

# David Samuel Bindel

Courant Instructor of Mathematics

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## Education

May 1999            B.S. in Mathematics and in Computer Science, University of Maryland, College Park  
December 2006    Ph.D. in Computer Science, University of California, Berkeley

Advisors:            James Demmel (Computer Science Division and Department of Mathematics)  
                          Sanjay Govindjee (Department of Civil Engineering)

Dissertation title: *Structured and Parameter-Dependent Eigensolvers for Simulation-Based Design of Resonant MEMS*

## Professional Experience

Fall 2006-present.      Courant Instructor of Mathematics, New York University  
Fall 1999-Summer 2006.    Graduate student researcher, CS Division, UC Berkeley  
Fall 2005 and Spring 2001.   Graduate student instructor, CS Division, UC Berkeley

## Research interests

- Modeling microelectromechanical systems (MEMS)
- Numerical linear algebra, particularly eigenvalue problems
- Bifurcation analysis and nonlinear eigenvalue problems
- Computational mechanics and finite element analysis
- Numerical analysis of problems from computer networking and systems
- Numerical software engineering
- Floating point computations

## Awards

Alston S. Householder Award for Best Dissertation in Numerical Linear Algebra (2008)  
NSF Graduate Student Fellowship (Fall 99-Spring 02)

## Publications

### Journal articles

1. David S. Bindel, James Demmel, and Mark Friedman. Continuation of invariant subspaces in large bifurcation problems. *SIAM Journal on Scientific Computing*, 30(2): 637–656, February 2008.
2. Yan Chen, David S. Bindel, Hanhee Song, Brian Chavez, and Randy H. Katz. Algebra-based scalable overlay network monitoring: Algorithms, evaluation, and applications. *ACM Transactions on Networks*, 15(5): 1084–1097, October 2007.

3. David S. Bindel and Maciej Zworski. Symmetry of bound and antibound states in the semiclassical limit. *Letters in Math Physics*, 81(2):107–117, August 2007.
4. David S. Bindel and Sanjay Govindjee. Elastic PMLs for resonator anchor loss simulations. *International Journal for Numerical Methods in Engineering*, 64(6):789–818, October 2005.
5. David S. Bindel, James W. Demmel, William Kahan, and Osni Marques. On computing Givens rotations reliably and efficiently. *ACM TOMS*, 28(2):206–238, June 2002.

## Conference proceedings

1. Cynthia Bruyns-Maxwell and David S. Bindel, Spectrum Tracking for Shape Changing Objects. In *Proceedings of DAFx 2007*, Bordeaux, France, September 2007.
2. James Demmel, Jack Dongarra, Beresford N. Parlett, William Kahan, Ming Gu, David S. Bindel, Yozo Hida, Xiaoye S. Li, Osni Marques, E. Jason Riedy, Christof Voemel, Julien Langou, Piotr Luszczek, Jakub Kurzak, Alfredo Buttari, Julie Langou, Stanimire Tomov. Prospectus for the next LAPACK and ScaLAPACK libraries. In *Proceedings of PARA 2006*, pages 11–23, 2006.
3. Cynthia Bruyns and David S. Bindel, Shape Changing Symmetric Objects for Sound Synthesis. In *Proceedings of 121st AES*, San Francisco, CA, October 2006.
4. Yao Zhao, Yan Chen, and David Bindel. Toward unbiased end-to-end network diagnosis. In *Proceedings of SIGCOMM 2006*, pages 219–230, 2006.
5. Yao Zhao, Yan Chen, and David Bindel. Toward deterministic overlay diagnosis. In *ACM SIGMETRICS/Performance 2006* (poster), pages 387–388, 2006.
6. Tsuyoshi Koyama, David S. Bindel, Wei He, Emmanuel Quevy, James Demmel, Sanjay Govindjee, and Roger T. Howe. Simulation of thermoelastic damping in high frequency resonators. In *Proceedings of IEEE SENSORS 2005*, Irvine, CA, November 2005.
7. Yao Zhao, Yan Chen, and David S. Bindel. Scalable and deterministic overlay network diagnosis. In *Proceedings of ACM SIGCOMM 2005* (poster), 2005.
8. David S. Bindel, James W. Demmel, Mark J. Friedman, Willy J.F. Govaerts, and Yuri A. Kuznetsov. Bifurcation analysis of large equilibrium systems in MATLAB. In *Proceedings of ICCS 2005*, volume 3514, pages 50–57. Springer-Verlag, April 2005.
9. David S. Bindel, Emmanuel Quevy, Tsuyoshi Koyama, Sanjay Govindjee, James W. Demmel, and Roger T. Howe. Anchor loss simulation in resonators. In *Proceedings of MEMS 2005*, Miami, FL, February 2005.
10. Yan Chen, David S. Bindel, Hanhee Song, and Randy H. Katz. An algebraic approach to practical and scalable overlay network monitoring. In *Proceedings of ACM SIGCOMM 2004*, 2004.
11. David S. Bindel, Zhaojun Bai, and James W. Demmel. Model reduction for RF MEMS simulation. In *Proceedings of PARA 04*, Lecture Notes in Computer Science. Springer, June 2004. To appear.
12. David S. Bindel, James W. Demmel, and Mark J. Friedman. Continuation of invariant subspaces for large bifurcation problems. In *SIAM Linear Algebra Meeting, 2003*, Williamsburg, VA, July 2003.
13. Yan Chen, David S. Bindel, and Randy H. Katz. Tomography-based overlay network monitoring (poster). In *ACM SIGCOMM 2003*, 2003. Abstract to appear in *ACM Computer Communication Review*, 2004.
14. Yan Chen, David S. Bindel, and Randy H. Katz. Tomography-based overlay network monitoring. In *Proceedings of ACM SIGCOMM Internet Measurement Conference (IMC)*, 2003.
15. James V. Clark, David S. Bindel, Wayne Kao, Ernest Zhu, Andrew Kuo, Ningning Zhou, Jiawang Nie, James W. Demmel, Zhaojun Bai, Sanjay Govindjee, Kristofer S. J. Pister, Ming Gu, and Alice Agogino. Addressing the needs of complex MEMS design. In *Proceedings of MEMS 2002*, Las Vegas, NV, January 2002.
16. Yan Chen, Adam Bargteil, David S. Bindel, Randy H. Katz, and John Kubiawicz. Quantifying network denial of service: A location service case study. In S. Qing, T. Okamoto, and J. Zhou, editors, *Proceedings of the International Conference on Information and Communications Security (ICICS)*, volume 2229 of *Lecture Notes in Computer Science*, pages 340–351, Xian, China, November 2001. Springer.

17. Jason V. Clark, David S. Bindel, Ningning Zhou, Sunil Bhave, Zhaojun Bai, James W. Demmel, and Kristofer S. J. Pister. SUGAR: Advancements in a 3D multi-domain simulation package for MEMS. In *Proceedings of the Microscale Systems: Mechanics and Measurements Symposium*, Portland, OR, June 2001.
18. Zhaojun Bai, David S. Bindel, Jason V. Clark, Ningning Zhou, James W. Demmel, and Kristofer S.J. Pister. New numerical techniques and tools in SUGAR for 3D MEMS simulation. In *Tech. Proc. of the 4th Intern. Conf. on Modeling and Simulation of Microsystems*, Hilton Head Island, SC, March 2001.
19. John Kubiawicz, David S. Bindel, Yan Chen, Steven Czerwinski, Patrick Eaton, Dennis Geels, Ramakrishna Gummadi, Sean Rhea, Hakim Weatherspoon, Westley Weimer, Chris Wells, and Ben Zhao. OceanStore: An architecture for global-scale persistent storage. In *Proceedings of the Ninth international Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2000)*, November 2000.
20. Jason V. Clark, Ningning Zhou, David S. Bindel, Luca Schenato, W. Wu, James W. Demmel, and Kristofer S. J. Pister. 3D MEMS simulation modeling using modified nodal analysis. In *Proceedings of the Microscale Systems: Mechanics and Measurements Symposium*, pages 68–75, Orlando, FL, June 2000.

## Reports

1. David S. Bindel. Structured and parameter-dependent eigensolvers for simulation-based design of resonant MEMS. Technical Report EECS-2006-109, UC Berkeley Computer Science Division, August 2006.
2. David S. Bindel, James W. Demmel, and Mark J. Friedman. Continuation of invariant subspaces for large bifurcation problems. Technical Report EECS-2006-13, UC Berkeley Computer Science Division, February 2006.
3. David S. Bindel, Shivkumar Chandrasekaran, James W. Demmel, David Garmire, and Ming Gu. A fast and stable nonsymmetric eigensolver for certain structured matrices. Technical report in progress, 2005.
4. David S. Bindel and Sanjay Govindjee. Elastic PMLs for resonator anchor loss simulation. Technical Report UCB/SEMM-2005/01, Structural Engineering Mechanics and Materials, Department of Civil and Environmental Engineering, University of California, Berkeley. February 2005
5. Yan Chen, David S. Bindel, Hanhee Song, and Randy H. Katz. Tomography-based overlay network monitoring. Technical Report CSD-03-1252, UC Berkeley Computer Science Division, June 2003.
6. John Kubiawicz, David S. Bindel, Yan Chen, Steven Czerwinski, Patrick Eaton, Dennis Geels, Ramakrishna Gummadi, Sean Rhea, Hakim Weatherspoon, Westley Weimer, Chris Wells, and Ben Zhao. OceanStore: An architecture for global-scale persistent storage. Technical Report CSD-00-1102, UC Berkeley Computer Science Division, March 2000.

## Talks

### Colloquium and seminar talks

1. “Computer-Aided Design of MEMS.” Applied Mathematics Colloquium, MIT, November 2008.
2. “Bounds and Error Estimates for Nonlinear Eigenvalue Problems.” Applied Mathematics Seminar, UC Berkeley, October 2008.
3. “Computer-Aided Design of MEMS.” Applied Mathematics Seminar, McGill University, February 2008.
4. “Computer-Aided Design of MEMS.” Computational and Applied Mathematics Colloquium, Rice University, January 2008.

5. "Computer-Aided Design of MEMS." Applied Mathematics and Scientific Computing Seminar, Temple University, November 2007.
6. "Computer-Aided Design of MEMS." Computer Science Colloquium, Cornell University, November 2007.
7. "Computer-Aided Design of MEMS." Applied Math Colloquium, Columbia University, March 2007.
8. "Spectral Inclusion Regions for Bifurcation Analysis." Numerical Analysis Seminar, NYU, August 2006.
9. "Spectral Inclusion Regions for Bifurcation Analysis." Numerical Analysis Seminar, Stanford University, August 2006.
10. "Computer-Aided Design of MEMS." Computer Science Colloquium, Purdue University, April 2006.
11. "Computer-Aided Design of MEMS." Computer Science Colloquium, CU Boulder, April 2006.
12. "Computer-Aided Design of MEMS." Computer Science Colloquium, UC Davis, March 2006.
13. "Computer-Aided Design of MEMS." Computer Science Colloquium, Penn State University, February 2006.
14. "Computer-Aided Design of MEMS." Information Science and Technology Seminar, Caltech, February 2006.
15. "Computer-Aided Design of MEMS." Sandia National Labs, January 2006.
16. "Computer-Aided Design of MEMS: Eigenvalues, Energy Losses, and Dick Tracy Watches." Numerical Analysis Seminar, NYU, November 2004.
17. "Simulating MicroElectroMechanical Systems." Presentation at UC Davis, Mar 2002.

### Minisymposia and invited talks

1. "Numerical Methods for Resonance Calculations." BIRS Workshop on Mathematical Theory of Resonances, October 2008.
2. "Computer-Aided Design of Micro-Electro-Mechanical Systems." (Householder 2008 Prize Lecture). Householder meeting, June 2008.
3. "Error Bounds and Error Estimates for Nonlinear Eigenvalue Problems." Householder meeting, June 2008.
4. "Error Bounds and Error Estimates for Nonlinear Eigenvalue Problems." Householder meeting, June 2008.
5. "Numerical and Semi-Analytical Structure Preserving Model Reduction for MEMS." ENUMATH 2007, September 2007.
6. "Numerical and Semi-Analytical Structure Preserving Model Reduction for MEMS." ICIAM 2007, July 2007.
7. "Continuation of Sparse Eigendecompositions." SIAM Computational Science and Engineering 2007, February 2007.
8. "Model Reduction and Mode Computation for Damped Resonant MEMS." SIAM Computational Science and Engineering 2007, February 2007.
9. "Computer-Aided Design for Micro-Electro-Mechanical Systems." Bay Area Scientific Computing Day, March 2006.
10. "Modeling Resonant Microsystems: Toward Cell Phones on a Chip?" Abel Symposium 2006, May 2006.
11. "Eigenproblems in Resonant MEMS Design." SIAM Annual Meeting, July 2005.
12. "Continuation of Invariant Subspaces of Sparse Parameter-Dependent Matrices." Householder meeting, May 2005.
13. "Continuation of Invariant Subspaces." ARCC Workshop on Stability Criteria for Multi-Dimensional Waves and Patterns, May 2005.
14. "Fast Hessenberg QR Iteration for Companion Matrices." SIAM Annual Meeting, July 2004.
15. "Simulating RF MEMS." Bay Area Scientific Computing Day, March 2004.
16. "Fast QR Iteration for Companion Matrices." SIAM Linear Algebra Meeting, July 2003.

## Other talks

1. “Finite Element Analysis of Human Bone Models.” Courant Biomathematics Seminar, April 2008.
2. “Damping Mechanisms in Resonant Microsystems.” Courant Materials Working Group, March 2008.
3. “Numerical and Semi-Analytical Structure-Preserving Model Reduction for MEMS.” DARPA MEMS/NEMS Workshop, December 2007.
4. “Structure Preserving Model Reduction for Damped Resonant MEMS.” US National Congress on Computational Mechanics, July 2007.
5. “Elastic PMLs for Resonator Anchor Loss Simulation.” US National Congress on Computational Mechanics, July 2005.
6. “Modeling of Thermoelastic Damping in MEMS Resonators.” US National Congress on Computational Mechanics, July 2005. (Presenter: Tsuyoshi Koyama)
7. “MEMS Resonator Simulation.” BSAC Industrial Advisory Board meeting, March 2005.
8. “SUGAR: A MEMS Simulation Program.” Presentation at Sun Microsystems, Jun 2002.
9. “SUGAR: A MEMS Simulation Tool.” Tutorial talk at Modeling and Simulation of Microsystems (MSM), April 2002.

## Teaching

Spring 2008	Scientific Computing
Fall 2008	High-Performance Scientific Computing
Spring 2008	Honors Calculus II
Fall 2007	Introduction to Probability Theory
Spring 2007	Honors Calculus II
Fall 2006	Quantitative Reasoning: Mathematical Patterns in Nature
Fall 2005	CS 164: Compilers and programming languages.
Spring 2001	CS 267: Applications of parallel computers.

## Undergraduate research students

1. Jiexun Xu (2008)
2. Iva Vukicevic (2008)
3. Daniel Parry (2008)
4. Anwis Das (2002)
5. Ernest Zhu (2001)
6. Wayne Kao (2001)

## Released software packages

1. **MWwrap** A wrapper generator for automating calls to C/C++ and Fortran codes from MATLAB.
2. **Matexpr** A source-to-source translator for compiling MATLAB-like expressions within C/C++.
3. **BoneFEA** A commercial code for fast simulation of failure in human bone.
4. **HiQLab** A finite element simulator for computing losses in resonant microsystems.
5. **MATFEAP/FEAPMEX** MATLAB interfaces to the FEAP finite element analysis code.
6. **SUGAR** A lumped-element modeling system for MEMS based on modified nodal analysis. I also worked on M&MEMS, a web-based interface to the SUGAR simulator.
7. **CLAPACK** C translation of version 3.0 of the LAPACK library for dense numerical linear algebra.

## Referee activity

- *SIAM Journal on Matrix Analysis* (2005, 2006, 2007, 2008)
- *SIAM Journal on Scientific Computing* (2008)
- *IEEE Journal of Microelectromechanical Systems* (2003, 2007, 2008)
- *IEEE Transactions on Signal Processing* (2007)
- *Applicable Analysis* (2007)
- *Journal of Applied Mechanics* (2007)
- *Journal of Applied Physics* (2007)
- *Journal of Micromechanics and Microengineering* (2007)
- *Journal of Physics A: Mathematical and Theoretical* (2007)
- *Mathematics of Computation* (2007)
- *Linear Algebra and its Applications* (2003)
- PARA04 conference proceedings (2004)
- IEEE ARITH conference (2004)
- ACM International Conference on Supercomputing (2003)
- Proposal referee for the Netherlands science foundation (NWO)

## Professional activities

- Managing editor for special editions, *Electronic Transactions on Numerical Analysis*, 2008.
- Organizer, NYU numerical analysis and scientific computing seminar, 2007-2008.
- Secretary, IEEE 754 standard revision committee, Jan 02 – Mar 04  
(<http://grouper.ieee.org/groups/754/>)
- Member: American Mathematical Society, Society for Industrial and Applied Mathematics, Association for Computing Machinery, and US Association for Computational Mechanics

## Academic references

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