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 9/2017

M.S. Mathematics. Thesis: Computational Experiments in Markov Chain Monte Carlo 9/2013

University of California, Berkeley, Berkeley, CA

B.A. Mathematics; minor, Computer Science 5/2009

Research Experience:

Postdoctoral Scholar, Inst. Comp. & Math. Engineering, Stanford University, Stanford, CA
Cardiovascular Biomechanics Computation Laboratory 11/2017 – present

- Research in computational cardiac mechanics, focused on mechanics of the aortic valve, flow through bicuspid aortic valves, image-based left-heart modeling and personalized virtual surgery for precision treatment of hypertrophic cardiomyopathy.

Graduate student, Courant Institute of Math. Sciences, New York University, New York, NY
Department of Mathematics 9/2011 – 9/2017

- Research on modeling and simulation of cardiac mechanics, focused on the mechanics of heart valves. Built fiber-based model of the mitral valve, simulated interaction with blood using the immersed boundary method. Results show accurate flow when subject to physiological pressures over multiple beats.
- Research on Markov chain Monte Carlo (MCMC) methods for parameter estimation in differential equations. Research on parallel acceleration of MCMC methods using graphics processing units (GPUs).

Consultant, Innovein Medical, San Carlos, CA 11/2018 – 9/2019

- Consulting regarding a prosthetic vein valve medical device.

Computer Systems Engineer, Lawrence Berkeley National Laboratory, Berkeley, CA
Complex Systems Group & Future Technologies Group 6/2009 – 8/2011

- Collaborated on Numerical Analysis research. Developed, maintained and used scientific libraries. Developed software for simulation-based materials-properties database.

Visiting Researcher, University of Newcastle, Newcastle, NSW, Australia
Centre for Computer Assisted Research and Applications 6/2011 – 7/2011

- 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.

Cooperative Researcher, Apple Inc., Cupertino, CA
Advanced Computation Group 10/2009 – 1/2010

- 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.

Summer Student Researcher, Jet Propulsion Laboratory, NASA, Pasadena, CA
Information Processing Group 6/2007 – 8/2007

- Generated and evaluated performance data for error correcting codes developed for the NASA Deep Space Network communication standard. Designed and implemented schemes to eliminate false positives. Proved reliability and validation through extensive testing.

Honors and awards:

- Benchmark Capital Fellowship in Congenital Cardiovascular Bioengineering 7/2020
- Mechanisms and Innovation in Cardiovascular Disease, T32 training fellowship, National Heart Lung and Blood Institute, National Institutes of Health via Stanford Cardiovascular Institute 6/2018
- Kurt O. Friedrichs Prize for Outstanding Dissertation in Mathematics (PhD thesis award), Dept. of Mathematics, Courant Institute 4/2018
- Thomas Tyler Bringley Fellowship, for applications of mathematics to medicine and biology 4/2016
- Math Master's Thesis Prize (MS thesis award), Dept. of Mathematics, Courant Institute 4/2014
- NSF (National Science Foundation) Graduate Research Fellowship 4/2013

Publications and Preprints:

1. **Alexander D. Kaiser**, Rohan Shad, Nicole Schiavone, William Hiesinger, Alison L. Marsden. "Simulated Hemodynamics of Bicuspid Aortic Valves." *In preparation*, 2020.
2. **Alexander D. Kaiser**, Rohan Shad, William Hiesinger, Alison L. Marsden. "A Design-Based Model of the Aortic Valve for Fluid-Structure Interaction." *Submitted*, 2020. arXiv:2010.02346
3. Rohan Shad, **Alexander D. Kaiser**, Sandra Kong, Robyn Fong, Nicholas Quach, Cayley Bowles, Patpilai Kasinpila, Yasuhiro Shudo, Jeffrey Teuteberg, Y. Joseph Woo, Alison L. Marsden, William Hiesinger "Patient Specific Computational Fluid Dynamics Reveal Localized Flow Patterns Predictive of Post-LVAD Aortic Incompetence" *Submitted*, 2020.
4. Patpilai Kasinpila, Sandra Kong, Robyn Fong, Rohan Shad, **Alexander D. Kaiser**, Alison Marsden, Joseph Woo, William Hiesinger. "Use of Patient-Specific Computational Models for Optimization of Aortic Insufficiency after Implantation of Left Ventricular Assist Device." *The Journal of Thoracic and Cardiovascular Surgery,* in press, 2020. doi.org/10.1016/j.jtcvs.2020.04.164
5. **Alexander D. Kaiser**, David M. McQueen, Charles S. Peskin. "Modeling the Mitral Valve." *International Journal of Numerical Methods in Biomedical Engineering*, 2019; 35:e3240. doi.org/10.1002/cnm.3240, arXiv:1902.00018
6. **Alexander D. Kaiser**, Alison L. Marsden. "Modeling Patient-Specific Left-Ventricular Blood Flow and Mitral Valve Dynamics." *Proceedings of 6th International Conference on Computational and Mathematical Biomedical Engineering (CMBE)*, v1, 2019. PDF
7. Yuanxun Bao, **Alexander D. Kaiser**, Jason Kaye, Charles S. Peskin. "Gaussian-Like Immersed Boundary Kernels with Three Continuous Derivatives and Improved Translational Invariance." 4/2017. arXiv preprint. arxiv.org/abs/1505.07529v3
8. David H. Bailey, Jonathan M. Borwein, **Alexander D. Kaiser**. "Automated Simplification of Large Symbolic Expressions." *Journal of Symbolic Computation*, v. 60, 1/2014, p. 120-136. doi.org/10.1016/j.jsc.2013.09.001
9. **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*, 12/2010. PDF
10. 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." *Proceedings of the International Conference on Numerical Analysis and Applied Mathematics*, 2010, v. 1281. 9/10. doi.org/10.1063/1.3497950
11. **Alex Kaiser**, Samuel Williams, Kamesh Madduri, Khaled Ibrahim, David Bailey, James Demmel, Erich Strohmaier, "A Principled Kernel Testbed for Hardware/Software Co-Design Research." *Proceedings of USENIX Workshop on Hot Topics in Parallelism*, 6/2010. PDF
12. **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*, 11/2009. doi.org/10.1109/GLOCOM.2009.5425765

Professional Service:

- **Grant review:** Stanford Cardiovascular Institute Seed Grant Competition 10/2020
- **Journal peer review:** International Journal for Numerical Methods in Biomedical Engineering, Journal of Biomechanical Engineering, Computers in Biology and Medicine, Computer Graphics Forum
- **President:** Courant Student Organization 9/2015 – 5/2016
- **Organizer:** Graduate Student & Postdoc Seminar, Courant Institute 9/2015 – 5/2016
- **Session Chair:** Fluid Dynamics I, SIAM Life Sciences, (cancelled due to covid) 6/2020

Teaching Experience:

- Teaching assistant, Analysis (undergraduate level) Spring 2015
- Teaching assistant, Introduction to Mathematical Analysis I (graduate level) Fall 2015

Software, Programming and Skills:

- Development of open-source scientific software:
  - heart_valves: Model generation and FSI for aortic and mitral valves
  - mc_stretch: Fast, affine-invariant, GPU parallel MCMC
  - SimplifySum: Automatic simplification of symbolic sums in Mathematica
- Collaborative development of scientific software libraries, including IBAMR, SimVascular, ARPREC and Apple's MatrixFFT.
- Programming in C, MATLAB, Python, Mathematica.
- Parallel programming in OpenCL, some experience with OpenMP and MPI.

Additional Experience:

Department of Music, UC Berkeley Berkeley, CA

Teaching assistant, lead drummer, U.C. Berkeley African Music Ensemble 9/2007 – 5/2010

Recitation section leader, Music 148 1/2008 – 5/2008

- 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 4/2008 – 6/2009

- Head instructor of Berkeley Ironworks Teen Team, non-competive rock-climbing team for teenagers. Mentored over thirty teenagers, including some with physical disabilities including cerebral palsy.

Drumming experience

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

- Drummer, rock bands *Primes, Soft Signals, Scully* 1/2012 – 9/2017
  Continued playing as a hobby
- Drummer, rock band *Magic Bullets* 4/2010 – 8/2011
  Reviewed favorably by Washington Post, NY Magazine, Pitchfork.
- Drummer, rock band *Maus Haus* 2/2011 – 6/2011
  Reviewed favorably by national media including Rolling Stone, SF Weekly.
- Member, *African Music Ensemble* 5/2009 – 8/2011
  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* 12/2004 – 5/2010
  Reviewed favorably by Rolling Stone, Pitchfork. Voted "Best Student Band" at Berkeley.

Other:

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

Talks and poster presentations:

1. "A Design-Based Model of the Aortic Valve," Cardiac Imaging, Mechanics, and Modeling Symposium (CIM2), Stanford University, 9/2020
2. "Simulating Patient-Specific Left-Ventricular Flow from Scan Data," SIAM Life Sciences meeting, (cancelled due to covid), 6/2020
3. "Simulations of Patient-Specific Left-Ventricular Flow", Stanford-Penn Cardiovascular Symposium, poster presentation, 11/2019
4. "A Design-Based Model of the Mitral Valve & Simulations of Patient-Specific Left-Ventricular Flow," Mitral Day, Boston Childrens Hospital, Harvard University, 10/2019
5. "Modeling Patient-Specific Left-Ventricular Blood Flow and Mitral Valve Dynamics," 6th International Conference on Computational and Mathematical Biomedical Engineering (CMBE), Tohoku University, Sendai, Japan, 6/2019
6. "Modeling Heart Valves," guest lecture, BIOE 285: Computational Modeling in the Cardiovascular System, Stanford University, 5/2019

7. "A Design-Based Model of the Mitral Valve & Simulations of Patient-Specific Left-Ventricular Flow," guest lecture, MED 289: Introduction to Bioengineering Research, Stanford University, 11/2019
8. "A Design-Based Model of the Mitral Valve & Simulations of Patient-Specific Left-Ventricular Flow," Cardiac Imaging, Mechanics, and Modeling Symposium (CIM2), Stanford University, 8/2019
9. "Modeling the Mitral Valve," Stanford-Duke Cardiovascular Research Symposium, poster presentation, Stanford University, 11/2018
10. "Modeling the Mitral Valve," Bioengineering department retreat, poster presentation, Stanford University, 11/2018
11. "SimCardio: Open-Source, Multi-Physics, Cardiac Modeling and Simulation," NSF SI2 PI meeting, poster presentation, 5/2018
12. "Modeling the Mitral Valve," ICME (Institute for Computational and Mathematical Engineering) student seminar, Stanford University, 2/2018
13. "Modeling the Mitral Valve," Marsden Lab seminar, Stanford University, 1/2018
14. "Modeling the Mitral Valve," PhD thesis defense, Courant Institute, New York University, 9/2017
15. "Modeling the Mitral Valve," American Institute of Physics, Division of Fluid Dynamics Annual Meeting (APS DFD 16), 11/2016
16. "Modeling the Mitral Valve," Computational Biology Colloquium, Courant Institute, New York University, 10/2016
17. "Computational Experiments in Markov Chain Monte Carlo," Student Numerical Analysis Seminar, Courant Institute, New York University, 10/2016
18. "Automated Simplification of Large Symbolic Expressions," Centre for Computer Assisted Research and Applications, University of Newcastle, 7/2011
19. "A Testbed Based on the Motifs of Parallel Computing," Lawrence Berkeley National Laboratory, 4/2010
20. "Undetected Errors in Quasi-cyclic LDPC Codes Caused by Receiver Symbol Slips," IEEE Global Conference on Communications, 11/2009