

Alexander D. Kaiser

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Education

Courant Institute of Mathematical Sciences, New York University, New York, NY

Ph.D. Mathematics. Thesis: Modeling the Mitral Valve 9/17

M.S. Mathematics. Thesis: Computational Experiments in Markov Chain Monte Carlo 9/13

University of California, Berkeley, Berkeley, CA

B.A. Mathematics; minor, Computer Science 5/09

Research Experience

Institute for Computational & Mathematical Engineering and Department of Cardiothoracic Surgery, Stanford University, Stanford, CA

Postdoctoral Scholar, Cardiovascular Biomechanics Computation Laboratory 11/17 — present

Research in computational cardiac mechanics, focused on comprehensive left-heart modeling and personalized virtual surgery for precision treatment of hypertrophic cardiomyopathy.

Courant Institute of Mathematical Sciences, New York University, New York, NY

Graduate student 9/11 — 9/17

Research in cardiac mechanics, focused on the mitral valve, one of the valves of the human heart. Built fiber based model of the valve, and simulated its function in a model test chamber using the immersed boundary method. Results show accurate flow when subject to physiological pressures over multiple beats, including vibrations that create the S₁ heart sound. Synthesized realistic heart sounds from flux.

Research on Markov chain Monte Carlo (MCMC) methods for parameter estimation in differential equations. Topics include finding statistical evidence of exoplanets and inference on parameters on stochastic differential equations. Research on parallel acceleration of MCMC methods using graphics processing units (GPUs).

Lawrence Berkeley National Laboratory, Berkeley, CA

Computer Systems Engineer, Complex Systems Group 10/10 — 8/11

Computer Systems Engineer, Future Technologies Group 6/09 — 9/10

Participating Guest Researcher, Computational Research Division 8/08 — 5/09; 9/11 — 9/13

Collaborated on Numerical Analysis research. Developed, maintained and used arbitrary- and extended-precision algorithms packages, Arprec and QD. Analyzed and corrected results using symbolic computation and Integer-Relation Detection algorithms. Primary author of Torch: Computational Reference Kernels, a testbed of computational kernels designed to represent the spectrum of High Performance Computing. Allows researchers to explore quickly and experiment with programming models, languages, parallelizations and architectures. Additional development for simulation-based materials-properties database.

University of Newcastle, Newcastle, NSW, Australia

Visiting Researcher, Centre for Computer Assisted Research and Applications 6/11 — 7/11

Research on symbolic simplification. Designed and implemented algorithms for automated simplification of constants of the form $\sum_{i=1}^n \alpha_i z_i$ with α_i rational, z_i complex and n large.

Apple Computer Inc., Cupertino, CA

Cooperative Researcher, Advanced Computation Group 10/09 — present, active to 1/10

Collaborated with Apple staff on development of scientific computing libraries. Co-authored mixed-language interface to MatrixFFT, Apple's high-performance library for Fast Fourier Transforms.

Jet Propulsion Laboratory, NASA, Pasadena, CA*Summer Student Researcher, Information Processing Group*

6/07 — 8/07

Developed and ran simulations of near-channel-capacity Error Correcting Codes. Generated and evaluated performance data for Low-Density Parity-Check codes developed for the NASA Deep Space Network communication standard. Designed and implemented schemes to eliminate false positives in error correction. Proved reliability and validation through extensive testing.

Honors

- Mechanisms and Innovation in Cardiovascular Disease T32 training grant, Cardiovascular Institute, Stanford University 6/18
- Kurt O. Friedrichs Prize for Outstanding Dissertation in Mathematics (PhD thesis award), Dept. of Mathematics, Courant Institute of Mathematical Sciences 4/18
- Thomas Tyler Bingley Fellowship, for applications of mathematics to medicine and biology 4/16
- Math Master's Thesis Prize (MS thesis award), Dept. of Mathematics, Courant Institute 4/14
- NSF Graduate Research Fellowship 4/13
- Named Apple Cooperative Researcher for collaborations on MatrixFFT 10/09

Publications and Preprints

1. Yuanxun Bao, Alexander D. Kaiser, Jason Kaye, Charles S. Peskin. *Gaussian-Like Immersed Boundary Kernels with Three Continuous Derivatives and Improved Translational Invariance* ArXiv preprint, arXiv:1505.07529v3, 4/2017.
2. David H. Bailey, Jonathan M. Borwein, Alexander D. Kaiser. *Automated Simplification of Large Symbolic Expressions*. Journal of Symbolic Computation, v. 60, 1/14, p. 120-136.
3. Alex Kaiser, Samuel Williams, Kamesh Madduri, Khaled Ibrahim, David H. Bailey, James W. Demmel, Erich Strohmaier. *TORCH — Computational Reference Kernels: A Testbed for Computer Science Research*. Tech Report LBNL-4172E. 12/10.
4. Erich Strohmaier, Samuel Williams, Alex Kaiser, Kamesh Madduri, Khaled Ibrahim, David H. Bailey, James W. Demmel. *A Kernel Testbed for Parallel Architecture, Language and Performance Research*. Invited, extended abstract version of 4. International Conference on Numerical Analysis and Applied Mathematics 2010, American Institute of Physics Conference Proceedings, v. 1281. 9/10.
5. Alex Kaiser, Samuel Williams, Kamesh Madduri, Khaled Ibrahim, David Bailey, James Demmel, Erich Strohmaier, *A Case for a Testbed of Kernels for Software/Hardware Co-Design Research*, Proceedings of USENIX Workshop on Hot Topics in Parallelism, Berkeley, California, 6/10.
6. A. Kaiser, S. Dolinar and M. K. Cheng, *Undetected Errors in Quasi-cyclic LDPC Codes Caused by Receiver Symbol Slips*, Proceedings of IEEE Global Conference on Communications, Honolulu, Hawaii, 11/09.

Software

- MC_Stretch: Fast, affine-invariant, GPU parallel MCMC
github.com/alexkaiser/mc_stretch
- SimplifySum: Automatic simplification of symbolic sums in Mathematica
github.com/alexkaiser/SimplifySum

Teaching Experience

- Adjunct Instructor, Analysis (undergraduate level), Department of Mathematics, New York University Spring 15
- Teaching assistant, Introduction to Mathematical Analysis I (graduate level), Department of Mathematics, New York University Fall 15

Relevant Coursework

Courant Institute

- Adv. Topics in Numerical Analysis: High Performance Computing, Computational Fluid Dynamics, The Immersed Boundary Method, Approximation Theory and Approximation Practice
- Adv. Topics in Math Biology: Partial Differential Equations in Biology
- Adv. Topics in Fluid Mechanics: Numerical Methods for Fluid Structure Interaction
- Numerical Methods, including ODE, PDE, stability theory, error analysis, linear algebra
- Real, Complex and Functional Analysis, including abstract measure theory, Hilbert spaces, etc.
- Fluid Dynamics, Mechanics, Partial Differential Equations, Methods of Applied Mathematics, Linear Algebra, Probability

UC Berkeley

- Adv. Topics in Applied Math: Flow, Deformation and Fracture, graduate level; Real and Complex analysis, Numerical Analysis, Algorithms, Artificial Intelligence, Machine Structures, Data Structures, Fourier Analysis and Wavelets, Linear Algebra, Abstract Algebra, undergraduate level

Programming and skills

- Extensive programming experience using C and MATLAB
- Additional work with C++, Python, Fortran (including mixed language programming) and Mathematica
- Parallel programming in OpenCL, some experience with OpenMP and MPI
- Use and development of scientific software libraries, including IBAMR (Immersed Boundary Adaptive Mesh Refinement) and Apple's MatrixFFT

Membership

American Mathematical Society (AMS), Society for Industrial and Applied Mathematics (SIAM), American Physical Society (APS)

Service

- President, Courant Student Organization 9/15-5/16
- Co-organizer, Graduate Student & Postdoc Seminar, Courant Institute 9/15-5/16

Other

Erdős Number 3, via Sam Dolinar, Robert McEliece, Erdős.

Additional Experience

Music Department, U.C. Berkeley, Berkeley, CA

Teaching assistant, lead drummer, U.C. Berkeley African Music Ensemble 9/07 — 5/10
Recitation leader, Music 148 1/08 — 5/08

Volunteer teaching assistant and lead drummer for U.C. Berkeley African Music Ensemble. Performance of traditional music of the Ewe people of Ghana and Togo. Led ensemble of over one hundred people in rehearsal and performance. Ran recitation sections. Tutored students in drumming, dancing and singing.

Berkeley Ironworks Climbing and Fitness, Berkeley, CA

Head Coach, Berkeley Ironworks Teen Team 4/08 — 6/09

Head instructor of Berkeley Ironworks Teen Team, community oriented rock-climbing team for teenagers. Mentored over thirty teenagers, including some with physical disabilities including cerebral palsy. Supervised staff. Responsible for hiring and terminations.

Drumming experience

Twenty two years of drumming experience in rock and traditional African styles.

- Drummer, rock bands *Primes*, *Soft Signals*, *Scully* 1/12 — 9/17
Continued playing as a hobby
- Drummer, rock band *Magic Bullets* 4/10 — 8/11
Reviewed favorably by Washington Post, NY Magazine, Pitchfork.
- Drummer, rock band *Maus Haus* 2/11 — 6/11
Reviewed favorably by national media including Rolling Stone, SF Weekly.
- Member, *African Music Ensemble* 5/09 — 8/11
Traditional music of Ewe people of Ghana and Togo. Led by master drummer C.K. Ladzekpo, of UC Berkeley Music, formerly of Ghana Dance Ensemble.
- Drummer, rock band *Tempo No Tempo* 12/04 — 5/10
Reviewed favorably by Rolling Stone, Pitchfork. Voted “Best Student Band” at Berkeley.

Talks

- *Modeling the Mitral Valve*,
ICME (Institute for Computational and Mathematical Engineering) student seminar,
Stanford University 2/18
Marsden Lab lunch seminar, Stanford University 1/18
PhD thesis defense, Courant Institute of Mathematical Sciences, New York University 9/17
American Institute of Physics Division of Fluid Dynamics Annual Meeting (APS DFD 16) 11/16
Computational Biology Colloquium,
Courant Institute of Mathematical Sciences, New York University 10/16
- *Computational Experiments in Markov Chain Monte Carlo & Automated Simplification of Large Symbolic Expressions*, Student Numerical Analysis Seminar,
Courant Institute of Mathematical Sciences, New York University 10/16
- *Automated Simplification of Large Symbolic Expressions*, lunch seminar,
Centre for Computer Assisted Research and Applications, University of Newcastle 7/11
- *A Testbed Based on the Motifs of Parallel Computing*, Lawrence Berkeley National Laboratory 4/10
- *Undetected Errors in Quasi-cyclic LDPC Codes Caused by Receiver Symbol Slips*,
IEEE Global Conference on Communications 11/09