

Daniel A. Spielman

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- Academic Positions**
- YALE UNIVERSITY July '05 - present
Professor of Applied Mathematics and Computer Science
 - MASSACHUSETTS INSTITUTE OF TECHNOLOGY July '02 - July '05
Associate Professor of Applied Mathematics (tenured '04)
 - MASSACHUSETTS INSTITUTE OF TECHNOLOGY July '96 - July '02
Assistant Professor of Applied Mathematics
 - U. C. BERKELEY, DIVISION OF COMPUTER SCIENCE July '95–June '96
N.S.F. Mathematical Sciences Postdoc
- Education**
- MASSACHUSETTS INSTITUTE OF TECHNOLOGY Ph.D. June '95
Department of Mathematics, adviser: M. Sipser.
Thesis: “Computationally efficient error-correcting codes and holographic proofs”
 - YALE UNIVERSITY B.A. May '92
Summa cum laude. Exceptional distinction in Computer Science.
Beckwith prize in Mathematics.
- Awards and Honors**
- 2003 Semi-plenary speaker, International Symposium on Math Programming
 - 2002 Information Theory Society Paper Award.
 - 2002 Invited speaker at International Congress of Mathematicians.
 - 2002 Work on smoothed analysis listed as one of three significant accomplishments funded by the computer science division of the NSF in its 2003 Budget Request to Congress (http://www.nsf.gov/bfa/bud/fy2003/nar_cise.htm).
 - 1998 Alfred P. Sloan Foundation Research Fellowship.
 - 1997 NSF CAREER Award.
 - 1995 Association for Computing Machinery Doctoral Dissertation Award.
 - 1995 MIT Laboratory for Computer Science Thesis Award.
 - Best Student Paper at the 27th ACM STOC.
 - Best Student Paper at the 26th ACM STOC.

Grants

NSF Medium ITR CCR-0324914: “Collaborative Research: Smoothed Analysis of Algorithms.” 9/1/03–9/1/08. \$1,000,000. With Shang-Hua Teng (BU).

NSF Small ITR/SY(CISE) CCR-0112487: “Why Algorithms Work Well In Practice: Perturbation-Based Average-Case Analysis of the Simplex Algorithm and Beyond.” 7/1/01–6/31/04. \$272,040.

NSF CAREER Award CCR-9701304: “Computationally Efficient Error-Correcting Codes and Their Applications”. 7/1/97–6/30/01. \$205,000.

Patents

Error-Correcting Codes: I have applied for five patents on the error-correcting codes presented in the papers, “Efficient Erasure Correcting Codes” and “Improved Low-Density Parity-Check Codes Using Irregular Graphs”. These codes provide an efficient solution to the problem of packet-loss over the internet, and are particularly useful in multicast communications. They also provide one of the best-known coding techniques for minimizing the power consumption required to achieve reliable communication in the presence of white Gaussian noise. So far, four of these patents have been granted as U.S. patent numbers 6163870, 6081918, 6073250 and 6081909.

Calling lines in Tennis: For my eleventh-grade physics project, I invented and constructed a device that employs arrays of light together with a computer to determine on which side of a line a ball bounces. I patented my invention for use in tennis. (U.S. pat. no. 4,814,986)

Supervision

Jonathan Kelner, Ph.D., M.I.T., EECS '06

“New Geometric Techniques for Linear Programming and Graph Partitioning”

Arvind Sankar, Ph.D., M.I.T., Applied Math '04,

“Smoothed Analysis of Gaussian Elimination”

Mohammad Mahdian, Ph.D., M.I.T., Applied Math '04

“Facility Location and the Analysis of Algorithms through Factor-Revealing Programs

Louay Bazzi, Ph.D., M.I.T., EECS '03, (co-Advised with Sanjoy Mitter)

“Minimum Distance of Error Correcting Codes versus Encoding Complexity, Symmetry, and Pseudorandomness”

Nodari Sitchinava, M.S., M.I.T., EECS '03

“Dynamine Scan Chains - A Novel Architecture to Lower the Cost of VLSI Test”

Adam Klivans, Ph.D., M.I.T., Applied Math '02

“A Complexity Theoretic Approach to Learning”

Joseph D. Kanapka, M.S., M.I.T., EECS '98

“Faster Eigenvector Computation for Laplacians of Well-Shaped Meshes”

Professional service

Program Committee for the 2007 SIAM Workshop on Combinatorial Scientific Computing.

Organizer of the 2nd Cowles Foundation Conference on Optimization, 2007.

Program Committee for the 47th Annual Symposium on Foundations of Computer Science, 2006.

Organizer of the 1st Cowles Foundation Conference on Optimization, 2006.

Program Committee for the 7th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems, 2004.

NSF Panel in Mathematics, 2003.

Program Committee for the 2002 IEEE Symposium on Foundations of Computer Science (FOCS '02).

Program Committee for the 13th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA '02).

Organizer, DIMACS Workshop on Codes and Complexity, December 2001.

NSF Panel in Computer Science, 2001.

Guest Associate Editor for *IEEE Transactions on Information Theory* Special Issue on Codes and Graph and Iterative Algorithms. Volume 47 (2), Feb. 2001.

Program Committee for the Twelfth Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA '00).

Program Committee for the Tenth Annual Symposium on Combinatorial Pattern Matching (CPM '99).

Program Committee for the 1998 IEEE Symposium on Foundations of Computer Science (FOCS '98).

Program Committee for the 9th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA '98).

Program Committee for the Thirteenth Annual IEEE Conference on Computational Complexity (Complexity '98).

2. Papers in Refereed Journals

“Smoothed Analysis of the Condition Numbers and Growth Factors of Matrices”, *SIAM. J. Matrix Anal. & Appl.*, Vol 28, pp. 446–476, 2006. With A. Sankar and S.-H. Teng.

“Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” *Journal of the ACM*, Vol 51 (3), pp. 385 - 463, 2004.

“Smoothed Analysis of Termination of Linear Programming Algorithms”, *Mathematical Programming, Series B*, Vol 97, pp. 375-404, 2003. With S.-H. Teng.

“Efficient Erasure Correcting Codes,” *IEEE Transactions on Information Theory*, 47(2), pp. 569-584, Feb. 2001. With M. G. Luby, M. Mitzenmacher and M. A. Shokrollahi.

“Improved Low-Density Parity-Check Codes Using Irregular Graphs,” *IEEE Transactions on Information Theory*, 47(2), pp. 585-598, Feb. 2001. With M. G. Luby, M. Mitzenmacher and M. A. Shokrollahi. (Received Information Theory Society Paper Prize)

“Min-Max Boundary Domian Decomposition,” *Theoretical Computer Science*, pp. 253-266, Volume 261, Issue 2, 2001. With M. Kiwi and S.-H. Teng.

“Alternation in Interaction,” *Computational Complexity* 9(3-4):202-246, 2000. With M. Kiwi, C. Lund, A. Russell, and R. Sundaram.

“A Remark on Matrix rigidity,” *Information Processing Letters*, 64(6), pp. 283–285, Dec. 1997. With M. A. Shokrollahi and V. Stemann

“Linear-Time Encodable and Decodable Error-Correcting Codes,” *IEEE Transactions on Information Theory*, 42(6), pp. 1723-1731, Nov. 1996.

“Expander Codes,” *IEEE Transactions on Information Theory*, 42(6), pp. 1710-1722, Nov. 1996. With M. Sipser.

“PP is closed under intersection,” *Journal of Computer and System Sciences*, 50(2), pp. 191-202, 1995. With R. Beigel and N. Reingold.

“The Power of Adaptiveness and Additional Queries in Random-Self-Reductions,” *Computational Complexity*, vol. 4, pp. 158-174, 1994. With J. Feigenbaum, L. Fortnow and C. Lund.

3. Proceedings of Refereed Conferences

“A Randomized Polynomial-Time Simplex Algorithm for Linear Programming”, *Proceedings of the 38th annual ACM symposium on Theory of computing*, 2006. With Jonathan A. Kelner

“Accelerated Gossip Algorithms for Distributed Computation” *44th Annual Allerton Conference on Communication, Control, and Computation*, 2006. With Ming Cao and Edmund Yeh

“Lower-Stretch Spanning Trees”, *Proceedings of the 37th Annual ACM Symposium on Theory of Computing*, 2005. With M. Elkin, Y. Emek, and S.-H. Teng.

“Nearly-Linear Time Algorithms for Graph Partitioning, Graph Sparsification, and Solving Linear Systems,” *Proceedings of the 36th Annual ACM Symposium on Theory of Computing*, pp. 81–90, 2004.

“Parallel Delaunay Refinement with Off-Centers” *10th International EURO-PAR Conference*, pp. 812–819, 2004. With S.-H. Teng and A. Ungor.

“Solving Sparse, Symmetric, Diagonally-Dominant Linear Systems in Time $O(m^{1.31})$,” *Proceedings of the 44th Annual IEEE Symposium on Foundations of Computer Science*, pp. 416–427, 2003. With S.-H. Teng.

“Exponential algorithmic speedup by a quantum walk,” *Proceedings of the 35th Annual ACM Symposium on Theory of Computing*, pp. 59–68, 2003. With A. M. Childs, R. Cleve, E. Deotto, E. Farhi and S. Gutmann.

“Parallel Delaunay Refinement: Algorithms and Analyses” *Proceedings of the 11th International Meshing Roundtable*, pp. 205–217, 2002. With S.-H. Teng and A. Ungor. Submitted to the *International Journal of Computational Geometry & Applications*.

“Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” *Proceedings of the 33rd Annual ACM Symposium on Theory of Computing*, pp. 296–305, 2001. With S.-H. Teng.

“Randomness Efficient Identity Testing of Multivariate Polynomials”, *Proceedings of the 33rd Annual ACM Symposium on Theory of Computing*, pp. 216–223, 2001. With A. R. Klivans.

“Finding Good LDPC Codes,” *Proceedings of the Thirty-Sixth Allerton Conference on Communications, Control, and Computing*, pp. 211–219, 1998.

“Analysis of Low Density Codes and Improved Designs Using Irregular Graphs” *Proceedings of the 30th Annual ACM Symposium on Theory of Computing*, pp. 249–258, 1998. With M. G. Luby, M. Mitzenmacher and M. A. Shokrollahi.

“Improved Low-Density Parity-Check Codes Using Irregular Graphs and Belief Propagation” *1998 IEEE International Symposium on Information Theory*, p. 117, 1998. With M. G. Luby, M. Mitzenmacher and M. A. Shokrollahi.

“Min-Max Boundary Domian Decomposition,” *Proceedings of The Fourth Annual International Computing and Combinatorics Conference*, 1998. With M. Kiwi and S.-H. Teng.

“Practical Loss-Resilient Codes” *Proceedings of the Twenty-Ninth Annual ACM Symposium on Theory of Computing*, pp. 150–159, 1997. With M. G. Luby, M. Mitzenmacher, M. A. Shokrollahi and V. Stemann.

“Highly Fault-Tolerant Parallel Computation,” in *Proceedings of the 35th Annual IEEE Symposium on Foundations of Computer Science*, pp. 154–163, 1996.

“Spectral Partitioning Works: Planar Graphs and Finite-Element Meshes,” *Proceedings of the 35th Annual IEEE Symposium on Foundations of Computer Science*, pp. 96–105, 1996. With S.-H. Teng.

“Faster Isomorphism Testing of Strongly Regular Graphs,” *Proceedings of the Twenty-eighth ACM Symposium on the Theory of Computing*, pp. 576-584, 1996.

“Disk Packings and Planar Separators,” *Proceedings of the 12th Annual ACM Symposium on Computational Geometry*, pp. 349-358, 1996. With S.-H. Teng.

“Linear-Time Encodable and Decodable Error-Correcting Codes,” *Proceedings of the Twenty-seventh ACM Symposium on the Theory of Computing*, 1995, pp. 388–397.

“Expander Codes,” *Proceedings of the 35th Annual IEEE Symposium on Foundations of Computer Science*, 1994, pp. 566-576. With M. Sipser.

“Nearly Linear-Size Holographic Proofs,” *Proceedings of the 26th Annual ACM Symposium on the Theory of Computing*, pp. 194-203, 1994. With A. Polishchuk.

“Fault Diagnosis in a Small Constant Number of Parallel Testing Rounds,” *Proceedings of the 5th Annual ACM Symposium on Parallel Algorithms and Architectures*, 1993. With R. Beigel and G. Margulis.

“The Power of Adaptiveness and Additional Queries in Random-Self-Reductions,” *Proceedings of the 7th Annual IEEE Conference on Structure in Complexity Theory*, 1992, pp. 338-346. With J. Feigenbaum, L. Fortnow and C. Lund.

“The Perceptron Strikes Back,” *Proceedings of the 6th Annual IEEE Conference on Structure in Complexity Theory*, 1991, pp. 286-291. With R. Beigel and N. Reingold.

“PP is closed under intersection,” *Proceedings of the 23rd Annual ACM Symposium on the Theory of Computing*, 1991, pp. 1-9. With R. Beigel and N. Reingold.

4. Other Major Publications

“Smoothed Analysis: Motivation and Discrete Models” *Proceedings of WADS 2003, Lecture Notes in Computer Science 2748*, pp. 256-270, 2003. With S.-H. Teng

“Smoothed Analysis of Algorithms”, *Proceedings of the International Congress of Mathematicians*, vol I, pp. 597-606, 2002. With S.-H. Teng

“Constructing Error-Correcting Codes from Expander Graphs,” in *Emerging Applications of Number Theory*, pp. 591-600, IMA volumes in mathematics and its applications, vol 109, 1999.

“The Complexity of Error-Correcting Codes,” in the *Proceedings of the 11th International Symposium on Fundamentals of Computation Theory*, Krakow, Poland, September 1997. Published as *Lecture Notes in Computer Science* no. 1279, pp. 67–84, 1997.

5. Technical Reports & Submitted for Publication

“Smoothed Analysis of the Renegar’s Condition Number for Linear Programming,” Submitted to *Mathematical Programming, Series A*. Available at <http://arxiv.org/abs/cs.DS/0302011>. With S.-H. Teng and J. Dunagan.

“The Minimum Distance of Turbo-Like Codes,” submitted to *IEEE Transactions on Information Theory*. With L. Bazzi and M. Mahdian.

7. Invited Talks

December 2006, “Nearly-Linear Time Algorithms for Solving Symmetric, Diagonally-Dominant Linear Systems”, Courant Institute, New York.

October 2006, “Nearly-Linear Time Algorithms for Graph Partitioning, Graph Sparsification, and Solving Symmetric, Diagonally-Dominant Linear Systems”, at Brown University Computer Science Dept.

July 2006, “Nearly linear time algorithms for solving symmetric, diagonally-dominant linear systems, and approximating Fiedler vectors for spectral partitioning,” invited talk at the SIAM Conference on Applied Linear Algebra, Germany.

June 2006, “Fast algorithms for graph partitioning, sparsifications, and solving SDD systems”, invited talk at the Workshop on Algorithms for Modern Massive Datasets, Stanford.

May 2006, “A Randomized Polynomial-Time Simplex Algorithm for Linear Programming”, invited talk at the Workshop: Complexity of Games, Polyhedra and Lattice Points, ETH Zurich.

April 2006, “Gary’s Algorithms for Graph Isomorphism”, Invited talk at the MillerFest 2006, a conference at CMU in honor of Gary Miller’s 60th birthday.

August 2005, “Smoothed Analysis of Algorithms”, Plenary talk at the 15th International Symposium on Fundamentals of Computation Theory, Luebeck, Germany.

June 2005, “Fast, randomized algorithms for partitioning, sparsification, and the solution of linear systems” Tutorial at the 11th Conference on Integer Programming and Combinatorial Optimization, Berlin, Germany.

April 2005, “Nearly-Linear Time Algorithms for Graph Partitioning, Graph Sparsification, and Solving SDD Linear Systems”, IBM Research—NYU—Columbia Theory Day Conference.

March 2005, “Nearly-Linear Time Algorithms for Graph Partitioning, Graph Sparsification, and Solving SDD Linear Systems”, Carnegie Mellon University University, Department of Computer Science.

February 2005, “Nearly-Linear Time Algorithms for Graph Partitioning, Graph Sparsification, and Solving SDD Linear Systems” 2005 SIAM Conference on Computational Science & Engineering

December 2004, “(Matching, Orthogonal, Basis) pursuit and the foundations of linear programming”, Workshop on Overcomplete Representations at the Eighteenth Annual Conference on Neural Information Processing Systems, Whistler, Canada.

February 2004, “Nearly-Linear Time Algorithms for Graph Partitioning, Graph Sparsification, and Solving SDD Linear Systems” 2004 SIAM Workshop on Combinatorial Scientific Computing.

August 2003, “Smoothed Analysis of Algorithms” Semi-plenary talk at the 18th International Symposium on Mathematical Programming, Copenhagen, Denmark.

August 2003, “Perturbation Models for Smoothed Analysis” Invited talk at the 2003 Workshop on Algorithms and Data Structures, Ottawa, Canada.

January 2003, “The Complexity of Communication Near Channel Capacity”, Yale University, Department of Electrical Engineering.

September 2002, “Smoothed Analysis of Algorithms” Invited talk at the International Workshop on Randomization and Approximation Techniques in Computer Science, Cambridge, Massachusetts.

August 2002, “Smoothed Analysis of Algorithms” Invited talk at the International Congress of Mathematicians, Beijing.

August 2002, “Smoothed analysis of growth factors of matrices under Gaussian Elimination” Workshop on Numerical Linear Algebra at the 2002 Conference on Foundations of Computational Mathematics.

January 2002, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” Workshop on Extremal Combinatorics, Forschungsinstitut fuer Mathematik, ETH Zurich.

November 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” Georgia Institute of Technology, Department of Computer Science

November 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” University of Washington, Department of Computer Science

October 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” Yale University, Department of Computer Science Colloquium

October 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” M.I.T. LIDS Colloquium.

August 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” I.B.M. Yorktown Heights, Operations Research Seminar

May 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” M.I.T. Applied Math Colloquium

April 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” M.I.T. Lab for Computer Science Theory Seminar

April 2001, “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” Microsoft Research

February 2001 “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” Institute for Advanced Study

February 2001 “Smoothed Analysis of Algorithms: Why The Simplex Algorithm Usually Takes Polynomial Time,” Princeton University, Department of Computer Science

February 1999, “Spectral Partitioning Works”, Princeton University, Department of Computer Science

June 1998, “Models of Computation in Coding Theory” Invited Survey at 13th Annual IEEE Conference on Computational Complexity

February 1998, “Analysis of Low-Density Codes from Irregular Graphs” 1998 IEEE Information Theory Workshop, San Diego, California.

September 1997, “The Complexity of Error-Correcting Codes” Plenary speaker at the 11th International Symposium on Fundamentals of Computation Theory, Krakow, Poland.

April 1997, “Spectral Partitioning Works”, University of Texas at Austin, Department of Computer Science

March 1997, “The Complexity of Coding”, Dartmouth University, Department of Computer Science

June 1996, “Spectral Partitioning Works”, University of Pennsylvania, Department of Computer Science

May 1996, “Spectral Partitioning Works”, Stanford University, Department of Computer Science

July 1996, “Linear-Time Encodable and Decodable Error-Correcting Codes,” Institute for Mathematics and its Applications

June 1996, “Linear-Time Encodable and Decodable Error-Correcting Codes,” 8th SIAM Conference on Discrete Mathematics

April 1996, “Linear-Time Encodable and Decodable Error-Correcting Codes,” California Institute of Technology, Department of Electrical Engineering

November 1995 “Disk Packings and Planar Separators” Randomized Algorithms and Computation Workshop, Berkeley, California.

September 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” Centre International de Recherches Mathématiques, France.

April 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” Princeton University, Department of Computer Science.

April 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” University of Pennsylvania, Department of Computer Science

March 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” Columbia University, Department of Computer Science

March 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” Carnegie Mellon University, Department of Computer Science

February 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” University of Minnesota, Department of Computer Science

January 1995, “Linear-Time Encodable and Decodable Error-Correcting Codes,” Weizmann Institute, Israel.

May 1994, “Expander Codes,” University of Chicago, Department of Computer Science

May 1994, “Nearly Linear-Size Holographic Proofs,” University of Chicago, Department of Computer Science

May 1994, “Nearly Linear-Size Holographic Proofs,” Boston University, Department of Computer Science

January 1994, “Nearly Linear-Size Holographic Proofs,” Weizmann Institute, Israel.

June 1993, “Fault Detection in 33 Parallel Rounds,” AT&T Bell Labs.

June 1991, “The Perceptron Strikes Back,” AT&T Bell Labs.

November 1990, “PP is Closed Under Intersection,” Carnegie Mellon University.