

## Stephen A. Vavasis

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### Education

- Ph.D., Stanford University, computer science, 1989. Dissertation: *Complexity of Fixed Point Computations*, advised by C. H. Papadimitriou.
- Certificate of Advanced Study, Cambridge University, mathematics, 1985
- A.B., Princeton University, mathematics, 1984

### Employment since 1989

- 2002–present, Professor, Cornell University, Ithaca, NY.
- Summer, 2000. University Summer Faculty, Sandia National Laboratories, Livermore, CA.
- Summer, 1999. Consultant, Bell Laboratories (Lucent Technologies), Murray Hill, NJ.
- July 1996—July 1997. Sabbatical Faculty Visitor, Argonne National Laboratory, Argonne, IL.
- July 1995—2002. Associate Professor, Cornell University, Ithaca, NY.
- Summer, 1995. Technical research, Xerox Palo Alto Research Center, Palo Alto, CA.
- Summer, 1995. Technical research, Research Institute for Advanced Computer Science (RIACS), NASA Ames Research Center, Moffett Field, CA.
- Summers 1991 & 1992. University Summer Faculty, Applied and Numerical Mathematics Div., Sandia National Laboratories, Albuquerque, NM.
- January 1989—July 1995. Assistant Professor, Cornell University, Ithaca, NY. (September 1993 – September 1994, holder of Xerox Chair of Computer Science.)

### Honors and awards

- Fiona Ip Li and Donald Li Teaching Award (Cornell), 1999.
- J. S. Guggenheim Memorial Foundation Fellowship (Cornell), 1996–97.
- NSF Presidential Young Investigator (Cornell), 1990–95.

- Hertz Foundation Graduate Fellowship (Stanford), 1985–1989.
- Cert. of Adv. Study awarded with Distinction (Cambridge), 1985.

### Research interests

- Numerical linear algebra: weighted least squares, stability issues, sparse matrix computation, preconditioning.
- Numerical solution of differential equations: mesh generation, fast and accurate solution, conformal mapping.
- Numerical optimization: linear algebra issues, complexity issues
- Computational geometry: mesh generation, robust geometric primitives, computational algebra.

### Selected university and departmental activities

- Director, Master of Engineering Program in Computer Science, 1990–1993.
- Acting Director, Center for Applied Mathematics, 1996–1997.
- Chair, PhD Admission Committee, Computer Science, 2002–2004.
- Faculty Senator, 2000–present.

### Selected external activities

- NRC Board of Assessment for NIST Information Technology Laboratory, (2002–present)
- Local organizer, 11th International Meshing Roundtable, 2002
- Editorial Board: *J. Global Optimization* (1991–2001), *SIAM J. Matrix Analysis App.* (1997–2004), *SIAM Review* (1996–2005), *Math. Progr.* (2000–2005)
- Vice-Chair, SIAM Activity Group in Linear Algebra (2001–2003)
- Program Committee: 2000 ACM Symposium on Theory of Computing, 1998 and 2002 ACM Symposium on Computational Geometry
- Organizer, Workshop on Numerical Linear Algebra, Symposium on Foundations of Computational Mathematics, 2002 (Minneapolis, MN) and 2005 (Santander, Spain).
- Member: SIAM, ACM, IEEE Computer Society.

### PhD students advised

- Julio M. Stern, PhD, Sparse null bases for structured optimization problems, 1991.
- Scott A. Mitchell, PhD, Mesh generation with provable quality bounds, 1993.
- David M. Bond, PhD, Fast wavelet transforms of boundary element matrices, 1995.
- Patricia D. Hough, PhD, Stable and efficient solution of weighted least-squares problems with applications in interior point methods, 1996.
- Gudbjorn F. Jónsson, PhD, Eigenvalue methods for accurate solution of polynomial

equations, 2001.

- Victoria E. Howle, PhD, Efficient iterative methods for ill-conditioned linear and non-linear network problems, 2001.
- Suzanne Shontz, PhD, Numerical methods for problems on moving meshes, 2004.
- Jaime Barrera, PhD expected in 2006.
- Gun Srijuntongsiri, PhD expected in 2007.

### **Software projects**

- QMG, software for mesh generation. Release 1.0, April, 1995. Release 1.1, November, 1996. Release 2.0, September, 1999.

### **Recent grants**

- “Applications of Weighted Least Squares”, NSF, \$118,000, 7/1/97–6/30/99, Vavasis is PI.
- “Crack propagation on Teraflop Computers”, NSF Grand Challenge grant, \$1,800,000, 9/1/97–8/30/00, Vavasis is co-PI.
- “Adaptive Software for Field-Driven Simulations”, NSF ITR grant, \$5,000,000, Oct 1, 2000 – Sept 30, 2004, Vavasis is co-PI.
- “MSPA-MCS: Automatic Geometric Simplification”, NSF, \$500,000, August 1, 2004 – July 31, 2007, Vavasis is PI.
- “(ASE)-(sim+dmc): Algorithms for Large-Scale Simulations of Turbulent Combustion”, NSF ITR grant, \$1,200,000, September 2004 – August 2007, Vavasis is co-PI.

### **Courses taught, Fall 1995-Spring 2005**

- CS 222, Introduction to Scientific Computing, Spring 1999, 2001, 2003, 2005. Renumbered as CS322 starting 2003. Includes statistics starting Spring 2005.
- CS 421, Numerical Analysis, Fall 1995, 1998, 2000, 2002, 2004.
- CS 621, Matrix Computation, Fall 1997, 1999, 2001.
- CS 624, Numerical Solution of Differential Equations, Spring 1996, 1998, 2000, 2002, 2004.
- CS 721, Topics in Numerical Analysis Fall 2000 (Mathematical aspects of the finite element method) and Fall 2003 (Modern optimization software and algorithms)
- CS 722, Topics in Numerical Analysis (Classic Papers in Applied Mathematics), Spring 2000.

### **Conference and seminar presentations, May 1999 — present**

- Accurate Solution of Polynomials using Eigenvalue Methods, Stanford University, Palo Alto, May 1999.
- —, University of California, Berkeley, May 1999.

- —, SIAM Optimization Conference, Atlanta, May 1999.
- Support-Tree Preconditioners for Structures, Plenary Lecture, Householder Symposium, Whistler (B.C.), June 1999.
- Accurate Solution of Polynomials using Eigenvalue Methods, Mathematical Foundations of Computer Science Conference, Oxford, July 1999.
- —, US National Conference on Computational Mechanics, August 1999.
- Support-Tree Preconditioners, University of Delaware, March 2000.
- Sparse Matrix Methods for Semidefinite Programming, Conference on Advances in Convex Analysis and Global Optimization, Samos, Greece, June 2000.
- —, International Symposium on Mathematical Programming, August 2000.
- A fully sparse algorithm for semidefinite programming, SIAM Optimization Conference, May 2001.
- Support tree preconditioners, US National Conference on Computational Mechanics, August, 2001.
- Curved mesh generation, invited short course, International Meshing Roundtable, October 2001.
- Solution of systems of polynomial equations by eigenvalue methods, Plenary Lecture, Householder Symposium, June 2002.
- A Bernstein-Beziér bound for invertibility of polynomial mappings, World Conference on Computational Mechanics, August 2002.
- Solving elliptic finite element problems in nearly linear time with support preconditioners, Plenary Lecture, Householder Symposium, May 2005.
- —, Foundations of Computational Mathematics, July 2005.

## Book

1. S. A. Vavasis. *Nonlinear Optimization: Complexity Issues*. Oxford University Press, New York, 1991.

## Book chapters

1. S. A. Vavasis. Complexity issues in global optimization: A survey. In R. Horst and P. M. Pardalos, editors, *Handbook for Global Optimization*. Kluwer Academic Publishers, 1993.
2. S. A. Vavasis. Convex optimization. In *Algorithms and Theory of Computation Handbook*. CRC Press, 1999.

## Journal and refereed collection articles

1. M. D. Hirsch, C. H. Papadimitriou, and S. A. Vavasis. Exponential lower bounds for finding Brouwer fixed points. *Journal of Complexity*, 5:379–416, 1989.

2. S. A. Vavasis. Gaussian elimination with pivoting is P-complete. *SIAM Journal on Discrete Mathematics*, 2:412–423, 1989.
3. S. A. Vavasis. Quadratic programming is in NP. *Information Processing Letters*, 36:73–77, 1990.
4. J. J. Moré and S. A. Vavasis. On the solution of concave knapsack problems. *Mathematical Programming*, 49:397–411, 1991.
5. P. M. Pardalos and S. A. Vavasis. Quadratic programming with one negative eigenvalue is NP-hard. *Journal of Global Optimization*, 1:15–22, 1991.
6. S. A. Vavasis. Automatic domain partitioning in three dimensions. *SIAM Journal on Scientific and Statistical Computing*, 12:950–970, 1991.
7. S. A. Vavasis. Approximation algorithms for indefinite quadratic programming. *Mathematical Programming*, 57:279–311, 1992.
8. S. A. Vavasis. Local minima for indefinite quadratic knapsack problems. *Mathematical Programming*, 54:127–153, 1992.
9. S. A. Vavasis. On approximation algorithms for concave quadratic programming. In C. A. Floudas and P. M. Pardalos, editors, *Recent Advances in Global Optimization*, pages 3–18. Princeton University Press, Princeton, N.J., 1992.
10. S. A. Vavasis. Preconditioners for boundary integral equations. *SIAM Journal on Matrix Analysis and Applications*, 13:905–925, 1992.
11. J. M. Stern and S. A. Vavasis. Nested dissection for sparse nullspace bases. *SIAM Journal on Matrix Analysis and Applications*, 14:766–775, 1993.
12. S. A. Vavasis. Black-box complexity of local minimization. *SIAM Journal on Optimization*, 3:60–80, 1993.
13. S. A. Vavasis. Stable numerical algorithms for equilibrium systems. *SIAM J. Matrix Anal. Appl.*, 15:1108–1131, 1994.
14. S. A. Vavasis. Stable finite elements for problems with wild coefficients. *SIAM J. Numer. Anal.*, 33:890–916, 1996.
15. S. A. Vavasis and Y. Ye. Identifying an optimal basis in linear programming. *Annals of Operations Research*, 62:565–572, 1996.
16. S. A. Vavasis and Y. Ye. On the relationship between layered least squares and affine scaling steps. In *Lectures in Applied Mathematics, volume 32*. American Mathematical Society, Providence, RI, 1996.
17. S. A. Vavasis and Y. Ye. A primal-dual interior point method whose running time depends only on the constraint matrix. *Mathematical Programming*, 74:79–120, 1996.

18. P. Hough and S. Vavasis. Complete orthogonal decomposition for weighted least squares. *SIAM J. Matrix Anal. Appl.*, 18, 1997.
19. G. L. Miller, S.-H. Teng, W. Thurston, and S. A. Vavasis. Separators for sphere-packings and nearest neighbor graphs. *J. ACM*, 44:1–29, 1997.
20. T. A. Driscoll and S. A. Vavasis. Numerical conformal mapping using cross-ratios and Delaunay triangulation. *SIAM J. Sci. Comput.*, 19:1783–1803, 1998.
21. G. L. Miller, S.-H. Teng, W. Thurston, and S. Vavasis. Geometric separators for finite-element meshes. *SIAM J. Sci. Comput.*, 19:364–386, 1998.
22. E. Bobrovnikova and S. Vavasis. A norm bound for projections with complex weights. *Linear Algebra and its Applications*, 307:69–75, 2000.
23. S. A. Mitchell and S. A. Vavasis. Quality mesh generation in higher dimensions. *SIAM J. Computing*, 29:1334–1370, 2000.
24. E. Y. Bobrovnikova and S. A. Vavasis. Accurate solution of weighted least squares by iterative methods. *SIAM J. Matrix Anal. App.*, 22:1153–1174, 2001.
25. K. Papoulia, S. Vavasis, and C.-H. Sam. Time continuity in cohesive finite element modeling. *International J. Numer. Meth. Eng.*, 58(5):679–701, 2003.
26. V. E. Howle and S. A. Vavasis. An iterative method for solving complex-symmetric systems arising in electrical power modeling. *SIAM J. Matrix Analysis App.*, 26:1150–1178, 2005.
27. G. Jónsson and S. Vavasis. Accurate solution of polynomial equations using Macaulay resultant matrices. *Mathematics of Computation*, 74:221–262, 2005.
28. G. Jónsson and S. Vavasis. Solving polynomials with small leading coefficients. *SIAM J. Matrix Analysis App.*, 26:400–414, 2005.
29. Chin-Hang Sam, K. Papoulia, and S. Vavasis. Obtaining initially rigid cohesive finite element models that are temporally convergent. *Engineering Fracture Mechanics*, 72:2247–2267, 2005.

### Submitted and unpublished manuscripts

1. S. A. Mitchell and S. Vavasis. An aspect ratio bound for triangulating a  $d$ -grid cut by a hyperplane (extended abstract). In *Proc. 12th ACM Symposium on Computational Geometry*, pages 48–57, 1996.
2. S. Vavasis. A note on efficient computation of the gradient in semidefinite programming. Preprint, 1999.
3. S. Vavasis. A Bernstein-Bézier sufficient condition for invertibility of polynomial mappings. Archived by arxiv.org, cs.NA/0308021, 2003.

4. E. Boman, B. Hendrickson, and S. Vavasis. Solving elliptic finite element systems in near-linear time with support preconditioners. Archived by arxiv.org, cs.NA/0407022; in revision, SIAM J. Numer. Anal., 2004.
5. P. Ganguly, S. Vavasis, and K. Papoulia. An algorithm for two-dimensional mesh generation based on the pinwheel tiling. Archived by arxiv.org, cs.CG/0407018; in revision, SIAM J. Sci. Comput., 2004.
6. S. Shontz and S. Vavasis. A linear weighted laplacian smoothing framework for warping tetrahedral meshes. Archived in arxiv.org, cs.NA/0410045, 2004.
7. Gun Srijuntongsiri and S. Vavasis. A fully sparse implementation of a primal- dual interior-point potential reduction method for semidefinite programming. Archived in arxiv.org, cs.NA/0412009, 2004.
8. K. Papoulia, S. Vavasis, and P. Ganguly. Spatial convergence of crack nucleation using a cohesive finite element model on a pinwheel-based mesh. In revision, Internat. J. Numer. Meth. Eng., 2005.