

# RESUME OF JESSE L. BARLOW

## PRESENT POSITION

Professor of Computer Science and Engineering  
The Pennsylvania State University  
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## EDUCATION

- 1977 B.A., (Computer Science and Mathematics), The University of Kansas, with distinction, departmental honors in both departments.
- 1979 M.S., (Computer Science), Northwestern University.
- 1980 M.S., (Statistics), Northwestern University.
- 1981 Ph.D., (Computer Science), Northwestern University.

Born: July 8, 1955, Lawrence, Kansas, U.S. citizen.

## EXPERIENCE

- Northwestern University. Instructor in Computer Science, March– June 1981.
- Northwestern University. Post–Doctoral Fellow in Computer Science, Summer 1981.
- The Pennsylvania State University. Professor of Computer Science and Engineering, since 1992. Assistant Professor, 1981–87, Associate Professor, 1987–92.
- Oak Ridge National Laboratory. Visiting Scientist, Mathematical Sciences Section, Summer 1986, 1987, 1988, 1989, 1990, 1992.
- New York University. Courant Institute of Mathematical Sciences, Visiting Associate Professor of Computer Science, August–December 1988.
- University of Naples, Italy, Department of Applied Mathematics, Visiting Scholar, May–June 1991.

- University of Minnesota, Institution for Mathematics and Its Applications, Senior Member, January -February 1992.
- University of Manchester, United Kingdom, Department of Mathematics, Visiting Faculty, January -June 1996.
- University of Linköping, Sweden, Department of Mathematics, Visiting Faculty, July-August 1996.
- City University of New York, Graduate Center, Visiting Professor, July 2002- January 2003.
- University of California at Berkeley, Department of Computer Science, Visiting Professor, August-December 2012.

## HONORS AND AWARDS

- Phi Beta Kappa
- Leslie Fox Prize, 1986; Paper presented Imperial College, London Title: On the Smallest Positive Singular Value of a Singular M-matrix with Applications to Ergodic Markov Chains (Second Prize)
- Second Place, SIAG Linear Algebra Prize, 1991. (with J.W. Demmel) Title: "Computing Accurate Eigensystems of Scaled Diagonally Dominant Matrices," SIAM J. Num. Anal.,27(3),pp.762–791, (June 1990).

## INVITED LECTURES

Invited lectures about over 50 institutions in nine countries including

Stanford–MIT–Cornell–Yale–NYU(Courant Institute)–Oxford(UK)– Cambridge(UK)  
 Rutherford Appleton Laboratory(UK)– Consiglio Nazionale delle Recherche(Rome,Italy)  
 Academia Sinica (Beijing,China)– Peking U. (China)  
 Lawrence Livermore National Laboratory – Oak Ridge National Laboratory  
 Lawrence Berkeley National Laboratory – Argonne National Laboratory.  
 U. Hong Kong (China), Case Western Reserve University  
 Purdue, U. Kansas, Northwestern  
 Fifth SERC Summer School in Numerical Analysis. July 20–24, 1992.  
 University of Lancaster, England, Series of five lectures titled  
 "Parallel solution of eigenvalue and singular value problems".

## RESEARCH INTERESTS

Numerical linear algebra, least squares problems, eigenvalue and singular value problems matrix computations in in signal and image processing.

## RESEARCH PUBLICATIONS

1. (with E.H. Bareiss), "Roundoff Error Distribution in Fixed Point Multiplication," BIT 20,247–50 (1980).
2. "On the Distribution of Accumulated Roundoff Error in Floating Point Arithmetic",Fifth IEEE Symposium on Computer Arithmetic,Ann Arbor, Michigan,1981.
3. (with E.H. Bareiss), "On Roundoff Error Distributions in Floating Point and Logarithmic Arithmetic," Computing 34, 325–347 (1985).
4. (with E.H. Bareiss), "Probabilistic Error Analysis of Gaussian Elimination in Floating Point and Logarithmic Arithmetic," Computing 34, 349–364 (1985).
5. "Stability Analysis of the G–algorithm and a Note on its Application to Sparse Least Squares Problems," BIT 25 , pp.507–520, (October 1985).
6. "A Note on Monitoring the Stability of Triangular Decomposition of Sparse Matrices," , SIAM J. Sci. Stat. Computing 7(1),pp.166–168,(January 1986).
7. (with R.J. Zaccone), "Improved Normalization Results for Digit On–line Arithmetic," Seventh IEEE Symposium on Computer Arithmetic, Urbana, IL, June 1985.
8. (with S. Gupta), "Numerical Methods and Matrix Splittings for Higher Order Two–Point Boundary Value Problems," in Computers and Computing, P.Chernin, C. di Crescenzo, and F. Robert, ed., Wiley, Paris,pp.72–76. Proceedings of Future Trends in Computing Conference, Grenoble, France, (December 2–6,1985).
9. "On the Smallest Positive Singular Value of a Singular M–matrix with Applications to Ergodic Markov chains", SIAM J. Algebraic Dis. Meth., 7(3),pp.414–424, (July 1986).

10. (with R.J. Zaccone), "Eliminating the Normalization Problem in Digit On-line Arithmetic," *IEEE Transactions on Computers*, C-36(1), pp.36-46,(January 1987).
11. (with I.C.F. Ipsen), "Parallel Scaled Givens Rotations for the Solution of Linear Least Squares Problems on a Systolic Array," *SIAM J. Sci. Stat. Computing* 8(5),pp.716-733, (September 1987).
12. (with S.L. Handy) "The Direct Solution of Weighted and Equality Constrained Least Squares Problems," *SIAM J. Sci. Stat. Computing*, 9(4),pp.704-716, (July 1988).
13. (with N.K. Nichols and R.J. Plemmons), "A Conjugate Gradient Method for the Solution of Equality Constrained Least Squares Problems," *Proc. SPIE Symposium-Matrix Computations IX, San Diego*, pp.23-30,(August 1986), in different form, *SIAM J. Sci. Stat. Computing*, 9(5),pp.892-906, (September 1988).
14. "Error Analysis and Implementation Aspects of Deferred Correction for equality constrained least squares problems," *SIAM J. Num. Anal.*,25(6),pp.1340-1358, (December 1988).
15. (with J.W. Demmel), "Computing Accurate Eigensystems of Scaled Diagonally Dominant Matrices," *SIAM J. Num. Anal.*,27(3),pp.762-791, (June 1990).
16. (with U.B. Vemulapati), "An Improved Method for One-Way Dissection with Singular Diagonal Blocks," *SIAM J. Matrix Anal. Appl.* 11(4), pp.575-588, (October 1990).
17. (with U.B. Vemulapati), "Incremental Condition Estimators for Parallel Sparse Factorizations", *Proc. Fifth Distributed Memory Computer Conference*, D. Walker and Q. Stout, eds., IEEE Computer Society Press, Los Alimitos, CA, pp.322-327, (April 1990).
18. "On the use of structural zeroes in orthogonal factorization," *SIAM J. Sci. Stat. Computing*, 11(3),pp.600-601, (May 1990).
19. "Error Analysis of a Pairwise Summation Algorithm to Compute the Sample Variance", *Numerische Mathematik*, 58(6), pp.583-590, (1991).

20. “Solution of Sparse Weighted and Equality Constrained Least Squares Problems”, Proc. Interface '90 Symposium, C. Page, ed., Lansing, Michigan (May 1990). (Invited Survey Paper)
21. (with U.B. Vemulapati), “A note on deferred correction for quality constrained least squares problems,” SIAM J. Numer. Anal., 29(1), pp.249–256, (1992).
22. (with U.B. Vemulapati), “Rank detection methods for sparse matrices,” SIAM J. Matrix Anal. Appl., 13(4), pp.1279–1297,(1992).
23. “Error analysis of update methods for the symmetric eigenvalue problem,” SIAM J. Matrix Anal. Appl., 14(2), pp.598–618,(1993).
24. “Error Bounds and condition estimates for the computation of null vectors with applications to Markov chains.”, SIAM J. Matrix Anal. Appl., 14(3), pp.798–812,(1993)
25. (with S.L. Handy), “The Numerical Solution of Banded, Toeplitz Eigenvalue Problems,” SIAM J. Matrix Anal. Appl., 15(1), pp.205–214,(1994).
26. ”Perturbation results for nearly uncoupled Markov chains with applications to iterative methods”, Numerische Mathematik, 65(1), pp.51–62,(1993).
27. (with S.–M. Lu) “Parallel computation of orthogonal factors of sparse matrices,” in *Proceedings of the Sixth SIAM Conference on Parallel Processing for Scientific Computing*, R.F. Sincovec, et al.,eds., Volume 1, pp.486–490, March 1993.
28. Numerical Aspects of Solving Least Squares Problems(survey paper). In *Handbook of Statistics*, 9:303–376. Edited by C.R. Rao,(1993).
29. Lecture Notes on Parallel Solution of the Symmetric Eigenvalue Problem(survey paper). in *Large–Scale Matrix Problems and the Numerical Solution of Partial Differential Equations*, J. Gilbert and D. Kershaw, eds. ,Oxford Science Publications, pp.3–53, 1994.
30. (with G. Toraldo) The effect of diagonal scaling on projected gradient methods for bound constrained quadratic programming problems, *Optimization Methods and Software* 5(3) pp. 235–245 (1995).

31. (with S.-M. Lu), Multifrontal Computation with the Orthogonal Factors of Sparse Matrices, *SIAM J. Matrix Anal. Appl.*, 17, pp.658–679, 1996.
32. (with P.A. Yoon and H. Zha), An algorithm and a stability theory for downdating the ULV decomposition, *BIT*, 36, pp.14–40, 1996.
33. (with P.A. Yoon), Modifying the singular value decomposition on the connection machine, *International Journal of High Speed Computing*, 8:145–170, 1996.
34. (with P.A. Yoon), Solving Recursive TLS Problems using the rank-revealing ULV decomposition, in *Recent Advances in Total Least Squares Techniques and Errors-In-Variables Modeling*, S. Van Huffel ed., SIAM Publications, Philadelphia, pp.117–126, 1997.
35. (with H. Zha) Growth in Gaussian Elimination, Orthogonal Matrices, and the Euclidean Norm, *SIAM J. Matrix Anal. Appl.*, 19(3) pp.807–815, 1998.
36. (with P.A. Yoon) An Efficient Rank Detection Procedure for Modifying the ULV Decomposition, *BIT* 28(4), pp. 781–801 1998.
37. (with I. Slapničar) Optimal Perturbation Bounds for the Hermitian Eigenvalue Problem, *Linear Algebra and Its Applications*, 309, pp.19–43, 2000.
38. Computing the Fundamental Matrix of Markov Chain, *SIAM J. Matrix Anal. Appl.*, 22(1), pp. 230–241, 2001.
39. (with A. Smoktunowicz and H. Erbay), Two-Step Gram-Schmidt Downdating Methods, *Advanced Signal Processing, Algorithms, Architectures, and Implementations XI*, F.T. Luk, ed., Proc. of SPIE, vol.4474, pp.273–284, 2001.
40. More Accurate Bidiagonal Reduction for Computing the Singular Value Decomposition, *SIAM J. Matrix Anal. Appl.*, 23(3), pp.761–798, 2002.
41. (with H. Erbay and Z. Zhang), A modified Gram-Schmidt-based downdating technique for ULV decompositions with applications to recursive TLS problems. *Computational Statistics and Data Analysis*, 41(1):195–211, 2003.

42. Modification and Maintenance of ULV Decompositions (invited survey paper), *Applied Mathematics and Scientific Computing*, p.31–62, Z. Drmač, V. Hari, L. Sopta, Z. Tatek, K. Veselić (eds.), Kluwer Academic Publishers.
43. (with H. Fu) A Regularized Structured Total Least Squares Algorithm for High Resolution Image Reconstruction, *Linear Algebra and Its Applications*, 391(1):75–98,2004.
44. (with H. Erbay, and I. Slapničar), Alternative Algorithms for Refinement of ULV Decompositions, *SIAM J. Matrix Anal. Appl.*,27(1):198–211, 2005.
45. (with H. Fu and H. Zha), Efficient Block Noise Removal Based on Non-linear Manifolds, *Proc. Tenth Annual IEEE International Conference on Computer Vision(ICCV 2005)*, 1:549–556, October 2005.
46. (with N. Bosner and Z. Drmač) A New Backward Stable Bidiagonal Reduction Method, *Linear Algebra and Its Applications*, 397: 35–84,2005.
47. (with A. Smoktunowicz and H. Erbay), Improved Gram–Schmidt Datedating Methods, *BIT*, 45(2): 259–285, 2005
48. (with H. Fu, M.K. Ng, and W.-K. Ching) Fast Algorithms for l1 Norm/Mixed l1 and l2 Norms for Image Restoration, *ICCSA(4)*: 843–851, 2005.
49. (with H. Erbay), An Alternative Algorithm for a Sliding Window ULV Decomposition, *Computing*, 76(1-2): 55–66,2006.
50. (with H. Fu, M. Niklova, and M. Ng) Efficient Minimization Methods of Mixed l1-l2 and l1-l1 Norms for Image Restoration, *SIAM J. Scientific Computing*, 27(6):1881-1902,2006.
51. (with H. Fu and M. Ng), Structured Total Least Squares for Color Image Restoration.,*SIAM J. Scientific Computing*, 28(3): 1100–1119, 2006.
52. (with X. Yang, H. Fu and Hongyuan Zha) Semi-Supervised Nonlinear Dimensionality Reduction, *Proceedings of the 23rd International Conference on Machine Learning, (ICML 2006)*.

53. (with A. Smokunowicz and J. Langou), A note on the error analysis of Classical Gram Schmidt, *Numerische Mathematik*, 105(2):299–313,2006.
54. (with N. Bosner) Block and parallel versions of one-sided bidiagonalization, *SIAM J. Matrix Anal. Appl.*,29(3):927-953,2007.
55. (with H. Erbay) A Modifiable Low-Rank Approximation of a Matrix, *Numerical Linear Algebra with Applications*, 16(10):833–860, 2009.
56. (with S. Yan, S. Bouaziz, and D. Lee) Semi-supervised dimensionality reduction for analyzing High-Dimensional Data with constraints, *Neurocomputing*,76(1):114–124, 2012.
57. (with A. Smokunowicz ), Reorthogonalized Block Classical Gram-Schmidt. *Numerische Mathematik*, 123(3):395–423,2013.
58. (with G. Lee and H. Fu) Fast High-resolution image reconstruction using Tikhonov Regularization based Total Least Squares, *SIAM J. Sci. Computing*, 35(1):B275–B290,2013.
59. Reorthogonalization for the Golub–Kahan–Lanczos bidiagonal reduction, *Numerische Mathematik*,124(2):237-278, 2013.
60. (with N. Jakočević-Stor and I. Slapničar), Accurate eigenvalue decomposition of real symmetric arrowhead matrices and applications, *Linear Algebra and Its Applications*, 464:62–89, 2015.
61. (with G. Lee), Two Projection Methods for Total Least Squares Approximation, *Linear Algebra and Its Applications*, 461:18–41, 2014.
62. Block Gram-Schmidt Downdating, *Electronic Transactions on Numerical Analysis*, 43:163–187, 2014.
63. (with N. Jakočević-Stor and I. Slapničar), Forward stable eigenvalue decomposition of rank-one modifications of diagonal matrices, *Linear Algebra and Its Applications*, 487:301–315, 2015.
64. (with G. Lee), Updating Approximate Principal Components with Applications to Template Tracking, , *Numerical Linear Algebra and its Applications*,24(2),e2081, 2017.<https://doi.org/10.1002/nla.2081>



65. (with D. Di Serifino, G. Toraldo, and M. Viola), A Two-Phase Gradient Method for Quadratic Programming Problems with a Single Variable Constraint and Bounds on the Variables, *SIAM J. Optimization*, 28(4):2809-2838,2018.
66. (with Yun X., Carević,A., Lee G., Slapničar I., Almekawy M.), Solving the ultrasound inverse scattering problem of inhomogeneous media using different approaches of total least squares algorithms. SPIE Medical Imaging conference, February 10, 2018.
67. (with Carević A., Yun X., Lee G., Slapničar I., Abdou A., Almekawy M.), Reconstruction of ultrasound tomography for cancer detection using total least squares and conjugate gradient method. SPIE Medical Imaging conference, February 10, 2018.
68. (with M. Almekawy, A Carević, A. Abdou, J. He, G. Lee), Regularization in ultrasound tomography using projection-based total least squares, *Inverse Problems in Science and Engineering*, DOI: 10.1080/17415977.2019.1628222 appeared online in June 2019.
69. Block Modified Gram-Schmidt Algorithms and their Analysis, *SIAM J. Matrix Anal. Appl.*,to appear, 2019.

## GRANTS

1. “Probabilistic Error Analysis of Algorithms from Numerical Linear Algebra for Floating Point Computers”,National Science Foundation Grant No.MCS-8201065, NSF Algorithms, Amount of Award:\$31,000,
2. July 1982–December 1984. Principal Investigator: Jesse L. Barlow Award: \$63,813, July 1982–October 1985. Principal Investigators: Mary Jane Irwin and Robert M. Owens. Participating Faculty: Jesse L. Barlow, Don E. Heller, Joseph Ja’Ja’, Janos Simon.
3. “Probabilistic Error Analysis of Numerical Computations in Special Computer Arithmetic,” National Science Foundation Grant No.DCR-8201065, NSF Algorithms, Amount of Award: \$76,822, July 1984–December 1986. Principal Investigator: Jesse L. Barlow.

4. “Fundamental Research Initiatives, Digital Signal Processing,” Office of Naval Research. October 1985–October 1988. Principal Investigators: Georg Schnitger, Leon Sibul, and Jesse Barlow. Amount of Award: \$75,000.
5. “Adaptive Numerical Methods for Fluid Flow,” NAVSEA (Applied Research Laboratory, PSU). October 1986–September 1988. Principal Investigators: Jesse Barlow and Suchitra Gupta. Amount of Award: \$28,000.
6. “Adaptive Numerical Methods,” NAVSEA (Applied Research Laboratory, PSU). October 1988–September 1989. Principal Investigator: Jesse Barlow. Amount of Award: \$14,000.
7. “Large Sparse Stable Matrix Computations,” National Science Foundation grant No.CCR–8701723. June 1987–December 1988. Principal Investigators: Jesse Barlow and Alex Pothen. Amount of Award: \$22,615.
8. “Large Sparse Stable Matrix Computations,” Air Force Office of Scientific Research grant No.AFOSR–88–0161. April 1988–June 1990. Principal Investigators: Jesse Barlow and Alex Pothen. Amount of Award: (1st Year) \$97,703, 4/1/88–11/31/88, (2nd Year) \$116,798, 1/1/89–6/30/90.
9. “Numerical Solution of Least Squares and Eigenvalue Problems,” National Science Foundation, June 1990–May 1992. Principal Investigator: Jesse Barlow. Amount of Award: \$54,975 for two years.
10. “Undergraduate Education and Research in Software and Algorithm Development for Massively Parallel Computers,” National Science Foundation, Instrumentation and Laboratory Improvement, January 1991–June 1993. Principal Investigators: Lyle N. Long and Jesse L. Barlow. Amount of Award: \$61,420.
11. “Numerical Solution of Eigenvalue Problems,” National Science Foundation: July 1992–August 1996. Grant no. CCR–9201612. Principal Investigator: Jesse L. Barlow. Amount of award: \$186,755 for three years. REU supplement of \$20,000 for last two years.

12. “Numerical Solution of Eigenvalue and Related Least Squares Problems,” National Science Foundation: August 1995–July 1998. Grant no. CCR–9424435. Principal Investigator: Jesse L. Barlow. Amount of award: \$149,327 for three years.
13. “Numerical Solution of Eigenvalue and Singular Value Problems with Applications,” National Science Foundation: August 1998–July 2002. Grant no. CCR–9732081. Principal Investigator: Jesse L. Barlow. Amount of award: \$217,326 for four years.
14. Efficient Computational Methods for Robust Multispectral Multiframe Superresolution, Principal Investigators: Jesse L. Barlow and Nirmal K. Bose. National Science Foundation, September 2004–August 2007. Amount of award: \$200,000
15. New and Improved Algorithms for Minimization and Subspace Tracking, Principal Investigator: Jesse L. Barlow National Science Foundation, August 2011–July 2014. Amount of Award: \$350,000.

#### **PH.D. THESES SUPERVISED**

1. Richard Zaccone, ”Numerical Computation in Digit On–Line Arithmetic.”, December 1984.
2. Susan Handy, ”On the Numerical Solution of the Eigenvalue and Inverse Eigenvalue Problem for Real, Symmetric Toeplitz Matrices,” May 1990.
3. Udaya Vemulapati ”Solving Least Squares Problems on Distributed Memory Machines,” December 1990.
4. Szu–Min Lu, “Computing the Orthogonal Factors of Large and Sparse Matrices,”, December 1994.
5. Peter Yoon, “ Modifying Two–Sided Orthogonal Decompositions: Algorithms, Implementation, and Applications, ” December 1995.
6. Jayant Kirtane, “Fast Multigrid Solvers for Elliptic Partial Differential Equations: Architecture and Algorithms,” May 1996.
7. Hasan Erbay, “Modifying Rank-Revealing Decompositions,” December 2000.

8. Haoying Fu, Deblurring for Image Processing: Beyond Least Squares, June 2005.
9. Geunseop Lee, Fast Regularized Total Least Squares Methods with Applications, August 2013.

## PROFESSIONAL ACTIVITIES

- Committee Member, Eighth IEEE Symposium on Computer Arithmetic, 1986.
- Associate Editor, Linear Algebra and Its Applications, January 1,2000 through December 31,2006.
- Associate Editor, International Journal on High-Speed Computing, 1988 to 2000.
- Associate Editor, Computational Statistics and Data Analysis, 2003 to 2009.
- Associate Editor, SIAM J. Matrix Analysis and Applications, January 1,2007 to present.
- Co-organizer, International Workshop on Accurate Eigensolving and Applications , Split, Croatia, July 11–17, 1996.
- Chairman, International Workshop on Accurate Solution of Eigenvalue Problems, University Park, PA, July 20–23, 1998 and in Napa, Ca, June 2012.
- Co-organizer, International Workshop on Accurate Solution of Eigenvalue Problems, Hagen, Germany, July 3–6, 2000. in Split, Croatia, June 24-27, 2002, in Hagen, Germany, July 2004, in Dubrovnik, Croatia, July 2008 and June 2014, and in Berlin, Germany, June 2010.
- Committee Member, European Conference on Parallel and Distributed Computing, Barcelona, 1997.
- Editor, Two Special Issues on Accurate Solution of Eigenvalue Problems, Linear Algebra and Its Applications, 2000 and 2002. (vol. 309 and vol. 358)

- Editor, Special Issue on Matrix Computations and Statistics, Computational Statistics and Data Analysis, 2002. (vol. 41, no.1)
- Editor, Special Issue on Accurate Solution of Eigenvalue Problems, SIAM J. Matrix Analysis and Applications.
- Member. Foundations of Computational Mathematics Council, 1996 to 1999.
- Local Arrangements Chair. 16th Householder Symposium on Numerical Algebra. Champion, PA, May 23–27,2005.
- Chairman, Sixth International Workshop on Accurate Solution of Eigenvalue Problems, University Park, PA, May 22–25,2006.
- Member — SIAM, IEEE, ILAS.