Alexander D. Kaiser

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Education

New York University, Courant Institute of Mathematical Sciences, New York, NY
PhD Mathematics. Thesis: Modeling the Mitral Valve 2017
MS Mathematics. Thesis: Computational Experiments in Markov Chain Monte Carlo 2013

University of California, Berkeley, Berkeley, CA
BA Mathematics; minor, Computer Science 2009

Research Experience

Postdoctoral Scholar, Institute for Computational & Mathematical Engineering; Department of Pediatrics (Cardiology) Stanford University Stanford, CA
Postdoctoral Scholar, Cardiovascular Biomechanics Computation Laboratory 2017 –

- Research in computational cardiac mechanics, focused on mechanics of the aortic valve, image-based left-heart modeling, validation of immersed boundary methods against in vitro data and flow through bicuspid aortic valves and its relationship to aneurysm formation.

Graduate student, Courant Inst. of Mathematical Sciences, New York University, New York, NY
Department of Mathematics 2011 – 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 2018 – 2019

- Consulting regarding a prosthetic vein valve medical device.

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

- Collaborated on numerical analysis research. Developed, maintained and used scientific libraries.

Visiting Researcher, University of Newcastle, Newcastle, Australia 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 2010

- Collaborative development on MatrixFFT, Apple's high-performance library for Fast Fourier Transforms.

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

Honors and Awards

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

Submitted for Review

1. **Kaiser AD***, Schiavone N*, Eaton J, Marsden AL. Validation of Immersed Boundary Simulations of Heart Valve Hemodynamics against In Vitro 4D Flow MRI Data. (*contributed equally) *Submitted*, 2021. arXiv:2111.00720
2. **Kaiser AD**, Shad R, Schiavone N, Hiesinger W, Marsden AL. Controlled Comparison of Simulated Hemodynamics across Tricuspid and Bicuspid Aortic Valves. *Submitted*, 2021. arXiv:2109.08261
3. Frishman S, Kight A, Pirozzi I, Maddineni S, Imbrie-Moore A, Karachiwalla Z, Paulsen MJ, **Kaiser AD**, Woo YJ, Cutkosky MR. DynaRing: a Patient Specific Mitral Annuloplasty Ring with Selective Stiffness Segments. *Submitted*, 2021.

Publications

1. **Kaiser AD**, Shad R, Hiesinger W, Marsden AL. A Design-Based Model of the Aortic Valve for Fluid-Structure Interaction. *Biomechanics and Modeling in Mechanobiology*, 2021. doi.org/10.1007/s10237-021-01516-7
2. Shad R, **Kaiser AD**, Kong S, Fong R, Quach N, Bowles C, Kasinpila P, Shudo Y, Teuteberg J, Woo YJ, Marsden AL, Hiesinger W. Patient Specific Computational Fluid Dynamics Reveal Localized Flow Patterns Predictive of Post-LVAD Aortic Incompetence *Circulation: Heart Failure*, 2021. 10.1161/CIRCHEARTFAILURE.120.008034
3. Kasinpila P, Kong S, Fong R, Shad R, **Kaiser AD**, Marsden AL, Woo YJ, Hiesinger W. 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*, 2020. doi.org/10.1016/j.jtcvs.2020.04.164
4. **Kaiser AD**, McQueen DM, Peskin CS. Modeling the Mitral Valve. *International Journal of Numerical Methods in Biomedical Engineering*, 2019. doi.org/10.1002/cnm.3240
5. Bailey DH, Borwein JM, **Kaiser AD**. Automated Simplification of Large Symbolic Expressions. *Journal of Symbolic Computation*, 2014. doi.org/10.1016/j.jsc.2013.09.001
6. **Kaiser AD**, Williams S, Madduri K, Ibrahim K, Bailey DH, Demmel JW, Strohmaier E. A Principled Kernel Testbed for Hardware/Software Co-Design Research. *Proceedings of USENIX Workshop on Hot Topics in Parallelism*, 2010. PDF
7. **Kaiser AD**, Dolinar S, Cheng MK, Undetected Errors in Quasi-cyclic LDPC Codes Caused by Receiver Symbol Slips. *Proceedings of IEEE Global Conference on Communications*, 2009. doi.org/10.1109/GLOCOM.2009.5425765

Preprints, Technical Reports & Conference Abstracts

1. **Kaiser AD**, Shad R, Schiavone N, Hiesinger W, Marsden AL. Fluid-Structure Interaction Simulations of Bicuspid Aortic Valve Disease. *American Heart Association Scientific Sessions*, conference abstract, accepted to appear, 2021.
2. **Kaiser AD**, Marsden AL. Modeling Patient-Specific Left-Ventricular Blood Flow and Mitral Valve Dynamics. *Proceedings of 6th International Conference on Computational and Mathematical Biomedical Engineering (CMBE)*, extended conference abstract, 2019. PDF
3. Bao Y, **Kaiser AD**, Kaye J, Peskin CS. Gaussian-Like Immersed Boundary Kernels with Three Continuous Derivatives and Improved Translational Invariance. Preprint, 2017. arXiv:1505.07529v4
4. **Kaiser AD**, Williams S, Madduri K, Ibrahim K, Bailey DH, Demmel JW, Strohmaier E. TORCH – Computational Reference Kernels: A Testbed for Computer Science Research. *LBNL Technical Report*, 2010. PDF
5. Strohmaier E, Williams S, **Kaiser AD**, Madduri K, Ibrahim J, Bailey DH, Demmel JW. A Kernel Testbed for Parallel Architecture, Language and Performance Research. *Proceedings of the International Conference on Numerical Analysis and Applied Mathematics*, extended conference abstract, 2010. doi.org/10.1063/1.3497950

Professional Service

- **Journal peer review:** International Journal for Numerical Methods in Biomedical Engineering, Journal of Biomechanical Engineering, Computers in Biology and Medicine, Computer Graphics Forum 2017 – 2021
- **Trainee Committee:** Intl. Conf. on Functional Imaging and Modeling of the Heart (FIMH-2021) 2021

- **Grant review:** Stanford Cardiovascular Institute Seed Grant Competition 2020
- **Session Chair:** Fluid Dynamics I, SIAM Life Sciences, (cancelled due to covid) 2020
- **President:** Courant Student Organization 2015 – 2016
- **Organizer:** Graduate Student & Postdoc Seminar, Courant Institute 2015 – 2016

Teaching Experience

- Guest lecture, "Modeling Heart Valves," BIOE 285: Computational Modeling in the Cardiovascular System, Stanford University 2019
- Guest lecture, "A Design-Based Model of the Mitral Valve & Simulations of Patient-Specific Left-Ventricular Flow," MED 289: Introduction to Bioengineering Research, Stanford University 2019
- Teaching assistant, Introduction to Mathematical Analysis I (graduate level) 2015
- Teaching assistant, Analysis (undergraduate level) 2015

Software

- Development of open-source scientific software:
  - heart_valves: Model generation and fluid-structure interaction for aortic and mitral valves
  - mc_stretch: Affine-invariant, GPU parallel MCMC sampler
  - SimplifySum: Automatic simplification of symbolic sums in Mathematica
- Collaborative development of scientific software libraries: IBAMR, SimVascular, ARPREC, MatrixFFT.

Talks and Poster Presentations

1. "Design-Based Models of Heart Valves and Flow through Bicuspid Aortic Valves," 17th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering (CMBBE), poster, 2021
2. "Design-Based Models of Heart Valves and Bicuspid Aortic Valve Flows" Society for Mathematical Biology Annual Meeting, 2021
3. "A Design-Based Model of the Aortic Valve," Cardiac Imaging, Mechanics, and Modeling Symposium (CIM2), Stanford University, 2020
4. "Simulating Patient-Specific Left-Ventricular Flow from Scan Data," SIAM Life Sciences meeting, (cancelled due to covid), 2020
5. "Simulations of Patient-Specific Left-Ventricular Flow", Stanford-Penn Cardiovascular Symposium, poster, 2019
6. "A Design-Based Model of the Mitral Valve & Simulations of Patient-Specific Left-Ventricular Flow," Mitral Day, Boston Children's Hospital, Harvard University, 2019
7. "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, 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, 2019
9. "Modeling the Mitral Valve," Stanford-Duke Cardiovascular Research Symposium, poster, Stanford University, 2018
10. "Modeling the Mitral Valve," Bioengineering department retreat, poster, Stanford University, 2018
11. "SimCardio: Open-Source, Multi-Physics, Cardiac Modeling and Simulation," NSF SI2 PI meeting, poster, 2018
12. "Modeling the Mitral Valve," ICME (Institute for Computational and Mathematical Engineering) student seminar, Stanford University, 2018
13. "Modeling the Mitral Valve," Marsden Lab seminar, Stanford University, 2018
14. "Modeling the Mitral Valve," PhD thesis defense, Courant Institute, New York University, 2017
15. "Modeling the Mitral Valve," American Institute of Physics, Division of Fluid Dynamics Annual Meeting (APS DFD 16), 2016

16. "Modeling the Mitral Valve," Computational Biology Colloquium, Courant Institute, New York University, 2016
17. "Computational Experiments in Markov Chain Monte Carlo," Student Numerical Analysis Seminar, Courant Institute, New York University, 2016
18. "Automated Simplification of Large Symbolic Expressions," Centre for Computer Assisted Research and Applications, University of Newcastle, 2011
19. "A Testbed Based on the Motifs of Parallel Computing," Lawrence Berkeley National Laboratory, 2010
20. "Undetected Errors in Quasi-cyclic LDPC Codes Caused by Receiver Symbol Slips," IEEE Global Conference on Communications, 2009

Other

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

Additional Experience

Department of Music, UC Berkeley Berkeley, CA
Drummer, U.C. Berkeley African Music Ensemble 2007 – 2009
Recitation section leader, Music 148 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, Teen Climbing Team 2008 – 2009

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

Drumming experience

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