

Jed Brown

Assistant Professor

Department of Computer Science

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Academic Honors & Awards

2015 SIAM/ACM Prize in Computational Science and Engineering (PETSc team)

2014 IEEE TCSC Young Achiever

2014 SIAG/SC Junior Scientist Prize

2004 Outstanding Mathematics Student of the Year, University of Alaska Fairbanks

2004 Outstanding Physics Student of the Year, University of Alaska Fairbanks

2000–2004 Alaska Scholar

Education

Doctor of Science, ETH Zürich, 2011.

Thesis: Computational Methods for Ice Flow Simulation.

M.S. Mathematics, University of Alaska Fairbanks, 2006.

B.S. Mathematics, *magna cum laude*, University of Alaska Fairbanks, 2004.

B.S. Physics, *magna cum laude*, University of Alaska Fairbanks, 2004.

Professional Experience

Asst. Professor, Department of Computer Science, University of Colorado Boulder, 2015–present

Asst. Computational Mathematician, MCS Division, Argonne National Laboratory, 2013–2015

Asst. Professor Adjoint, Department of Computer Science, University of Colorado Boulder, 2013–2015

Argonne Scholar, MCS Division, Argonne National Laboratory, 2012–2013

Postdoctoral Appointee, MCS Division, Argonne National Laboratory, 2011–2012

Research Assistant, ETH Zürich, 2007–2011

Research Technician, University of Alaska Fairbanks, 2006–2007

Research Assistant, University of Alaska Fairbanks, 2003–2006

Teaching Assistant, University of Northern British Columbia, 2003

Journal Papers Published

- [1] Debojyoti Ghosh, Emil M. Constantinescu, and Jed Brown. Efficient implementation of nonlinear compact schemes on massively parallel platforms. *SIAM Journal on Scientific Computing*, 37(3):C354–C383, 2015. Also preprint ANL/MCS-P5121-0414.

- [2] David A. May, Jed Brown, and Laetitia Le Pourhiet. A scalable, matrix-free multigrid preconditioner for finite element discretizations of heterogeneous Stokes flow. *Computer Methods in Applied Mechanics and Engineering*, 290(0):496–523, 2015.
- [3] Jed Brown, Matthew G. Knepley, and Barry F. Smith. Run-time extensibility and librarization of simulation software. *IEEE Computing in Science and Engineering*, 2015.
- [4] Jed Brown, Barry F. Smith, and Aron Ahmadi. Achieving textbook multigrid efficiency for hydrostatic ice flow. *SIAM Journal on Scientific Computing*, 35(2):359–375, 2013. Also preprint ANL/MCS-P743-1298.
- [5] David E. Keyes, Lois Curfman McInnes, Carol Woodward, William Gropp, Eric Myra, Michael Pernice, John Bell, Jed Brown, Alain Clo, Jeffrey Connors, Emil Constantinescu, Don Estep, Kate Evans, Charbel Farhat, Ammar Hakim, Glenn Hammond, Glen Hansen, Judith Hill, Tobin Isaac, Xiangmin Jiao, Kirk Jordan, Dinesh Kaushik, Efthimios Kaxiras, Alice Koniges, Kihwan Lee, Aaron Lott, Qiming Lu, John Magerlein, Reed Maxwell, Michael McCourt, Miriam Mehl, Roger Pawlowski, Amanda Peters Randles, Daniel Reynolds, Beatrice Rivière, Ulrich Rüde, Tim Scheibe, John Shadid, Brendan Sheehan, Mark Shephard, Andrew Siegel, Barry Smith, Xianzhu Tang, Cian Wilson, and Barbara Wohlmuth. Multiphysics simulations: Challenges and opportunities. *International Journal of High Performance Computing Applications*, 27(1):4–83, Feb 2013. Special issue.
- [6] Tareq M. Malas, Aron J. Ahmadi, Jed Brown, John A. Gunnels, and David E. Keyes. Optimizing the performance of streaming numerical kernels on the IBM BlueGene/P PowerPC 450 processor. *International Journal of High Performance Computing Applications*, 27(2):193–209, 2013.
- [7] Rodney Biezuner, Jed Brown, Grey Ercole, and Eder Martins. Computing the first eigenpair of the p -Laplacian via inverse iteration of sublinear supersolutions. *Journal of Scientific Computing*, 52:180–201, 2012.
- [8] Jed Brown. Efficient nonlinear solvers for nodal high-order finite elements in 3D. *Journal of Scientific Computing*, 45:48–63, 2010. 10.1007/s10915-010-9396-8.
- [9] Jason M. Amundson, Mark Fahnestock, Martin Truffer, Jed Brown, Martin P. Lüthi, and Roman J. Motyka. Ice mélange dynamics and implications for terminus stability, Jakobshavn Isbræ, Greenland. *J. Geophys. Res.*, 115:F01005, 2010.
- [10] E. Bueler and J. Brown. Shallow shelf approximation as a “sliding law” in a thermomechanically coupled ice sheet model. *Journal of Geophysical Research-Earth Surface*, 114(F3):F03008, 2009.
- [11] E. Bueler, J. Brown, and C. Lingle. Exact solutions to the thermomechanically coupled shallow ice approximation: effective tools for verification. *J. Glaciol.*, 53:499–516, 2007.
- [12] E. Bueler, C.S. Lingle, and J. Brown. Fast computation of a viscoelastic deformable Earth model for ice-sheet simulations. *Ann. Glaciol.*, 46:97–105, 2007.
- [13] E. Bueler, C. S. Lingle, J. A. Kallen-Brown, D. N. Covey, and L. N. Bowman. Exact solutions and numerical verification for isothermal ice sheets. *J. Glaciol.*, 51(173):291–306, 2005.

Refereed Proceedings Papers

- [1] Dave A. May, Jed Brown, and Laetitia Le Pourhiet. pTatin3D: High-performance methods for long-term lithospheric dynamics. In *Proceedings of SC14: International Conference for High Performance Computing, Networking, Storage and Analysis*. ACM, 2014.

- [2] Matthew G. Knepley, Jed Brown, Lois Curfman McInnes, and Barry F. Smith. Accurately citing software and algorithms used in publications. In *Workshop towards Sustainable Software for Science: Practice and Experiences (WSSSPE)*, 2013. Preprint <http://dx.doi.org/10.6084/m9.figshare.785731>.
- [3] Barry F. Smith Jed Brown, Matthew G. Knepley. Run-time extensibility: anything less is unsustainable. In *Workshop towards Sustainable Software for Science: Practice and Experiences (WSSSPE)*, 2013. Preprint <http://dx.doi.org/10.6084/m9.figshare.791571>.
- [4] Jed Brown and Peter Brune. Low-rank quasi-Newton updates for robust Jacobian lagging in Newton-type methods. In *International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering*, pages 2554–2565, 2013.
- [5] J. Brown, M. G. Knepley, D. A. May, L. C. McInnes, and B. F. Smith. Composable linear solvers for multiphysics. In *Proceedings of the 11th International Symposium on Parallel and Distributed Computing (ISPDC 2012)*, pages 55–62. IEEE Computer Society, 2012.
- [6] K. Burekhardt, D. Szczerba, J. Brown, K. Muralidhar, and G. Székely. Fast implicit simulation of oscillatory flow in human abdominal bifurcation using a schur complement preconditioner. In *Euro-Par 2009*, 2009.

Technical Reports

- [1] M. F. Adams, J. Brown, J. Shalf, B. Van Straalen, E. Strohmaier, and S. Williams. HPGMG 1.0: A benchmark for ranking high performance computing systems. Technical Report LBNL-6630E, LBNL, Berkeley, 2014.
- [2] Debojyoti Ghosh, Emil M. Constantinescu, and Jed Brown. Scalable nonlinear compact schemes. Technical Report ANL/MCS-TM-340, Argonne National Laboratory, 2014.
- [3] Jed Brown. Vectorization, communication aggregation, and reuse in stochastic and temporal dimensions. In *Exascale Mathematics Workshop, Aug 21–22, Washington, DC*. DOE Office of Advanced Scientific Computing Research, 2013.
- [4] Mark F. Adams, Jed Brown, and Matt Knepley. Low-communication techniques for extreme-scale multi-level solvers. In *Exascale Mathematics Workshop, Aug 21–22, Washington, DC*. DOE Office of Advanced Scientific Computing Research, 2013.
- [5] Jennifer Arrigo, Jed Brown, Louise Kellogg, Lorraine Hwang, Scott Peckham, and David Tarboton. EarthCube modeling workshop results. Technical report, Computational Infrastructure for Geodynamics, 2013.
- [6] Jed Brown. User-defined non-blocking collectives must make progress. *IEEE Technical Committee on Scalable Computing*, 2012.
- [7] Barry Smith, Lois Curfman McInnes, Emil Constantinescu, Mark Adams, Satish Balay, Jed Brown, Matthew Knepley, and Hong Zhang. PETSc’s software strategy for the design space of composable extreme-scale solvers. Preprint ANL/MCS-P2059-0312, Argonne National Laboratory, 2012. DOE Exascale Research Conference, April 16-18, 2012, Portland, OR.
- [8] Mark Adams, Jed Brown, and Barry F. Smith. Exascale programming models must vigorously enable libraries. In *DOE Exascale Research Conference*, 2012.
- [9] Mihai Anitescu, Jed Brown, Paul Fischer, Sven Leyffer, Lois Curfman McInnes, Todd Munson, and Barry F. Smith. Exascale co-design opportunities: Multilevel approaches for hierarchical models, architectures, algorithms, and software. In *DOE Exascale Research Conference*, 2012.

- [10] L. Ridgway Scott, Jed Brown, George W. Bergantz, Dan Cooley, Clint Dawson, Maarten de Hoop, Donald Estep, Natasha Flyer, Efi Foufoula-Georgiou, Michael Ghil, Matthew Knepley, Randall J. LeVeque, Lek-Heng Lim, Serge Prudhomme, Adrian Sandu, Frederik J. Simons, Philip B. Stark, Michael Stein, Seth Stein, Toshiro Tanimoto, Daniel Tartakovsky, Jonathan Weare, Robert Weiss, Grady B. Wright, and Dave Yuen. Fostering interactions between the geosciences and mathematics, statistics, and computer science. Technical Report 2012-02, University of Chicago, 2012.
- [11] Satish Balay, Shrirang Abhyankar, Mark F. Adams, Jed Brown, Peter Brune, Kris Buschelman, Lisandro Dalcin, Victor Eijkhout, William D. Gropp, Dinesh Kaushik, Matthew G. Knepley, Lois Curfman McInnes, Karl Rupp, Barry F. Smith, Stefano Zampini, and Hong Zhang. PETSc users manual. Technical Report ANL-95/11 - Revision 3.6, Argonne National Laboratory, 2015.

Papers In Review

- [1] Mark F Adams, Jed Brown, Matt Knepley, and Ravi Samtaney. Segmental refinement: A multigrid technique for data locality. *SIAM Journal on Scientific Computing*, 2015 (accepted). arXiv:1406.7808.
- [2] Jed Brown and Matthew G. Knepley. A new modularization for physics simulators. *submitted to CSD*, 2014.

Software

Developer of the Portable Extensible Toolkit for Scientific computing (PETSc) since 2008, <http://mcs.anl.gov/petsc>.

Principal author of the Parallel Ice Sheet Model (PISM) 2004–2007, <http://pism-docs.org>.

Author of the Dohp finite element library, <https://github.com/jedbrown/dohp>.

I have released and maintained software written in C, C++, Fortran, Python, Haskell, Perl, Ruby, and L^AT_EX, and have a working knowledge of several other languages including Lisps and x86 and PowerPC assembly.

Internal Professional Activities

CS Executive Committee

CS Graduate Committee

External Professional Activities

Member of the Science Steering Committee for CIG (Computational Infrastructure for Geodynamics), 2011–present.

Co-organizer of IMA Hot Topics Workshop: Modelling Waves Impacting Coastal Areas, UMN, Oct 2014.

Associate Editor, SISC Special Section for CSE15 - CSE Software and Big Data in CSE.

Technical program committee:

PDESof2016 PDE Software Frameworks, Warwick, England, 2016-07-04 to 08.

SC15 International Conference for High Performance Computing, Networking, Storage and Analysis, Austin, TX, 2015-11-15 to 2013-11-20.

SC14 International Conference for High Performance Computing, Networking, Storage and Analysis, New Orleans, LA, 2014-11-16 to 2013-11-21.

ISC'14 International Supercomputing Conference, Leipzig, Germany, 2014-06-22 to 26.

VECPAR2014 11th International Meeting on High-Performance Computing for Computational Science, Eugene, OR, 2014-06-30 to 2013-07-03.

EASC2014 Exascale Applications and Software Challenges, Stockholm, Sweden, 2014-04-02 to 04

SC13 International Conference for High Performance Computing, Networking, Storage and Analysis, Denver, CO, 2013-11-17 to 22.

GPU-SMP2013 International Workshop of GPU and MIC Solutions to Multiscale Problems in Science and Engineering, Changchun, China, 2013-07-29 to 08-02.

MC2013 International Conference for Numerical and Mathematics and Computational Methods Applied to Nuclear Science and Engineering, Sun Valley, ID, 2013-05-06 to 10.

HPC³ 2012 Workshop on High Performance Computing and Hybrid Programming Concepts for Hyperbolic PDE Codes, KAUST, Saudi Arabia, 2012-02-04 to 08.

Session convener at the American Geophysical Union Fall Meeting, 2009–2015.

Session convener at SIAM CSE 2015, SIAM PP 2016.

BoF organizer, SC14, SC15.

Contributed to the MPI-3 standard.

Reviewer for ASCR Leadership Computing Challenge (ALCC), Advances in Water Resources, Computational Science and Discovery, EuroMPI, ETH Zürich, Geoscientific Model Development, International Journal of High Performance Computing Applications, IEEE International Parallel and Distributed Processing Symposium, International Conference on Supercomputing, IMUDI, Journal of Computational Physics, Journal of Fluid Mechanics, Journal of Geophysical Research, Journal of Scientific Computing, SIAM Journal on Scientific Computing, SIAM Journal on Numerical Analysis, The Cryosphere, Transactions and Mathematical Software, ACM Transactions on Mathematical Software, SIAM books, Wiley books

Teaching and Advising

CU Boulder CSCI 7000-014 Topics in CS&E (Fall 2015)

CU Boulder CSCI 4830-014/7000-018 HPC Performance Analysis (Spring 2015)

CU Boulder students advised: Dmitry Duplyakin (PhD expected 2016), Arash Mehraban (PhD expected 2017)

Argonne summer students advised/co-advised:

2013

Dr. Steven Dalton, UIUC, GPU-accelerated distributed-memory parallel algebraic multigrid. (Also served on Steven's thesis committee.) Now at NVIDIA Research.

Jesse Lopez, CSGF at OHSU, performance optimization, multilevel solvers, and discretization for estuary simulation.

Matthew Otten, IIT, "Scientific Application Web server" for monitoring and steering simulations. Now a PhD student at Cornell.

Dr. Patrick Sanan, Caltech, adaptive HMM and FLAVORS multiscale and variational time integrators in PETSc. Now a postdoc at ETH Zürich/USI Lugano.

2012

Lulu Liu, KAUST, nonlinear solution methods for oil extraction problems.

Abraham Taicher, UT Austin, compatible discretizations for Darcy-Stokes melt-migration.

Xuan Zhou, IIT, scalable dense linear support in PETSc using Elemental.

Founding member of scicomp.stackexchange.com, profile at <http://scicomp.stackexchange.com/users/119/jed-brown>

Thousands of technical explanations of numerical methods and software design in support of hundreds of scientific and engineering applications (many on PETSc mailing lists and externally).

Tutorials and short courses

PETSc Tutorial, tutorial at IT4I, Ostrava, Czech Republic, 2015-05-21 to 22.

Intro to parallel algebraic solvers using PETSc, tutorial at UC Merced, 2014-10-31.

PETSc, tutorial at SUNY Buffalo (with Matt Knepley), 2014-04-22.

PETSc, tutorial at PRACE summer school, Ostrava, Czech Republic, 2013-06-17 to 21.

High performance implicit solvers for geodynamics, CIG Webinar, 2013-01-10.

PETSc, tutorial at National Renewable Energy Laboratory, Golden, CO, 2012-04-27.

Advanced PETSc, tutorial at TACC, Austin, TX, 2012-02-20.

PETSc tutorial at the 2011 ACTS workshop, NERSC, Berkeley, CA, 2011-08-17.

PETSc, 3-day tutorial at the Arctic Region Supercomputing Center, Fairbanks, AK, 2010-08-03 to 05.

PETSc, 2-day tutorial at the Swiss National Supercomputing Center, Manno, Switzerland, 2010-05-10 to 11.

Scalable solvers for nonlinear equations: mini-course on Newton-Krylov methods, 3-week mini-course at the University of Alaska Fairbanks, 2009-01-22 to 02-05, 59A2.org/newton-krylov.

Two days of hands-on with students at ATPESC, plus panel discussion, 2014-08-08 to 09.

Two days of hands-on with students at ATPESC, plus panel discussion, 2015-08-07 to 2014-08-08.

Software carpentry boot camp, University of Chicago, 2013-01-12 to 13.

Memberships

SIAM Society of Industrial and Applied Mathematics

AGU American Geophysical Union

ANS American Nuclear Society

IGS International Glaciological Society

SIGHPC ACM Special Interest Group on High Performance Computing

CMG++ Consortium for Mathematics in the Geosciences