

Curriculum Vitae

B. David Saunders

Professor Emeritus
Department of Computer and Information Sciences
University of Delaware
Newark, DE 19716

Professional History

- 2017-present Professor Emeritus, Computer and Information Sciences Department, University of Delaware, Newark, Delaware
- 1984-2017 Professor, Computer and Information Sciences Department, University of Delaware, Newark, Delaware
- 2012, spring Professeur Invité, ENS Lyon, France
- 2011, fall Visiting Professor, University of Waterloo, Waterloo, Ontario, Canada
- 2005-2010 Chair, Computer and Information Sciences Department, University of Delaware
- 2005, spring Visiting Professor, Université Joseph Fourier, Grenoble, France
- 2001 Ontario Research Chair in Computer Algebra, U Waterloo and U Western Ontario, Canada (3 months)
- 1997 Guest Professor, Institute for Experimental Mathematics, Universität Essen, Germany (2 months)
- 1990-1991 Visiting Mathematics and Computer Science Department, Drexel University, Philadelphia, Pennsylvania
- 1988-1989 Acting Chair, Computer and Information Sciences Department, University of Delaware.
- 1975-1985 Professor (Assistant, Associate), Rensselaer Polytechnic Institute, Troy, New York
- 1976, summer Visiting Scientist, Mathematics Research Center, University of Wisconsin,
- 1974 Mathematisches Institut der Technischen Universität München, Germany
- 1975 Ph.D. in Mathematics, University of Wisconsin (Advisor: Hans Schneider)

Research interests

Symbolic and exact matrix computations. Building a library, LinBox, for solution of large sparse linear systems over finite fields and for solution of rational and Diophantine linear algebra problems. Algorithms, languages, and data structures for symbolic mathematical computation. Algebraic computation in parallel and distributed computing environments,

Research Publications

- [1] Gavin Harrison, Jeremy R. Johnson, and B. David Saunders. Probabilistic analysis of block wiedemann for leading invariant factors. *Journal of Symbolic Computation*, 108:98–116, 2022.
- [2] Robert M. Corless, Leili Rafiee Sevyeri, and B David Saunders. Equivalences for linearizations of matrix polynomials. In *Proceedings of the 2021 on International Symposium on Symbolic and Algebraic Computation*, ISSAC '21, page 107–114, New York, NY, USA, 2021. Association for Computing Machinery.
- [3] Robert M. Corless, Mark Giesbrecht, Leili Rafiee Sevyeri, and B. David Saunders. On parametric linear system solving. In *Computer Algebra in Scientific Computing: 22nd International Workshop, CASC 2020, Linz, Austria, September 14–18, 2020, Proceedings*, page 188–205, Berlin, Heidelberg, 2020. Springer-Verlag.
- [4] Gavin Harrison, Jeremy R. Johnson, and B. David Saunders. Probabilistic analysis of block wiedemann for leading invariant factors. *CoRR*, abs/1803.03864, 2018.
- [5] Matthew A. Lambert and B. David Saunders. Compiler auto-vectorization of matrix multiplication modulo small primes. In Jean-Charles Faugère, Michael B. Monagan, and Hans-Wolfgang Loidl, editors, *Proceedings of the International Workshop on Parallel Symbolic Computation, PASCOS@ISSAC 2017, Kaiserslautern, Germany, July 23-24, 2017*, pages 7:1–7:10. ACM, 2017.
- [6] A. Novocin, B. D. Saunders, A. Stachnik, and B. Youse. 3-ranks for strongly regular graphs. In J-G Dumas and E. Kaltofen, editors, *Proceedings of the 2015 International Workshop on Parallel Symbolic Computation PASCOS'15*, pages 101–108. ACM Press, 2015.
- [7] B. David Saunders. Matrices with two nonzero entries per row. In *Proc. 2015 Internat. Symp. Symbolic Algebraic Comput. ISSAC'15*, pages 323–330. ACM Press, 2015.
- [8] Gavin Harrison, Jeremy Johnson, and B. David Saunders. Probabilistic analysis of Wiedemann's algorithm for minimal polynomial computation. *Journal of Symbolic Computation*, 74:55–69, 2016. (available online June 12, 2015, final version online 20-NOV-2015, also arXiv:1412.5071 [cs.SC]).
- [9] Brice Boyer, Jean-Guillaume Dumas, Pascal Giorgi, Clément Pernet, and B. David Saunders. Elements of design for containers and solutions in the linbox library. *arXiv:1407.3262 [cs.MS]*, 2014.
- [10] Christopher Thorpe, Feng Li, Zijia Li, Zhan Yu, David Saunders, and Jingyi Yu. A co-prime blur scheme for data security in video surveillance. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 35(12):16–23, 2013. arXiv:1203.4874v1.
- [11] Mustafa ElSheik, Mark Giesbrecht, Andrew Novocin, and B. D. Saunders. Fast computation for Smith forms of sparse matrices over local rings. In *Proc. 2012 Internat. Symp. Symbolic Algebraic Comput. ISSAC'12*, pages 146–153. ACM Press, 2012.
- [12] Matthew Wezowicz, B. D. Saunders, and Michela Taufer. Dealing with performance/portability and performance/accuracy trade-offs in heterogeneous computing systems:

A case study with matrix multiplication modulo primes. In *Proceedings of the DSS11 SPIE Defense, Security, and Sensing Symposium - Modeling and Simulation for Defense Systems and Applications VI*, 2012.

- [13] B. D. Saunders, D. H. Wood, and B. Youse. Numeric-symbolic exact rational linear system solver. In *Proc. 2011 Internat. Symp. Symbolic Algebraic Comput. ISSAC'11*, pages 305–312. ACM Press, 2011.
- [14] E. Kaltofen, M. Nehring, and B. D. Saunders. Quadratic-time certificates in linear algebra. In *Proc. 2011 Internat. Symp. Symbolic Algebraic Comput. ISSAC'11*, pages 171–176. ACM Press, 2011.
- [15] Feng Li, B. D. Saunders, and Jingyi Yu. A theory of coprime blurred pairs. In *Proc. 2011 ICCV*, 2011.
- [16] J-G Dumas, T. Gautier, C. Pernet, and B. D. Saunders. Linbox founding scope allocation, parallel building blocks, and separate compilation. In K. Fukuda, J. vander Hoeven, M. Joswig, and N. Takayama, editors, *ICMS'10, Proceedings of the Third international congress conference on Mathematical software*, pages 77–83. Springer Verlag, LNCS 6327, 2010.
- [17] B. D. Saunders and B. Youse. Large matrix, small rank. In *Proc. 2009 Internat. Symp. Symbolic Algebraic Comput. ISSAC'09*, pages 317–324. ACM Press, 2009.
- [18] Jean-Guillaume Dumas, Clement Pernet, and B. D. Saunders. On finding multiplicities of characteristic polynomial factors of sparse matrices. In *Proc. 2009 Internat. Symp. Symbolic Algebraic Comput. ISSAC'09*, pages 135–142. ACM Press, 2009.
- [19] J. P. May, B. D. Saunders, and Z. Wan. Efficient matrix rank computation with application to the study of strongly regular graphs. In *Proc. 2007 Internat. Symp. Symbolic Algebraic Comput. ISSAC'07*, pages 277–284. ACM Press, 2007.
- [20] B. W. Char, B. D. Saunders, and B. Youse. Linbox and future high performance computer algebra. In *Internat. Symp. Parallel Symbolic Comput. PASCO*, pages 102–103. ACM Press, 2007.
- [21] J. P. May, B. D. Saunders, and D. H. Wood. Numerical techniques for computing the inertia of products of matrices of rational numbers. In *SNC'07*, pages 125–132. ACM Press, 2007.
- [22] J. Adams, B. D. Saunders, and Z. Wan. Signature of symmetric rational matrices and the unitary dual of lie groups. In *Proc. 2005 Internat. Symp. Symbolic Algebraic Comput. ISSAC'05*, pages 13–20. ACM Press, 2005.
- [23] B. D. Saunders and Z. Wan. Smith normal form of dense integer matrices, fast algorithms into practice. In *Proc. 2004 Internat. Symp. Symbolic Algebraic Comput. ISSAC'04*, pages 274–281. ACM Press, 2004.
- [24] B. D. Saunders, A. Storjohann, and G. Villard. Matrix rank certification. *Electronic J. of Linear Algebra*, 11:16–23, 2004.
- [25] J-G Dumas, F. Heckenbach, D. Saunders, and V. Welker. Computing simplicial homology based on efficient Smith normal form algorithms. In M. Joswig and N. Takayama, editors, *Algebra, Geometry, and Software Systems*, pages 177–206. Springer Verlag, 2003.

- [26] A. Duran, B. D. Saunders, and Z. Wan. Rank of sparse (1,0,-1)-matrices. In *Proceeding of the SIAM International Conference on Applied Linear Algebra*. online at www.siam.org/meetings/la03/proceedings, 2003.
- [27] E. Kaltofen and B. D. Saunders. Linear systems. In J. Grabmeier, E. Kaltofen, and V. Weispfenning, editors, *Computer Algebra Handbook*, pages 36–38. Springer Verlag, 2003.
- [28] Dumas, Gautier, Giesbrecht, Giorgi, Hovinen, Kaltofen, Saunders, Turner, and Villard. Linbox: A generic library for exact linear algebra. In A. Cohen, X-S Gao, and N. Takayama, editors, *Mathematical Software: ICMS 2002 (Proceedings of the first International Congress of Mathematical Software)*, pages 40–50. World Scientific, 2002.
- [29] L. Chen, W. Eberly, E. Kaltofen, W. J. Turner, B. D. Saunders, and G. Villard. Efficient matrix preconditioners for black box linear algebra. *Linear Algebra and Applications*, 343-344:119–146, 2002.
- [30] B. D. Saunders. Black box methods for least squares problems. In *Proc. 2001 Internat. Symp. Symbolic Algebraic Comput. ISSAC'01*, pages 297–302. ACM Press, 2001.
- [31] J-G. Dumas, B. D. Saunders, and G. Villard. On efficient sparse integer matrix Smith normal form computations. *J. Symbolic Comput.*, 32:71–99, 2001.
- [32] J-G. Dumas, B. D. Saunders, and G. Villard. Integer Smith form via the valence: Experience with large sparse matrices from homology. In *Proc. 2000 Internat. Symp. Symbolic Algebraic Comput. ISSAC'00*, pages 95–105. ACM Press, 2000.
- [33] Giesbrecht, A. Lobo, and B. D. Saunders. Certifying inconsistency of sparse linear systems. In *Proc. 1998 Internat. Symp. Symbolic Algebraic Comput. ISSAC'98*, pages 113–119. ACM Press, 1998.
- [34] Lakshman Y. N. and B. D. Saunders. On computing sparse shifts for univariate polynomials. *J. of Applic. Algebra Engin. Commun. Comput.*, 7,5:351–364, 1996.
- [35] Lakshman Y. N. and B. D. Saunders. Sparse polynomial interpolation in non-standard bases. *SIAM J. Comput.*, 24(2):387–397, 1995.
- [36] H. R. Lee and B. D. Saunders. Fraction free gaussian elimination for sparse matrices. *J. Symbolic Comput.*, 19:393–402, 1995.
- [37] B. Char, J. Johnson, B. D. Saunders, and A. Wack. Some experiments with parallel bignum arithmetic. In *Internat. Symp. Parallel Symbolic Comput. PASC0*, pages 94–103. World Scientific, 1994.
- [38] Lakshman Y. N. and B. D. Saunders. A note on computing sparse shifts for univariate polynomials. In *Proc. 1994 Internat. Symp. Symbolic Algebraic Comput. ISSAC'94*, pages 108–113, 1994.
- [39] E. Kaltofen and B. D. Saunders. On Wiedemann’s method of solving sparse linear systems. In H. F. Mattson, T. Mora, and T. R. N. Rao, editors, *Proc. Applic. Algebra Engin. Commun. Comput. AA ECC-9*, volume 539 of *Lect. Notes Comput. Sci.*, pages 29–38, Heidelberg, Germany, 1991. Springer Verlag.

- [40] E. Kaltofen, M. S. Krishnamoorthy, and B. D. Saunders. Parallel algorithms for matrix normal forms. *Linear Algebra and Applications*, 136:189–208, 1990.
- [41] B. D. Saunders, H. R. Lee, and S. K. Abdali. A parallel implementation of the cylindrical algebraic decomposition algorithm. In *The 1989 International Symposium on Symbolic and Algebraic Computation*, pages 298–307. ACM Press, 1989.
- [42] E. Kaltofen, M. S. Krishnamoorthy, and B. D. Saunders. Mr. Smith goes to Las Vegas: Randomized parallel computation of the Smith normal form of polynomial matrices. In J. H. Davenport, editor, *Proc. EUROCAL '87*, volume 378 of *Lect. Notes Comput. Sci.*, pages 317–322, Heidelberg, Germany, 1989. Springer Verlag. Journal version in [40].
- [43] E. Kaltofen, M. S. Krishnamoorthy, and B. D. Saunders. Fast parallel computation of Hermite and Smith forms of polynomial matrices. *SIAM J. Alg. Discrete Math.*, 8:683–690, 1987.
- [44] E. Kaltofen, M. S. Krishnamoorthy, and B. D. Saunders. Fast parallel algorithms for similarity of matrices. In B. W. Char, editor, *Proc. 1986 ACM Symp. Symbolic and Algebraic Comput.*, pages 65–70, New York, N. Y., 1986. ACM. Journal version in [43] and [40].
- [45] S. K. Abdali and B. D. Saunders. Transitive closure and related semiring properties via eliminants. *Theoretical Computer Science*, 40:257–274, 1985.
- [46] B.F. Caviness, B. D. Saunders, and M.F. Singer. An extension of Liouville’s theorem on integration in finite terms. *SIAM J. Comput.*, 14:966–990, 1985.
- [47] A. Kandri Rody and B. D. Saunders. Primality of ideals in polynomial rings. In *Proc. 1984 MACSYMA Users Conference*, pages 459–471, 1984.
- [48] S. Agnarsson, A. Kandri Rody, D. Kapur, P. Narendran, and B. D. Saunders. Complexity of testing whether a polynomial ideal is nontrivial. In *Proc. 1984 MACSYMA Users Conference*, pages 452–458, 1984.
- [49] N. Glinos and B. D. Saunders. Operational calculus techniques for solving differential equations. In *EUROSAM '84*, pages 23–34, 1984.
- [50] E. Kaltofen, D. R. Musser, and B. D. Saunders. A generalized class of polynomials that are hard to factor. *SIAM J. Comput.*, 12(3):473–485, 1983.
- [51] E. Kaltofen, D. R. Musser, and B. D. Saunders. A generalized class of polynomials that are hard to factor, extended abstract. In *Proc. 1981 ACM Symp. Symbolic and Algebraic Comput.*, pages 188–194. ACM, 1981. Journal version in [50].
- [52] A. Berman and B. D. Saunders. Matrices with zero-line-sums and maximal rank. *Linear Algebra and Applications*, 40:229–235, 1981.
- [53] B.F. Caviness, B. D. Saunders, and M.F. Singer. An extension of Liouville’s theorem on integration in finite terms (extended abstract). In *Proc. 1981 ACM Symp. Symbolic and Algebraic Comput.*, pages 23–24, 1981. Journal version in [46].
- [54] B. D. Saunders. An implementation of Kovacic’s algorithm for solving second order linear homogeneous differential equations. In *Proc. 1981 ACM Symp. Symbolic and Algebraic Comput.*, pages 105–108. ACM, 1981.

- [55] B. D. Saunders and Hans Schneider. Applications of the Gordan-Stiemke theorem in combinatorial matrix theory. *SIAM Review*, 21:528–541, 1979.
- [56] B. D. Saunders and Hans Schneider. Cones, graphs and optimal scalings of matrices. *Linear and Multilinear Algebra*, 8:121–135, 1979.
- [57] B. D. Saunders and Hans Schneider. Flows on graphs applied to diagonal similarity and diagonal equivalence for matrices. *Discrete Mathematics*, 24:205–220, 1978.
- [58] B. E. Cain, B. D. Saunders, and Hans Schneider. On the geometry of dual pairs. *Studies in Appl. Math.*, 56:71–79, 1977.
- [59] B. D. Saunders. A condition for the convexity of the norm-numerical range of a matrix. *Linear Algebra and Applications*, 16:167–175, 1977.
- [60] B. D. Saunders and Hans Schneider. A symmetric numerical range for matrices. *Numerische Math.*, 26:99–105, 1976.

Posters, Papers in Conferences without Proceedings, and Technical Reports

59. G. Harrison, J. Johnson, and B.D. Saunders, “Probabilistic analysis of Block Wiedemann for Leading Invariant Factors”, Poster at ISSAC’16, July 19-22, 2016, Waterloo Ontario. Abstract in ACM Communications in Computer Algebra, volume 50, number 4, pages 173-175.
60. B. Youse and B. D. Saunders, “Computing the Rank of a Huge Matrix over GF(3)”. Poster at ECCAD’13, April 2013, Naval Academy, MD.
61. B. Youse and B. D. Saunders, “Poster abstract: Numeric/symbolic exact rational linear system solver”. In M. Kauers and I. Kotsireas, editors, ACM Communications in Computer Algebra, volume 45, 2011, page 104.
62. B. Youse and B. D. Saunders, “Poster abstract: Bitslicing with matrix algorithms oblivious to the data compression”. In M. Kauers and I. Kotsireas, editors, ACM Communications in Computer Algebra, volume 44, 2010.
63. Z. Wan and B. D. Saunders, “Tighter Probability Bounds for Randomized Linear Algebra Algorithms”, East Coast Computer Algebra Day, Wilfrid Laurier U., Waterloo, ON, May 8, 2004.
64. A. Lobo, D. Saunders, and Z. Wan, “Rank and Smith form of extremely sparse matrices”, International Conference on Applications of Computer Algebra, NC State, Raleigh, NC, July 28-31, 2003.
65. Z. Wan and D. Saunders, “Exact solution to large sparse integer linear systems”, East Coast Computer Algebra Day, Brooklyn, NY, 2002.
66. A. Duran and D. Saunders, “GenBLAS: Basic Linear Algebra Subroutines in C++ over Any Fields”, <http://www.lagcc.cuny.edu/Mathematics/ECCAD2002/duran.pdf>, East Coast Computer Algebra Day, Brooklyn, NY, 2002.
67. M. W. Giesbrecht and B. D. Saunders, “Solving parametric linear systems” Paper presented at The Seventh Conference of the International Linear Algebra Society (ILAS ’98), Madison, June 3-6, 1998.
68. M. W. Giesbrecht and B. D. Saunders, “Parametric Linear Systems, the bivariate case,” Poster presentation, The 1997 International Symposium on Symbolic and Algebraic Computation, (ISSAC ’97), Maui, July 21-23, 1997.
69. M. W. Giesbrecht, B. D. Saunders, and A. Lobo, “A fast certificate of inconsistency for large sparse linear systems” Poster presentation, The 1997 International Symposium on Symbolic and Algebraic Computation, (ISSAC ’97), Maui, July 21-23, 1997.
70. “Parameter $\langle \rangle$ Indeterminate,” Poster presentation, East Coast Computer Algebra Day (ECCAD ’97), Boston, May 3, 1997.

71. Lakshman Y. N. and B. D. Saunders, "Sparse Polynomial Interpolation in Non-standard Bases". U. of Delaware Department of Computer and Information Sciences Technical Report CIS TR 93-11 (superceded by subsequent publication).
72. "Distributed Computation of Minor Expansions", with B. M. Char and R.H. Shtokhamer. Drexel Department of Mathematics and Computer Science Technical Report MCS-91-2.
73. "On Scheduling Algebraic Algorithms for Parallel Execution," with Hong R. Lee and Ruth Shtokhamer, U. of Delaware Department of Computer and Information Sciences Technical Report CIS TR-9015.
74. B. D. Saunders, Hong R. Lee, and S. Kamal Abdali, "A Parallel Implementation of the Cylindrical Algebraic Decomposition Algorithm," U. of Delaware Center for Mathematical Computation Technical Report CMC-8901 (superceded by subsequent publication).
75. B. D. Saunders, "Matrix Computations in Computer Algebra Systems," U. of Delaware Center for Mathematical Computation Technical Report CMC-8808.
76. E. Kaltofen, M. Krishnamoorthy, and B. D. Saunders, "Randomized Parallel Computation of the Smith Normal Form of Polynomial Matrices," U. of Delaware Center for Mathematical Computation Technical Report CMC-8702 (superceded by subsequent publication in *EURO-CAL '87*).
77. A. Kandri Rody and B. D. Saunders, "Primality of Ideals in Polynomial Rings," *Proceedings of the 1984 MACSYMA Users Conference*, 1984, 459-471.
78. S. Agnarsson, A. Kandri Rody, D. Kapur, P. Narendran, and B. D. Saunders, "Complexity of Testing Whether a Polynomial Ideal is Nontrivial," *Proceedings of the 1984 MACSYMA Users Conference*, 1984, 452-458.

Research Grants

NSF Grant CCF-1018063 "AF: Small: Collaborative Research: High Performance Exact Linear Algebra Kernels," PI: Saunders, Co-PI David Wood, \$227,230, 15Aug2010 to 31July2014. Collaboration with NSF grants 1019966, George Yuhasz, Morehouse College, and 1016728, Jeremy R. Johnson, Drexel University.

"CITADel - CyberInfrastructure Technology Advancement for Delaware," NSF ARI Grant OIA-0963399, PI: Saunders, Co-PIs: Barner, Sacher, Steiner, Initial PI: Swany, \$1,354,827.00 1Oct2010 to 30Sept2012.

"Symbolic-Numeric Linear Algebra Computation," NSF Grant CCF-0830130, PI: Saunders, Co-PI Wood, \$149,999, 1Sept2008 to 31Aug2011.

NSF Grant CCF-0515197, REU supplements, \$6,500, 1Jun2007 to 30Sep2008 (summer of 07: funds Matthew Fendt),

\$6,500, 1Jun2008 to 30Sep2009 (summer of 08: funds Matthew Fendt).

“DefCOM - Distributed Defense against DDoS Attacks” NSF CCF Grant, PI: Saunders (substitute for Mirkovic) \$179,130, 1Sep2005 to 28Feb2009.

“Integer Linear Algebra, LinBox Applications and Extensions,” NSF Grant CCF-0515197, PI: Saunders, \$259,998, 1Aug2005 to 31Jul2008.

NSF Grant CCR-0112807, REU supplements, PI: Saunders, \$6,000, 1Jun2003 to 31Jun2004 (summer of 03: funds 1 undergrad assistants),
\$6,000, 1Jun2004 to 31Jun2005 (summer of 04: funds S&E Scholar Daniel Roche),
\$5,500, 1Jun2005 to 30Sep2006 (summer of 05: funds Daniel Roche),
\$5,500, 1Jun2006 to 30Sep2007 (summer of 06: funds Bryan Youse).
\$7,500, 1Jun2010 to 30Sep2012 (summer of 11: funds Matthew Wezowicz).
\$6,500, 1Jun20013 to 30Sep2014 (summer of 13: funds Alex Stachnik).

“ITR/ACS: Collaborative Research - Linbox: A generic Library for Black Box Linear Algebra,” NSF Grant CCR-0112807, (paired with proposals from NCSU, WashColl), PI: Saunders, Co-PI's: Caviness, Xiang, \$170,200, 15Jul2001 to 30Jun2004.

NSF Grant CCR-0098284, REU supplement PI: Saunders \$5,500, 1Feb2002 to 31July2004 (Summer of 02: funds 1 undergrad assistants)

“Exact Computation in Sparse Linear Algebra,” NSF Grant CCR-0098284 CISE CCR Numeric, Symbolic and Geometric Computation Program, PI: Saunders \$254,993, 15Aug2001 to 31Jul2004

“Theory and Practice of Parallel Linear Algebra in Computer Algebra,” E. L. Kaltofen, A. W. Lobo, and B. D. Saunders, (paired with CNRS grant of Villard and Roch) Grant INT-9726763 of the NSF Western Europe Program, \$17,500, 1Apr98 to 31Mar01.

NSF Grant CCR-9712362, REU supplement, PI: Saunders \$10,500, 1June2001 to 31Aug2002 (Summer of 01: funds 2 undergrad assistants)

“Symbolic Linear Algebra Computations,” Grant CCR-9712362 of the NSF Numeric, Symbolic and Geometric Computation Program. \$180,885, 1Sept97 to 31Aug02.

“Acquisition of an Avalon-Beowulf Cluster and Development of Discipline Specific Parallel Research Tools” B.D. Saunders is a Co-investigator. Principal Investigator is William H. Matthaeus, Bartol Research Institute. NSF/MRI Grant ATM9977692, \$1,151,159, start date 10/1/99.

“Parallel and Distributed Computing: Systems and Application Development Infrastructure,” NSF Computing Systems, \$643,513, 7/1/97 to 6/30/98, Infrastructure grant to purchase high performance cluster, B.D. Saunders is an Affiliated Investigator. Prin-

Principal Investigators are S. Carberry, G. Gao, E. Lloyd, L. Pollock.

“East Coast Computer Algebra Day,” B. F. Caviness and B. D. Saunders, NSF CCR-9505363 \$9900, 1/95 to 12/95.

“Systems and Algorithms for Parallel and Distributed Symbolic Algebraic Computation,” B. D. Saunders, (paired with contract of Char and Johnson at Drexel), NSF CCR-9123666. \$221,228 for 3 years, 8/92 to 1/96.

Navy-ASEE Summer Faculty Research Program, \$12,000, 1990.

Navy-ASEE Summer Faculty Research Program, \$10,000, 1989.

“Parallel Scheduling of a Non Procedural Specification,” B. D. Saunders, substitute PI replacing Maya Gokhale, NSF grant CCR-8614219, 8/1987 to 1/1990.

“A Proposal for Computer Research Equipment,” (to purchase shared memory parallel computer) M. Gokhale and B. D. Saunders, NSF CISE Instrumentation program, grant CDA-8805353, \$99,730, 8/1988 to 1/1990.

“Algorithms and Systems for Symbolic and Algebraic Computation,” B. D. Saunders of UDel, E. L. Kaltofen and M. Krishnamoorthy of RPI, R. D. Jenks and B. M. Trager of IBM T. J. Watson Research Center, and D. Y. Y. Yun of SMU, sponsored by NSF Program on Industry/University Cooperation, \$54,984(UDel portion), 1986 to 1987.

“Algorithms and Systems for Symbolic and Algebraic Computation,” M. Krishnamoorthy and B. D. Saunders of RPI, R. D. Jenks and B. M. Trager of IBM T. J. Watson Research Center, and D. Y. Y. Yun of SMU, sponsored by NSF Program on Industry/University Cooperation, \$250,631(RPI portion), 1983 to 1985.

“Algorithms and Systems for Symbolic and Algebraic Computation,” B. F. Caviness and B. D. Saunders of RPI, R. D. Jenks and D. Y. Y. Yun of IBM T. J. Watson Research Center, sponsored by NSF Program on Industry/University Cooperation. \$239,389, 1979 to 1982.

“Research in Applied Mathematics and Numerical Analysis,” G. J. Habetler, E. H. Rogers, and B. D. Saunders, NSF sponsored, \$53,689, 1976 to 1978.

Prize

Computer Algebra Nederland Foundation prize (1000 Euros) awarded June 2002 to Carl Devore and David Saunders for *Matrix of Rational Functions Rank Algorithms Analysis*.

Misc. Professional Activities

Program Committee, ISSAC'15, Bath, England, 2015.

Tutorials Chair, ISSAC'13, Boston, MA, June, 2013.

Program Committee, PASCO'10, Grenoble, France, July, 2010.

Program Committee, ECCAD'08, Shepardsstown WV, May 2008.

Program Committee, PASCO'07, London, Ontario, July, 2007.

Program Chair, ISSAC'06, Genoa, Italy, July, 2006.

Associate Editor, Journal of Symbolic Computation, 1998-2004.

SIGSAM Treasurer, term 7/1999 to 6/2003. SIGSAM is the ACM special interest group on Symbolic and Algebraic Manipulation.

ISSAC Steering Committee, 1997-2000. Purpose is to provide stability and experience in the running of the annual International Symposium on Symbolic and Algebraic Computation meetings.

Program Committee, ACA'03, Raleigh, July, 2003.

Organizing Committee, ISSAC'03, Philadelphia, July, 2003.

NSF CCR Numeric, Symbolic, & Geometric Computing program panelist Symbolic Computing program panelist, December 15, 1997. Research Initiation Award panelist, April 2, 1991.

Conference Chair, "East Coast Computer Algebra Day (ECCAD '95)," University of Delaware, April 8, 1995. Approximately 95 attendees, approximately 40 presentations (talks, posters, demos). NSF funded.
(and on Organizing Committee 1996, 1998).

Program Committee, First International Symposium on Parallel Symbolic Computation (PASCO'94), Linz, Austria, September 1994.

Program Committee, ISSAC'90, Tokyo, Japan, Aug 1990.

Organized "Minisymposium on Exact Computation in Linear Algebra" at the Second Siam Conference on Applied Linear Algebra at Raleigh, North Carolina, April 29-May 2, 1985.

Organized "Special Session on Symbolic Mathematical Manipulation on the Computer" at the American Mathematical Society Summer Meeting, Ann Arbor, Michigan, August 19-21, 1980 (15 speakers).

National Research Council Graduate Fellowship Evaluation Panelist (Applications of Mathematics), February, 1980, February, 1981, and February, 1982 (chairman).

SIGSAM Bulletin Editor, 1980 to 1983. SIGSAM is the Special Interest Group on Symbolic and Algebraic Manipulation of the Association for Computing Machinery.

Invited Talks

“A brief history of matrix preconditioners in exact linear algebra”, MICA’16, Milestones in Computer Algebra, University of Waterloo, July 16–18, 2016.

“Certificates and probabilistic verification”, Laboratoire Jean Kuntzmann, Mathématiques Appliquées et Informatique, Université Joseph Fourier, Grenoble, June 14, 2012.

“Exact Linear Algebra in LinBox”, Laboratoire de l’Informatique du Parallélisme, ENS de Lyon, Lyon, May 10, 2012.

“LinBox status report”, David Cheriton School of Computer Science, University of Waterloo, Waterloo, Ontario, Sept 16, 2011.

“Exact Linear Algebra”, ECCAD ’10, East Coast Computer Algebra Day, Atlanta, May 15, 2010 (one of three invited speakers).

“Computation of rank and Smith normal form”, BIRS (Banff International Research Station) workshop 09w5071, Invariants of Incidence Matrices, March 31, 2009.

“Linear Algebra Modulo Tiny Primes”, ACA’09, Applications of Computer Algebra, High Performance Computer Algebra Session, Montreal, June 24, 2009.

“On matrix rank modulo small primes”, AMS Special Session on Sage and Mathematical Research Using Open Source Software, Washington, DC, January 8, 2009.

“Linear Algebra”, MICA’08, Milestones in Computer Algebra, Stonehaven Bay, Tobago, May 1-3, 2008.

“The case for exact linear algebra computation”, NSF CDI workshop, Arlington, VA, Oct 30-21, 2007

“Symbolic mathematical computation, evolution or revolution?”, 2007-2008 USNA Midshipman-Faculty Colloquium, Naval Academy, Annapolis, MD, Sep 24, 2007.

“The case for exact linear algebra computation”, U. of Delaware Mathematics Department Colloquium, December 1, 2006.

“A hybrid algorithm for the inertia of a symmetric rational matrix” Atlas of Lie Groups and Representations Workshop, American Institute of Mathematics, Palo Alto, California, July 29, 2005.

“Engineered hybrid algorithms for exact linear algebra”, Seminar, Laboratoire de Modélisation et Calcul, Grenoble, France, June 16, 2005.

“A brief history of exact linear algebra”, Applied Mathematics Colloquium, U. Joseph Fourier, Grenoble, France, June 9, 2005.

“Engineered algorithms in Linear Algebra”, Ontario Research Center for Computer Algebra, U. Waterloo, Canada, November 12, 2004. Again at Computer Algebra Seminar, North Carolina State University, February, 2005.

Banquet speaker, ISSAC'01, London, Ontario, July 24, 2001.

Commencement address, Department of Computer Science graduation ceremony, May 28, 1999.

“On solving parametric linear systems”, Department of Applied Mathematics, University of Western Ontario, February 23, 1999.

Department of Computer Science, ETH, Zurich, May 25, 1998.

Universitaet Tuebingen, Fakultae fuer Informatik, Tuebingen, May 20, 1998.

Applied Math Seminar, U.S. Naval Academy Department of Mathematics, Annapolis, April 21, 1998.

“Approximately solving sparse linear systems precisely,” Kolloquium des Graduiertenkollegs, Institute for Experimental Mathematics, Essen Universität, June 24, 1997.

Six lecture series on algorithms for the computation of Smith Normal Forms and related topics, Institute for Experimental Mathematics, Essen, Germany, June-July 1997.

“Parametric Linear Systems, the Univariate Case,” 6th Conference of the International Linear Algebra Society, Chemnitz, Germany, August 15, 1996.

“Interconnections between Maple and other Languages,” Maple Retreat, Sparrow Lake, Ontario, June 15 1992.

“The Lee/Saunders sparse matrix version of Bareiss’ algorithm,” Maple Retreat, Sparrow Lake, Ontario, June 17, 1992.

Invited conference talk: “Fast elimination for sparse integral matrices”, Computational Linear Algebra in Algebraic and Related Problems, Essen, Germany, July 27 - Aug 1, 1992.

“Determinants of Polynomial Matrices: exploiting sparsity, pattern, parallelism,” Rensselaer Polytechnic Institute, January 9, 1992

“Towards a more realistic abstract model of parallel computation,” Drexel University, October 9, 1991.

“Adaptive Parallel Algebraic Computation Systems,” Drexel University, April 12, 1990.

“Probabilistic Algebraic Algorithms, How Much Randomness?” CAP '90 (Computer Algebra and Parallelism Workshop), Cornell University, May 1990.

“Parallel Algebraic Computation, Experiences on a Shared Memory Machine,” Supercomputer Research Center (NSA), Bowie, MD, June 23, 1989.

“The Inverse Eigenvalue Problem for Real Symmetric Toeplitz Matrices: Consistency Conditions for the Eigenvectors,” with David Wood (presenter), Third SIAM Conference

on Applied Linear Algebra, Madison WI, May 24, 1988.

“Extremely fast computation of matrix canonical forms,” Van Vleck Hall 25th Anniversary Celebration, U. of Wisconsin, May 21, 1988.

“How fast can we compute,” Invited Colloquium, Swarthmore College, Feb. 11, 1988.

“Randomized Parallel Computation of the Smith Normal Form,” EUROCAL '87, Leipzig, DDR, June, 1987.

“Matrix Methods in Computer Algebra,” Invited Talk, Computers & Mathematics Conference, Stanford, Aug., 1986.

“Fast Parallel Algorithms for Similarity of Matrices,” SYMSAC '86, Waterloo, Ontario, July, 1986.

“Matrix Computations: External vs. Internal Approaches,” Computer Science Colloquium, RPI, Troy, NY, May 9, 1986.

Students

Abdelilah Kandri-Rody, *Effective Methods in the Theory of Polynomial Ideals*, RPI 1984.

Nikolaos Glinos, *Operational Calculus Methods for the Closed Form Solution of Ordinary Differential Equations*, RPI 1985.

Todd C. Torgersen, *Algebraic Techniques for Automatic Detection of Parallelism*, UDel 1989 (coadvisor - Maya Gokhale).

Andrew P. Wack, *Partitioning Dependency Graphs for Concurrent Execution: A parallel spreadsheet on a realistically modeled message passing environment*, UDel 1995.

Zhengdong Wan, *Computing the Smith Forms of Integer Matrices and Solving Related Problems*, UDel 2005.

Bryan Youse, *High Performance Exact Linear Algebra*, UDel 2015.

Matthew Lambert, *Analysis of High Performance Sparse Matrix-vector Multiplication for Small Finite Fields*, Udel 2020.

Lab Participants: Bruce Char (visiting professor, Feb, Mar 2007), Jeremy Johnson (visiting professor, Spring, 2015), Matthew Lambert (current PhD student), John May (postdoc 2006/7), Andy Novocin (2014-present), Matthew Wezowitz (REU undergrad cosupervised with Taufer 2011/12) David Wood (senior collaborator)

PhD Committee memberships include of: Wei(UD), Riu(UD), Hixley(UD), Laskov(UD), Zoppetti(UD), Way(UD), Mellinger(UD Math), Capursi(UD Math), Dumas (Grenoble), Turner (NCSU), Chen(Waterloo), Meng(Drexel), Harrison(Drexel, current), Brice

Boyer (2012, Grenoble, “rapporteur”, student of Dumas), Fan Wu (UD Math, ongoing, student of Xiang).

Habilitation committee (rapporteur) of Gilles Villard (Lyon).

REU supported Undergraduate research assistants: Richard Seagraves, Bradford Hovinen, Erich Schrag, Peter Steijn, Daniel Roche, Frank Bellamy, Bryan Youse, Matthew Fendt, Nicholas Messina, Matthew Wezowitz, Andrew Stachnik (also mentored in Google summer of code).

Courses Taught

Courses at University of Delaware include:

CISC 106 Introduction to CS for Engineers (Fortran),
CISC 170 Introduction to CS (Modula-2),
CISC 181 Introduction to Computer Science II (C++),
CISC 220 Data Structures (C++, using STL),
CISC 267 Rapid Prototyping,
CISC 280 Program Development Techniques(Scheme),
CISC 320 Algorithms and Advanced Programming,
CISC 372 Parallel Programming,
CISC 441 Heuristic Programming,
CISC 475 Object Oriented Software Engineering,
CISC 440/640 Computer Graphics,
CISC 449/649 Parallel Computation for Applications,
CISC 603 Program Validation,
CISC 621 Algorithm Design and Analysis,
CISC 821 Algebraic Algorithms I,
CISC 822 Algebraic Algorithms, polynomials and matrices,
CISC 829 Parallel Algebraic Computation,
CISC 829 Exact Matrix Computation,
CISC 849 Parallel Processing (with D. Nassimi),
CISC 829 Parallel Complexity Theory

Courses at Rensselaer Polytechnic Institute include:

Algebra (graduate & undergraduate, linear & abstract), Point Set Topology (graduate & undergraduate), Problem solving seminar - culminating in Putnam Exam. Calculus, Advanced programming, Systems programming (operating systems), Programming Languages, Data Structures, Intro to Computer Science (Pascal/Fortran).