CURRICULUM VITAE: CHRIS H. RYCROFT

Room 305, Pierce Hall
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

Paulson School of Engineering and Applied Sciences, Harvard University — 2014–present
Assistant Professor

Department of Mathematics, Lawrence Berkeley Laboratory — 2010–present
Visiting Faculty Scientist

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

Department of Mathematics, Lawrence Berkeley Laboratory — 2007–2010
Visiting Postdoctoral Scholar

Idaho National Laboratory — Summer 2006
Research Assistant

Westlakes Research Institute — Summer 1999
Research Assistant

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

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).

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).

JOURNAL PUBLICATIONS (CONTINUED)

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

C. H. Rycroft and M. Z. Bazant, *Asymmetric collapse by dissolution or melting in a uniform flow*, submitted to Proc. Roy. Soc. A.

M. M. Gaglia, C. H. Rycroft, and B. A. Glaunsinger, *A degenerate element underlies sequence-specific cleavage by the viral RNase SOX*, submitted to PLOS Pathogens.

CONFERENCE PUBLICATIONS AND TECHNICAL REPORTS

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

Department of Mathematical Sciences, University of Delaware	May 12, 2015
Courant Institute of Mathematical Sciences, New York	May 7, 2015
SIAM Student Chapter seminar, Massachusetts Institute of Technology	April 23, 2015
Department of Physics, Clark University	April 8, 2015
Department of Mathematics, Northeastern University	April 7, 2015
Department of Materials Science & Engineering, Johns Hopkins University	March 25, 2015
Department of Mathematics, University of Illinois, Chicago	February 2, 2015
Department of Physics, Brandeis University	October 7, 2014
Institute for Applied Computational Science, Harvard University	September 19, 2014
Department of Mechanical Engineering, Massachusetts Institute of Technology	April 15, 2014
Department of Mathematics, Massachusetts Institute of Technology	February 11, 2014
Department of Chemical Engineering, Massachusetts Institute of Technology	November 14, 2013
Department of Mechanical Engineering, University of Washington	April 8, 2013
School of Engineering and Applied Sciences, Harvard University	February 28, 2013
School of Mathematics, University of Minnesota	February 21, 2013
School of Computational Science & Engineering, Georgia Tech	February 8, 2013
Department of Mathematics, University of North Carolina, Chapel Hill	February 6, 2013
Department of Mathematics, University of Arizona	February 4, 2013
Mathematics Institute, University of Warwick, United Kingdom	January 28, 2013
Department of Mathematics, University of California, Davis	January 23, 2013
Department of Mathematics, National University of Singapore, Singapore	January 16, 2013
Mathematical Biology Seminar, University of California, Davis	May 7, 2012
Joint ICBP–PSOC Seminar, University of California, Berkeley	February 15, 2012
Scientific Computing Seminar, University of California, Berkeley	February 1, 2012
Department of Chemical Physics, Weizmann Institute of Science, Israel	January 11, 2012
Department of Mathematics, University of California, Davis	November 8, 2011
Department of Mechanical Engineering, University of California, Santa Barbara	April 25, 2011
Laboratory for Thermal-Hydraulics, Paul Scherrer Institute, Switzerland	July 2, 2010
Courant Institute of Mathematical Sciences, New York	March 9, 2010
Cancer Imaging Department, BC Cancer Research Centre, Vancouver	December 7, 2009
Center for Nonlinear Studies, Los Alamos National Laboratory	November 30, 2009
Department of Mathematics, Georgia Tech	November 16, 2009
Complex Fluids Seminar, University of Michigan	May 2, 2008
Department of Physics, University of California, Santa Barbara	April 4, 2007
Department of Applied and Computational Mathematics, Caltech	March 30, 2007
Department of Physics, Clark University	March 19, 2007
Department of Mathematics, University of California, Berkeley	February 28, 2007
Department of Mathematics, Massachusetts Institute of Technology	April 8, 2004

SELECTED CONFERENCE PRESENTATIONS

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.

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.

SELECTED CONFERENCE PRESENTATIONS (CONTINUED)

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.

PROFESSIONAL ACTIVITIES

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

Local organizing committee member
Annual Meeting of the APS Division of Fluid Dynamics November 22–24, 2015

Seminar organizer
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/

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, Chinese Physics B, Chaos: An Interdisciplinary Journal of Nonlinear Science, Powder Technology, Biophysical Journal, International Journal of Statistical Mechanics, Communications on Pure and Applied Analysis, Nuclear Engineering and Design, SIAM Journal of Applied Mathematics, PLOS ONE, Journal of Biomechanics

Proposal reviewer 2013–present
Advanced Scientific Computing Research (ASCR), U.S. Department of Energy

Member of professional societies
Materials Research Society 2014–present
American Nuclear Society 2012–2013
Society for Industrial and Applied Mathematics 2010–present
American Physical Society 2004–present

SOFTWARE

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

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

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

POSTDOCTORAL MENTORING

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

Thomas Fai — 2014–present

Yue Yu — Summer 2014
Summer project: *Sharp-interface reference map simulation methods*

PH.D. STUDENTS

Dan Fortunato — 2015–present

Nick Boffi — 2015–present

Yingying Li — 2015–present
Jointly supervised with Prof. Na Li, Harvard SEAS

Jordan Hoffmann — 2014–present

OTHER GRADUATE MENTORING

Yuexia (Luna) Lin — Summer 2015
Summer project: *Stochastic simulation of dissolution and melting*

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*

Anna Lieb — 2013–present
Collaborative project: *Optimization of intermittent water supply*

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

UNDERGRADUATE MENTORING

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*

UNDEGRADUATE MENTORING (CONTINUED)

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

Jung Heon Song — 2011–2012
Reading course: *Random walks and diffusive processes*
LBL summer project: *Voronoi network simplification in porous material screening*

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

TEACHING

Taught four courses in the Harvard School of Engineering and Applied Sciences:

Semester	*Course*
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)

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

FELLOWSHIPS AND AWARDS

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