Department of Mathematics, University of Arizona, Tucson, April 14, 2017.

High-throughput screening of crystalline porous materials, Applied Statistics Workshop, Harvard University, November 30, 2016.

Modeling the toughness of metallic glasses, CIRCS seminar, Northeastern University, November 15, 2016.

Modeling the toughness of metallic glasses, Department of Physics, Tufts University, April 27, 2016.

Modeling the toughness of metallic glasses, Division of Applied Mathematics, Brown University, January 22, 2016.

Modeling the toughness of metallic glasses, Department of Physics, Harvard University, November 17, 2015.

Interfacial dynamics of dissolving objects in fluid flow, Department of Mathematics, University of Wisconsin, Madison, November 7, 2015.

Computation of three-dimensional standing water waves, Department of Mathematical Sciences, University of Delaware, May 12, 2015.

Interfacial dynamics of dissolving objects in fluid flow, Courant Institute of Mathematical Sciences, New York, May 7, 2015.

Interfacial dynamics of aggregating and dissolving objects, SIAM Student Chapter seminar, Massachusetts Institute of Technology, April 23, 2015.

Interfacial dynamics of aggregating and dissolving objects, Department of Physics, Clark University, April 8, 2015.

Computation of three-dimensional standing water waves, Department of Mathematics, Northeastern University, April 7, 2015.

Modeling the toughness of metallic glasses, Department of Materials Science & Engineering, Johns Hopkins University, March 25, 2015.

INVITED SEMINARS AND COLLOQUIA (CONTINUED)

Computation of three-dimensional standing water waves, Department of Mathematics, University of Illinois, Chicago, February 2, 2015.

Modeling the toughness of metallic glasses, Department of Physics, Brandeis University, October 7, 2014.

High-throughput screening of crystalline porous materials, Institute for Applied Computational Science, Harvard University, September 19, 2014.

Computation of three-dimensional standing water waves, Department of Mechanical Engineering, Massachusetts Institute of Technology, April 15, 2014.

Computation of three-dimensional standing water waves, Department of Mathematics, Massachusetts Institute of Technology, February 11, 2014.

High-throughput screening of crystalline porous materials, Department of Chemical Engineering, Massachusetts Institute of Technology, November 14, 2013.

High-throughput screening of crystalline porous materials, Department of Mechanical Engineering, University of Washington, April 8, 2013.

Modeling the toughness of metallic glasses, School of Engineering and Applied Sciences, Harvard University, February 28, 2013.

Modeling the toughness of metallic glasses, School of Mathematics, University of Minnesota, February 21, 2013.

Modeling the toughness of metallic glasses, School of Computational Science & Engineering, Georgia Tech, February 8, 2013.

Modeling the toughness of metallic glasses, Department of Mathematics, University of North Carolina, Chapel Hill, February 6, 2013.

Modeling the toughness of metallic glasses, Department of Mathematics, University of Arizona, February 4, 2013.

Modeling the toughness of metallic glasses, Mathematics Institute, University of Warwick, United Kingdom, January 28, 2013.

Modeling the toughness of metallic glasses, Department of Mathematics, University of California, Davis, January 23, 2013.

Modeling the toughness of metallic glasses, Department of Mathematics, National University of Singapore, Singapore, January 16, 2013.

Mechanical simulation of mammalian acini, Mathematical Biology Seminar, University of California, Davis, May 7, 2012.

Mechanical simulation of mammalian acini, Joint ICBP–PSOC Seminar, University of California, Berkeley, February 15, 2012.

Application of the Voronoi tessellation for high-throughput analysis of crystalline porous materials, Scientific Computing Seminar, University of California, Berkeley, February 1, 2012.

Application of the Voronoi tessellation for high-throughput analysis of crystalline porous materials, Department of Chemical Physics, Weizmann Institute of Science, Israel, January 11, 2012.

INVITED SEMINARS AND COLLOQUIA (CONTINUED)

Analysis of material porosity properties using the Voronoi tessellation, Department of Mathematics, University of California, Davis, November 8, 2011.

Relations between local geometry and macro-scale properties in complex materials, Department of Mechanical Engineering, University of California, Santa Barbara, April 25, 2011.

Granular flow in pebble bed reactors: dust generation and scaling, Laboratory for Thermal-Hydraulics, Paul Scherrer Institute, Switzerland, July 2, 2010.

Multiscale modeling of granular flow, Courant Institute of Mathematical Sciences, New York, March 9, 2010.

Multiscale modeling of granular flow, Cancer Imaging Department, BC Cancer Research Centre, Vancouver, December 7, 2009.

Multiscale modeling of granular flow: an application of the Voronoi tessellation, Center for Nonlinear Studies, Los Alamos National Laboratory, November 30, 2009.

Multiscale modeling of granular flow, Department of Mathematics, Georgia Tech, November 16, 2009.

Multiscale modeling in granular flow, Complex Fluids Seminar, University of Michigan, May 2, 2008.

Multiscale modeling of granular flow, Department of Physics, University of California, Santa Barbara, April 4, 2007.

Multiscale modeling of granular flow, Department of Applied and Computational Mathematics, Caltech, March 30, 2007.

Multiscale modeling of granular flow, Department of Physics, Clark University, March 19, 2007.

Multiscale modeling of granular flow, Department of Mathematics, University of California, Berkeley, February 28, 2007.

Granular drainage: theory and simulation, Department of Mathematics, Massachusetts Institute of Technology, October 16, 2003.

SELECTED CONFERENCE PRESENTATIONS

Machine learning in a data-limited regime: Augmenting experiments with synthetic data uncovers order in crumpled sheets, CECAM Lorentz Workshop: Computing Complex Mechanical Systems, EPFL Lausanne, January 22–24, 2020.

A projection method for simulating incompressible porous media, SIAM Computational Science and Engineering 2019, Spokane, Washington, February 25–March 1, 2019.

The reference map technique for incompressible fluid–structure interaction problems, APS Division of Fluid Dynamics Annual Meeting, Atlanta, November 18–20, 2018.

Strain localization and fracture in metallic glasses, Northeastern Granular Materials Workshop, Yale University, June 8, 2018.

Modeling the diverse geometry of insect wings, AMS Spring Eastern Sectional Meeting, Northeastern University, Boston, April 21–22, 2018.

Simulations of Three-Dimensional Shear Band Structure in Metallic Glassses, MRS Spring Meeting, Phoenix, April 2–6, 2018.

SELECTED CONFERENCE PRESENTATIONS (CONTINUED)

Predicting the dynamics of crumpling with machine learning, APS March Meeting, Los Angeles, March 5–9, 2018.

The reference map technique for simulating complex materials, Modeling Complex Fluids and Gels for Biological Applications, University of Utah, Salt Lake City, May 4–6, 2017.

Interfacial Dynamics of Dissolving Objects from Discrete and Continuum Perspectives, SIAM Computational Science and Engineering 2017, Atlanta, February 27–March 3, 2017. (Joint with Yuexia Lin.)

The reference map technique for simulating complex materials and multi-body interactions, New England Complex Fluids Workshop, December 2, 2016.

Strain localization and fracture in metallic glass, SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, May 8–12, 2016.

High-throughput Screening of Crystalline Porous Materials, MRS Fall Meeting, Boston, November 29–December 4, 2015.

High-throughput screening of crystalline porous materials, PICS Symposium – D^3: Deformation, Defects, Diagnosis, University of Pennsylvania, Philadelphia, May 28–29, 2015.

An Eulerian projection method for quasi-static elastoplasticity, SIAM Computational Science and Engineering 2015, Salt Lake City, March 14–18, 2015.

Modeling the toughness of metallic glasses, APS March Meeting, San Antonio, March 2–6, 2015.

Modeling nonlinear elastic interactions between mammary acini, Joint ICBP/PSOC Mathematical Modeling Meeting, Tampa, February 26–28, 2015.

Interfacial dynamics of dissolving objects in fluid flow, BIRS Workshop on Modern Applications of Complex Variables, Banff, Canada, January 11–16, 2014.

Modeling the toughness of metallic glasses, 112th Statistical Mechanics Conference, Rutgers University, New Brunswick, December 14–16, 2014.

Extending the fluid projection method to quasi-static elastoplasticity, APS Division of Fluid Dynamics Annual Meeting, San Francisco, November 23–25, 2014.

Interfacial dynamics of dissolving objects in fluid flow, APS Division of Fluid Dynamics Annual Meeting, Pittsburgh, November 24–26, 2013.

Mechanical simulation of mammalian acini, SIAM Computational Science and Engineering 2013, Boston, February 26, 2013.

Granular flows in pebble-bed nuclear reactors: scaling and dust generation, International Congress on Advances in Nuclear Power Plants, Chicago, June 24–28, 2012.

Application of the Voronoi tessellation for high-throughput analysis of crystalline porous materials, Applied Mathematics Principal Investigators Meeting, Washington DC, October 17–19, 2011.

A mechanical model of mammalian acinus growth, ICIAM 2011 – 7th International Congress on Industrial and Applied Mathematics, Vancouver, July 18–22, 2011.

Computation of three-dimensional standing water waves, SIAM Computational Science and Engineering 2011, Reno, February 28–March 4, 2011.

Selected conference presentations (continued)

Real-time control of mixing in dense granular flow, Bay Area Scientific Computing Day, Lawrence Berkeley National Laboratory, Berkeley, May 9, 2009.

Anisotropies in granular temperature in a dense sheared granular flow, APS March Meeting, Pittsburgh, March 16–20, 2009.

A multiscale simulation technique for granular flow, IMA Conference on Dense Granular Flows, Isaac Newton Institute, University of Cambridge, January 5–9, 2009.

A multiscale simulation technique for granular flow, Canadian Mathematical Society Winter Meeting, Ottawa, December 6–8, 2008.

A multiscale simulation technique for optimization of granular mixing, Applied Mathematics Principal Investigators Meeting, Argonne National Laboratory, October 15–17, 2008.

A coupled continuum/discrete model of dense granular flow, Bay Area Scientific Computing Day, MSRI, Berkeley, March 29, 2008.

Stress, strain rate, and packing fraction in granular flow, APS March Meeting, Denver, March 2007.

Voronoi volumes in dense granular flow, APS March Meeting, Baltimore, March 2006.

Dynamics of random packings in granular flow, APS March Meeting, Los Angeles, March 2005.

Toward a theory of diffusion in dense granular flow, APS March Meeting, Montreal, March 2004.

Fellowships and awards

NSF CAREER award — 2018

Robert M. Rose Presidential Fellowship — 2002–2003
Massachusetts Institute of Technology

Foundress Prize — 2001
Pembroke College, University of Cambridge

Foundation Scholarship — 2000–2001
Pembroke College, University of Cambridge

Legg Prize — 1999
Pembroke College, University of Cambridge

Professional activities

Proposal reviewer — 2013–present
Advanced Scientific Computing Research (ASCR), U.S. Department of Energy
Division of Mathematical Sciences, National Science Foundation
Division of Materials Research, National Science Foundation

Member of professional societies
Society for Industrial and Applied Mathematics — 2010–present
American Physical Society — 2004–present
Materials Research Society — 2014–2015

Professional activities (continued)

Workshop organizer

Signal Processing & Integration in Complex Environments — September 20, 2019
http://people.seas.harvard.edu/∼chr/qbio_fluids/
Jointly organized with Dr. Agnese Seminara (CNRS, Université Côte d'Azur),
Prof. David Gire (University of Washington),
and Prof. Nicholas Bellono (Harvard University)

Computational Principles To Organize Complexity — June 25–29, 2018
http://sites.unice.fr/site/aseminara/qbio/
Jointly organized with Dr. Agnese Seminara (CNRS, Université Côte d'Azur)
and Prof. Thomas Fai (Brandeis University)

NewMech workshop — October 22, 2016
http://www.newmech.org/
Jointly organized with Prof. Katia Bertoldi (Harvard University)

Conference session/minisymposium organizer

Machine learning in nonlinear physics and mechanics — March 4, 2020
Jointly organized at the APS March Meeting 2020, Denver — *[Canceled due to COVID-19]*
with Prof. Shmuel Rubinstein (Harvard University)

Machine learning in nonlinear physics and mechanics — March 5, 2019
Jointly organized at the APS March Meeting 2019, Boston
with Prof. Shmuel Rubinstein (Harvard University)

Numerical methods for biological fluid dynamics — March 1, 2019
Jointly organized at SIAM Computational Science and Engineering 2019, Spokane
with Prof. Thomas Fai (Brandeis University)

Machine learning in nonlinear physics and mechanics — March 6, 2018
Jointly organized at the APS March Meeting 2018, Los Angeles
with Prof. Shmuel Rubinstein (Harvard University)

Journal reviewer — 2007–present

Physical Review Letters, Physical Review E, Computational Mechanics, Journal of the Mechanics and Physics of Solids, Journal of Fluids and Structures, Journal of Statistical Mechanics, International Journal of Thermal Sciences, Journal of Scientific Computing, Physics of Fluids, Annals of Nuclear Energy, International Journal of Chemical Reactor Engineering, PLOS ONE, Physica A, Chaos: An Interdisciplinary Journal of Nonlinear Science, Powder Technology, Biophysical Journal, Proceedings of the Royal Society A, Nuclear Engineering and Design, Communications on Pure and Applied Analysis, Journal of Biomechanics, SIAM Journal of Applied Mathematics, Chinese Physics B, Chinese Physics Letters, International Journal of Statistical Mechanics, Extreme Mechanics Letters, Astronomy and Computing, Journal of Materials Research, SoftwareX, IEEE Transactions on Visualization and Computer Graphics, Meccanica

Local organizing committee member — November 22–24, 2015

Annual Meeting of the APS Division of Fluid Dynamics

Conference paper reviewer — 2016–present

2016 Conference on High Temperature Reactor Technology

UNIVERSITY SERVICE ACTIVITIES

Director of Undergraduate Studies for Applied Mathematics — 2016
Harvard John A. Paulson School of Engineering and Applied Sciences

Faculty mentor — 2017–present
Harvard Graduate Women in Science and Engineering (HGWISE)

Faculty sponsor — 2015–present
Harvard University Chapter of SIAM

Advisory board member — 2014–present
Institute for Applied Computational Science, Harvard University

Seminar organizer/coordinator
Harvard Applied Mechanics Colloquium — 2016–present
http://www.seas.harvard.edu/hamc/

Berkeley Applied Mathematics Seminar — 2008–2009, 2012–2013
http://math.lbl.gov/ams/

Simple Person's Applied Math Seminar, MIT — 2005–2006
http://math.mit.edu/spams/

POSTDOCTORAL MENTORING

Simone Dussi — 2020–present

Xiaolin Wang — 2017–present
Jointly supervised with Prof. Ken Kamrin, MIT

Thomas Fai — 2014–2018

Chen-Hung Wu — 2014–2016
Jointly supervised with Prof. Ken Kamrin, MIT

Yue Yu — Summer 2014

PH.D. STUDENTS

Yue Sun — 2020–present

Michael Emanuel — 2020–present

Madelyn Leembruggen — 2020–present

Danyun He — 2019–present

Jiayin Lu — 2018–present

Xiaoxiao Ding — 2018–present

Eder Medina — 2016–present
Jointly supervised with Prof. Katia Bertoldi, Harvard SEAS

Jovana Andrejevic — 2016–present

Ph.D. students (continued)

Nicholas Derr 2016–present

Yuexia Luna Lin 2016–present

Nick Boffi 2015–present
Jointly supervised with Prof. Jean-Jacques Slotine, MIT

Shruti Mishra 2016–2020
Thesis title: *Simulating the evolution and control of dynamical systems*
Jointly supervised with Prof. L. Mahadevan, Harvard SEAS

Dan Fortunato 2015–2020
Thesis title: *Fast solvers for elliptic partial differential equations based on spectral and high-order methods*
Jointly supervised with Prof. Alex Townsend, Cornell University

Gary Pui Tung Choi 2016–2020
Thesis title: *Metamaterials, morphometrics, morphogenesis, and mappings*
Jointly supervised with Prof. L. Mahadevan, Harvard SEAS

Jordan Hoffmann 2014–2019
Thesis title: *Crickets, cross-veins, crumpling, crystals, and computers*

Anna Lieb 2013–2016
Thesis title: *Modeling and optimization of transients in water distribution networks with intermittent supply*
Co-advised with Prof. Jon Wilkening, UC Berkeley

Visiting students

Yushi Tang 2016–2017
Visiting Ph.D. student from Peking University, China

Darius Alix-Williams 2017
Visiting Ph.D. student from Johns Hopkins University

Vincenzo Gulizzi Fall 2016
Visiting Ph.D. student from the University of Palermo, Italy

Patryk Jedrasiak Spring 2016
Visiting Ph.D. student from the University of Cambridge, United Kingdom

Other graduate mentoring

Zhao Lyu 2019–present
Master's thesis: *Machine learning applied to an erosion model*

Yue Sun 2018–2020
Master's thesis: *A lattice Boltzmann implementation of the reference map technique*

Lihong Zhang Fall 2019
Course project: *A Voronoi-based territory model*

Other graduate mentoring (continued)

Danyun He — 2018–2019
Master's project: *Reinforcement learning for olfactory navigation*

Henry Wilkin — 2016–2019
Research project: *Colloidal crystallization on a cylinder*

Minjae Kim — 2014–2015
Research project: *Python implementation of the elastoplasticity projection method*

Raphaël Pestourie — Fall 2014
Course project: *Optimization methods applied to optics*

Taiyo Wilson — Summer 2014
Summer project: *Optimization of jammable assemblies for prosthetic design*

Jue Chen — Fall 2012
Research project: *Conformal methods for wave dynamics and dissolution processes*

Undergraduate mentoring

Bobae Johnson — 2020–present
Course project: *Analytical calculations of a Voronoi-based territory model*

Ruoxi (Michelle) Chen — 2017–2020
Senior thesis: *Coupling nonlinear elasticity to a cellular Potts model*

Nancy Knight Thomas — 2018–2019
Research project: *Using an autoencoder to reduce experimental noise*

Akhil Waghmare — 2018–2019
Course project: *Reference map technique for combating blurring in advection problems*

Jimmy Almgren-Bell — 2018–2019
Senior thesis: *An agent-based approach to Lenski's long-term experiment*

Zaahid Khan — 2016–2017
Senior thesis: *Statistical analysis of merger arbitrages*

Nat Casey — 2015–2016
Senior thesis: *Markov chain modeling of baseball at-bats*

Kathy Li — 2015–2016
Senior thesis: *Computational toolbox for automated geometric analysis of odonate wings*

Luke Chang — Fall 2015
Reading course: *Random walks with application to finance*

Tarik Adnan Moon & Nikhil Mehandru — Spring 2015
Nectar-funded project: *Development of the low-cost Bangla Pi computing platform*

Jeffrey Wang — 2014–2015
Senior thesis: *Cell–matrix interactions in tumor growth*

UNDERGRADUATE MENTORING (CONTINUED)

Yi Sui — Spring 2012
Senior thesis: *Finite-difference simulations of bulk metallic glasses*

Jung Heon Song — 2011–2012
LBL summer project: *Voronoi network simplification in porous material screening*

Cody Dance — Summer 2011
LBL summer project: *Voronoi computations in arbitrary domains*

Co-author of PSLIB, a pseudospectral software library — 2006–present
http://ktchu.serendipityresearch.org/software/pslib/

COURSES

Taught thirteen courses in the Harvard John A. Paulson School of Engineering and Applied Sciences:

Semester	*Course*
Spring 2021	Applied Math 50: Introduction to Applied Mathematics *(online-only due to COVID-19; assisting Prof. Cengiz Pehlevan)*
Spring 2021	Applied Math 225: Advanced Scientific Computing: Numerical Methods II *(online-only due to COVID-19)* (https://courses.seas.harvard.edu/courses/am225/)
Fall 2020	Applied Math 205: Advanced Scientific Computing: Numerical Methods *(online-only due to COVID-19; with Prof. Zhiming Kuang)* (https://courses.seas.harvard.edu/courses/am205/)
Fall 2019	Applied Math 205: Advanced Scientific Computing: Numerical Methods
Spring 2019	Applied Math 225: Advanced Scientific Computing: Numerical Methods II
Fall 2018	Applied Math 205: Advanced Scientific Computing: Numerical Methods
Spring 2018	Applied Math 225: Advanced Scientific Computing: Numerical Methods II
Fall 2017	Applied Math 205: Advanced Scientific Computing: Numerical Methods
Fall 2016	Applied Math 205: Advanced Scientific Computing: Numerical Methods
Fall 2016	Applied Math 201: Physical Mathematics I *(with five other Harvard lecturers)*
Spring 2016	Applied Math 50: Introduction to Applied Mathematics
Fall 2015	Applied Math 205: Advanced Scientific Computing: Numerical Methods
Spring 2015	Applied Math 50: Introduction to Applied Mathematics *(with Dr. Avi Shapiro)*
Fall 2014	Applied Math 205: Advanced Scientific Computing: Numerical Methods
Spring 2014	Applied Math 50: Introduction to Applied Mathematics *(with Dr. Avi Shapiro)*

COURSES (CONTINUED)

Taught three courses in the UC Berkeley mathematics department:

Semester	*Course*	*Website (mirrored)*
Spring 2013	Math 121A: Math. Tools for Phys. Sciences	http://seas.harvard.edu/~chr/121A.S13/
Spring 2012	Math 104: Introduction to Analysis	http://seas.harvard.edu/~chr/104.S12/
Spring 2011	Math 104: Introduction to Analysis	http://seas.harvard.edu/~chr/104.S11/

Teaching assistant for six semesters at MIT, for five graduate courses and two undergraduate courses:

Semester	*Course*	*Instructor*
Spring 2007	18.311 Principles of Applied Mathematics (undergraduate)	Prof. Martin Bazant
Fall 2006	18.366 Random Walks and Diffusion	Prof. Martin Bazant
Spring 2006	18.337 Applied Parallel Computing	Prof. Alan Edelman
Spring 2005	18.366 Random Walks and Diffusion	Prof. Martin Bazant
Spring 2005	18.311 Principles of Applied Mathematics (undergraduate)	Prof. Martin Bazant
Spring 2004	18.336 Numerical Methods of Applied Mathematics II	Dr. Plamen Koev
Fall 2003	18.435 Quantum Computation	Prof. Peter Shor

SOFTWARE

Author of TGMG, a templated geometric multigrid library in C++ 2020–present
https://github.com/chr1shr/tgmg

Co-author of IncRMT, a C++ implementation of the reference map technique 2020–present
https://github.com/chr1shr/incrmt

Author of utils-gp, a collection of utilities for analyzing Gnuplot matrix files 2020–present
https://github.com/chr1shr/utils-gp

Co-author of PyDegradome, a Python library to identify peaks in RNAseq data 2015–present
https://sites.tufts.edu/gaglialab/software-and-protocols/

Co-author of Zeo++, a software library for high-throughput analysis of porous materials 2012–present
http://zeoplusplus.org/

Author of Voro++, a three-dimensional Voronoi cell library in C++ 2009–present
http://math.lbl.gov/voro++/