Howard Elman

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Education

Ph.D. Yale University, Computer Science (May 1982)
M. S. Yale University, Computer Science (January 1979)
M. A. Columbia University, Mathematics (January 1977)
B. A. Columbia University, Mathematics (May 1975)

Employment

University of Maryland, College Park, Maryland
  Department of Computer Science
    Assistant Professor (1985–1990), Associate Professor (1990–1996), Professor (1996–Present)
  Institute for Advanced Computer Studies
    Assistant Professor (1987–1990), Associate Professor (1990–1996), Professor (1996–Present)
    Acting Director (1999-2000)
  Department of Mathematics
    Affiliate Professor (2017 – Present)
    Director, Applied Mathematics Program (2018 – Present)
  Institute for Physical Science and Technology, Assistant Professor (1986–1987)

Yale University, New Haven, Connecticut
  Research Associate, Department of Computer Science, 1982 – 1985

Scientific Computing Associates, New Haven, Connecticut
  Vice President, 1984 – 1985, Consultant, 1982 – 1987

Books

1. **Finite Elements and Fast Iterative Solvers**, with D. J. Silvester and A. J. Wathen, Oxford University Press, 2005, second edition 2014.

Refereed Journal Publications

1. "Variational iterative methods for nonsymmetric systems of linear equations," with S. C. Eisenstat and M. H. Schultz, *SIAM Journal on Numerical Analysis* 20:345-357, 1983.

2. "Preconditioning by fast direct methods for non-self-adjoint nonseparable elliptic equations," with M. H. Schultz, *SIAM Journal on Numerical Analysis* 23:44-57, 1986.

3. "A hybrid Chebyshev Krylov-subspace algorithm for solving nonsymmetric systems of linear equations," with Y. Saad and P. E. Saylor, *SIAM Journal on Scientific and Statistical Computing* 7:840-855, 1986.

4. "A stability analysis of incomplete LU factorizations," *Mathematics of Computation* 47:191-217, 1986.

5. "Block-preconditioned conjugate gradient-like methods for numerical reservoir simulation," with S. C. Eisenstat and M. H. Schultz, *SPE Reservoir Engineering* (February 1988), 307-312.

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6. "Fourier analysis of iterative methods for elliptic problems," with T. F. Chan, *SIAM Review* 31:20-49, 1989.

7. "Approximate Schur complement preconditioners for serial and parallel computers," *SIAM Journal on Scientific and Statistical Computing* 10:581-604, 1989.

8. "Ordering techniques for the preconditioned conjugate gradient method on parallel computers," with E. Agròn, *Computer Physics Communications* 53:253-269, 1989.

9. "Some aspects of parallel implementation of the finite element method on message passing architectures," with I. Babuška, *Journal of Computational and Applied Mathematics* 27:157-187, 1989.

10. "Relaxed and stabilized incomplete factorizations for non-self-adjoint linear systems," *BIT* 29:890-915, 1989.

11. "Iterative methods for cyclically reduced non-self-adjoint linear systems," with G. H. Golub, *Mathematics of Computation* 54:671-700, 1990.

12. "Iterative Methods for cyclically reduced non-self-adjoint linear systems II," with G. H. Golub. *Mathematics of Computation* 56:215-242, 1991.

13. "Line iterative methods for cyclically reduced discrete convection-diffusion problems," with G. H. Golub. *SIAM Journal on Scientific and Statistical Computing* 13:339-363, 1992.

14. "Parallel implementation of the *hp*-version of the finite element method on a shared-memory architecture," with I. Babuška and K. Markley. *SIAM Journal on Scientific and Statistical Computing* 13:1433-1469, 1992.

15. "Parallel sparse Cholesky factorization on a shared memory multiprocessor," with G. Zhang, *Parallel Computing* 18, 1009-1022, 1992.

16. "Performance enhancements and parallel algorithms for two multilevel preconditioners," with X. Z. Guo, *SIAM Journal on Scientific Computing* 14:890-913, 1993.

17. "Performance of the *hp*-version of the finite element method with various elements," with I. Babuška, *International Journal for Numerical Methods in Engineering* 36:2503-2524, 1993.

18. "Ordering effects on relaxation methods applied to the discrete one-dimensional convection-diffusion equation," with M. P. Chernesky, *SIAM Journal on Numerical Analysis* 30:1268-1290, 1993.

19. "On the convergence of line iterative methods for cyclically reduced non-symmetrizable linear systems," with G. H. Golub and G. S. Starke, *Numerische Mathematik* 67:177-190, 1994.

20. "Inexact and preconditioned Uzawa algorithms for saddle point problems," with G. H. Golub, *SIAM Journal on Numerical Analysis* 30:1645-1661, 1994.

21. "Algebraic analysis of the hierarchical basis preconditioner," with Xuejun Zhang, *SIAM Journal on Matrix Analysis and Applications* 16:192-206, 1995.

22. "Use of linear algebra kernels to build an efficient finite element solver," with D. K.-Y. Lee, *Parallel Computing* 21:161-173, 1995.

23. "Fast nonsymmetric iterations and preconditioning for Navier-Stokes equations," with D. Silvester, *SIAM Journal on Scientific Computing* 17:33-46, 1996.

24. "Multigrid and Krylov subspace methods for the discrete Stokes equations," *International Journal for Numerical Methods in Fluids* 22:755-770, 1996.

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25. "A note on conjugate gradient convergence," with A. E. Naiman and I. M. Babuška, *Numerische Mathematik* 76:209-230, 1997.

26. "Perturbation of eigenvalues of preconditioned Navier-Stokes operators," *SIAM Journal on Matrix Analysis and Applications* 18:733-751, 1997.

27. "Efficient iterative solution of the three-dimensional Helmholtz equation," with D. P. O'Leary, *Journal of Computational Physics* 142:163-181, 1998.

28. "Preconditioning for the steady-state Navier-Stokes equations with low viscosity," *SIAM Journal on Scientific Computing* 20:1299 - 1316, 1999.

29. "Modified streamline diffusion schemes for convection-diffusion problems," with Y.-T. Shih, *Computer Methods in Applied Mechanics and Engineering,* 174:137-151, 1999.

30. "Eigenanalysis of some preconditioned Helmholtz problems," with D. P. O'Leary, *Numerische Mathematik* 83:231-257, 1999.

31. "Iterative methods for stabilized discrete convection-diffusion problems," with Y.-T. Shih, *IMA Journal of Numerical Analysis* 20:333-358, 2000.

32. "Efficient preconditioning of the linearized Navier-Stokes equations," with D. Silvester, D. Kay and A. Wathen, *Journal of Computational and Applied Mathematics* 128:261-279, 2001.

33. "A multigrid method enhanced by Krylov subspace iteration for discrete Helmholtz equations," with O. G. Ernst and D. P. O'Leary, *SIAM Journal on Scientific Computing* 23:1291-1315, 2001.

34. "Performance and analysis of saddle point preconditioners for the discrete steady-state Navier-Stokes equations," with D. J. Silvester and A. J. Wathen, *Numerische Mathematik* 90:665-688, 2002.

35. "An analysis of smoothing effects of upwinding strategies for the convection-diffusion equation," with A. Ramage, *SIAM Journal on Numerical Analysis* 40:254-281, 2002.

36. "Block preconditioners for the discrete incompressible Navier-Stokes equations," with D. J. Silvester and A. J. Wathen. *International Journal for Numerical Methods in Fluids* 40:333-344, 2002.

37. "Preconditioners for saddle point problems arising in computational fluid dynamics," *Applied Numerical Mathematics* 43:75-89, 2002.

38. "A characterisation of oscillations in the discrete two-dimensional convection-diffusion equation," with A. Ramage, *Mathematics of Computation* 72:263-288, 2003.

39. "Complete stagnation of GMRES," with I. Zavorine and D. P. O'Leary, *Linear Algebra and its Applications* 367:165-183, 2003.

40. "A parallel block multi-level preconditioner for the 3D incompressible Navier-Stokes equations," with V. E. Howle, J. Shadid and R. Tuminaro, *Journal of Computational Physics* 187:505-523, 2003.

41. "Preconditioning techniques for Newton's method for the incompressible Navier-Stokes equations," with D. Loghin and A. J. Wathen. *BIT* 43:961-974, 2003.

42. "Preconditioning strategies for models of incompressible flow," *Journal of Scientific Computing*, 25:347-366, 2005.

43. "Efficient iterative algorithms for the stochastic finite element method with application to acoustic scattering," with O. G. Ernst, D. P. O'Leary and M. Stewart, *Computer Methods in Applied Mechanics and Engineering* 18:1037-1055, 2005.

44. "Block preconditioners based on approximate commutators," with V. E. Howle, J. Shadid, R. Shuttleworth and R. Tuminaro, *SIAM Journal on Scientific Computing*, 27:1651–1668, 2005.

45. "Fourier analysis of multigrid for the two-dimensional convection-diffusion equation," with A. Ramage. *BIT* 46:283-306, 2006.

46. "Analysis and comparison of geometric and algebraic multigrid for convection-diffusion equations," with C.-T. Wu. *SIAM Journal on Scientific Computing* 28:2208-2228, 2006.

47. "Some observations on multigrid convergence for convection-diffusion equations," with A. Ramage, *Computing and Visualization in Science*, 10:43-56, 2007.

48. "IFISS: A Matlab toolbox for modelling incompressible flow," with A. Ramage and D. J. Silvester. *ACM Transactions on Mathematical Software*, 33:14, 2007. Article 14, 18 pages.

49. "Solving the stochastic steady-state diffusion problem using multigrid," with D. Furnival. *IMA Journal of Numerical Analysis* 27:675–688, 2007.

50. "Least squares preconditioners for stabilized discretizations of the Navier-Stokes equations," with V. E. Howle, J. Shadid, D. Silvester and R. Tuminaro. *SIAM Journal on Scientific Computing* 30:290-311, 2007.

51. "A finite element model for protein transport in vivo", with K. Sadegh Zadeh, H. J. Montas and A. Shirmohammadi. *BioMedical Engineering Online* 6: Article No. 24, June 2007.

52. "A taxonomy and comparison of parallel block multi-level preconditioners for the incompressible Navier-Stokes equations," with V. E. Howle, J. Shadid, R. Shuttleworth and R. Tuminaro, *Journal of Computational Physics* 227:1790–1808, 2008

53. "Block-diagonal preconditioning for spectral stochastic finite element systems," with C. E. Powell, *IMA Journal of Numerical Analysis* 29:350–375, 2009.

54. "Convergence analysis of iterative solvers in inexact Rayleigh quotient iteration," with Fei Xue, *SIAM Journal on Matrix Analysis and Applications* 31:877-899, 2009.

55. "Boundary conditions in approximate commutator preconditioners for the Navier-Stokes equations," with Ray S. Tuminaro, *Electronic Transactions on Numerical Analysis* 35:257-280, 2009.

56. "H(div) preconditioning for a mixed finite element formulation of the diffusion problem with random data," with Darran G. Furnival and Catherine E. Powell, *Mathematics of Computation* 79:733-760, 2010.

57. "Assessment of collocation and Galerkin approaches to linear diffusion equations with random data," with C. W. Miller, E. T. Phipps and R. S. Tuminaro, *International Journal for Uncertainty Quantification* 1:19-34, 2011.

58. "Fast iterative solver for convection-diffusion systems with spectral elements," with P. Aaron Lott, *Numerical Methods for Partial Differential Equations* 27:231-254, 2011.

59. "Fast solvers for models of ICEO microfluidic flows," with Robert R. Shuttleworth, Kevin R. Long and Jeremy A. Templeton, *International Journal for Numerical Methods in Fluids*, 65:383-404, 2011.

60. "Fast iterative solvers for buoyancy driven flow problems," with Milan Mihajlović and David Silvester, *Journal of Computational Physics* 230:3900-3914, 2011.

61. "Fast inexact subspace iteration for generalized eigenvalue problems," with Fei Xue, *Linear Algebra and its Applications* 435:601-622, 2011.

62. "Efficient iterative solvers for stochastic Galerkin discretizations of log-transformed random diffusion problems," with Elisabeth Ullmann and Oliver G. Ernst, *SIAM Journal on Scientific Computing* 34:A659-A682, 2012.

63. "Fast inexact implicitly restarted Arnoldi method for generalized eigenvalue problems with spectral transformation," with F. Xue, *SIAM Journal on Matrix Analysis and Applications* 33:433-459, 2012.

64. "Lyapunov inverse iteration for identifying Hopf bifurcations in models of incompressible flow," with K. Meerbergen, A. Spence and M. Wu, *SIAM Journal on Scientific Computing* 34:A1584-A1609, 2012.

65. "Stochastic collocation with kernel density estimation," with C. W. Miller, *Computer Methods in Applied Mechanics and Engineering* 245-246:36-46, 2012.

66. "Reduced basis collocation methods for partial differential equations with random coefficients," with Q. Liao, *SIAM/ASA Journal on Uncertainty Quantification* 1:192-217, 2013.

67. "Lyapunov inverse iteration for computing a few rightmost eigenvalues of large generalized eigenvalue problems," with M. Wu, *SIAM Journal on Matrix Analysis and Applications* 34:1685-1707, 2013.

68. "IFISS: A computational laboratory for investigating incompressible flow problems," with A. Ramage and D. J. Silvester, *SIAM Review* 56:261-273, 2014.

69. "A block preconditioner for an exact penalty formulation for stationary MHD," with E. G. Phillips, E. C. Cyr, J. N. Shadid and R. P. Pawlowski, *SIAM Journal on Scientific Computing* 36:B930-B951, 2014.

70. "A stochastic approach to uncertainty in the equtions of MHD kinematics," with E. G. Phillips, *Journal of Computational Physics* 284:334-350, 2015.

71. "Preconditioning techniques for reduced basis methods for parameterized partial differential equations", with V. Forstall, *SIAM Journal on Scientific Computing* 37:S177-S194, 2015.

72. "Efficient iterative algorithms for linear stability analysis of incompressible flows," with M. W. Rostami, *IMA Journal of Numerical Analysis* 36:296-316, 2016.

73. "Inverse subspace iteration for spectral stochastic finite element methods," with B. Sousedík, *SIAM/ASA Journal on Uncertainty Quantification* 4:163-189, 2016.

74. "Stochastic Galerkin methods for the steady-state Navier-Stokes equations," with B. Sousedík, *Journal of Computational Physics* 316:435-452, 2016.

75. "Block preconditioners for stable mixed nodal and edge finite element representations of incompressible resistive MHD," with E. G. Phillips, J. N. Shadid, E. C. Cyr and R. P. Pawlowski, *SIAM Journal on Scientific Computing* 38:B1009-B1031, 2016.

76. "Numerical solution of the steady-state Navier-Stokes equations using empirical interpolation methods," with V. Forstall, *Computer Methods in Applied Mechanics and Engineering* 317:380-399, 2017.

77. "Algebraic multigrid preconditioners for multiphase flow in porous media," with Q. M. Bui and D. J. Moulton, *SIAM Journal on Scientific Computing* 39:S662-S680, 2017.

78. "A preconditioned low-rank projection method with a rank-reduction scheme for stochastic partial differential equations," with K. Lee, *SIAM Journal on Scientific Computing* 39:S828-S850, 2017.

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79. "A low-rank multigrid method for the stochastic steady-state diffusion equation," with T. Su, *SIAM Journal on Matrix Analysis and Analysis* 39:492-509, 2018.

80. "Stochastic least-squares Petrov-Galerkin method for parameterized linear systems," with K. Lee and K. Carlberg, *SIAM/ASA Journal on Uncertainty Quantification* 6:374-396, 2018.

81. "An adaptive reduced basis collocation method based on PCM ANOVA decomposition for anisotropic stochastic PDEs," with H. Cho, *International Journal for Uncertainty Quantification* 8:193-210, 2018.

82. "Collocation methods for exploring perturbations in linear stability analysis," with D. J. Silvester, *SIAM Journal on Scientific Computing* 40:A2667-A2693, 2018.

83. "Low-rank solution methods for stochastic eigenvelue problems," with T. Su, *SIAM Journal on Scientific Computing* 41:A2657-A2680, 2019.

84. "A low-rank solver for the Navier-Stokes equations with uncertain viscosity," with K. Lee and B. Sousedík, *SIAM/ASA Journal on Uncertainty Quantification* 7:1275-1300, 2019.

85. "Semi-smooth Newton methods for nonlinear complementarity formulation of compositional two-phase flow in porous media," with Q. Bui, *Journal of Computational Physics* 407, 2020.

86. "A low-rank solver for the stochastic unsteady Navier-Stokes problem," with T. Su, *Computer Methods in Applied Mechanics and Engineering* 364, 2020.

87. "Surrogate approximation of the Grad-Shafranov free boundary problem via stochastic collocation on sparse grids," with J. Liang and T. Sánchez-Vizuet, *Journal of Computational Physics*, 448, 2021.

88. "Enhanced alternating energy minimization methods for stochastic Galerkin matrix equations," with K. Lee, C. E. Powell and D. Lee, *BIT Numerical Mathematics* 62:965-994, 2022.

89. "On surrogate learning for linear stability assessment of Navier-Stokes equations with stochastic viscosity," with B. Sousedík, K. Lee and R. Price, *Applications of Mathematics* 67:727-749, 2022.

90. "A deep neural network approach for parameterized PDEs and Bayesian inverse problems," with H. Antil, O. Onwunta and D. Verna, *Machine Learning: Science and Technology* 4 0350150, 2023.

Conference Proceedings and Book Chapters

1. "Solving approximations to the convection-diffusion equation," with S. C. Eisenstat, A. H. Sherman, and M. H. Schultz, in *Proceedings of the Fifth Symposium on Reservoir Simulation,* Society of Petroleum Engineers of AIME, Denver, CO, 1979, pp. 127-132.

2. "Preconditioned conjugate-gradient methods for nonsymmetric systems of linear equations," in R. Vichnevetsky and R. S. Stepleman, Editors, *Advances in Computer Methods for Partial Differential Equations – IV,* IMACS, 1981, pp. 409-417.

3. "The (new) Yale sparse matrix package," with S. C. Eisenstat, M. H. Schultz and A. H. Sherman, in G. Birkhoff and A. Schoenstadt, Editors, *Elliptic Problem Solvers II,* Academic Press, 1984, pp. 45-52.

4. "Iterative methods for non-self-adjoint elliptic problems," in G. Birkhoff and A. Schoenstadt, Editors, *Elliptic Problem Solvers II,* Academic Press, 1984, pp. 271-283.

5. "Block-preconditioned conjugate gradient-like methods for numerical reservoir simulation," with S. C. Eisenstat and M. H. Schultz, in *Proceedings of the Eighth Symposium on Reservoir Simulation,* Society of Petroleum Engineers of AIME, Dallas, TX, 1985, pp. 397-403.

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6. "Polynomial iteration for nonsymmetric indefinite linear systems," with R. L. Streit. In J. P. Hennart, Editor, *Lecture Notes in Mathematics 1230,* Proceedings of the Fourth IIMAS Workshop on Numerical Analysis, Springer-Verlag, New York, 1986, pp. 103-117.

7. "Line iterative methods for cyclically reduced non-self-adjoint elliptic problems," with G. H. Golub, in *Transactions of the Seventh Army Conference on Applied Mathematics and Computing,* 1989, ARO Report 90-1, pp. 457-466.

8. "Block iterative methods for cyclically reduced non-self-adjoint elliptic problems," with G. H. Golub, in D. Kincaid and L. Hayes, Editors, *Iterative Methods for Large Linear Systems,* Academic Press, 1990, pp. 91-105.

9. "Iterative methods for linear systems," in J. Gilbert and D. Kershaw, Editors, *Large-Scale Matrix Problems and the Numerical Solution of Partial Differential Equations,* Oxford University Press, New York, 1994, pp. 69-118.

10. "Ordering effects on relaxation methods applied to the discrete convection-diffusion equation," with M. P. Chernesky, In G. H. Golub, A. Greenbaum and M. Luskin, Editors, *Recent Advances in Iterative Methods,* Springer-Verlag, New York, 1994, pp. 45-57.

11. "Multigrid and Krylov subspace methods for the discrete Stokes equations," in M. Natori and T. Nodera, Editors, *Advances in Numerical Methods for Large Sparse Sets of Linear Equations,* Proceedings of the PCG94 Symposium, Keio University, Yokohama, Japan, 1994, pp. 151-164.

12. "Iterative Methods for Problems in Computational Fluid Dynamics," with A. J. Wathen and D. J. Silvester, in R. Chan, T. F. C. Chan and G. H. Golub, Editors, *Iterative Methods in Scientific Computing,* Springer-Verlag, Singapore, 1997, pp. 271-327.

13. "A Preconditioner for the Oseen Equations," with A. Wathen, D. Loghin, D. Kay and D. Silvester, to appear in *Numerical Mathematics and Advanced Applications,* Proceedings of the 4th European Conference on Numerical Mathematics and Advanced Applications, Springer-Verlag, 2003.

Recent Grants and Contracts

"Preconditioning Techniques for Algebraic Equations Arising from Partial Differential Equations," National Science Foundation, 7/15/99 – 6/20/02.

"Solution Algorithms and Probabilistic Analysis of Models of Scattering," U. S. Office of Naval Research, with D. P. O'Leary, 2000-2003.

"Algorithms for Discrete and Stochastic Partial Differential Equations," National Science Foundation, 8/01/02 – 7/31/04.

"Fast Multipole Translational Algorithms for Solution of the 3D Helmholtz Equation," with R. Duraiswami, N. Gumerov, D. P. O'Leary and I. Mayergoyz, National Science Foundation, 10/01/02 – 9/30/04.

"Fast Solvers for the Incompressible Navier-Stokes Equations," Sandia National Laboratories, 6/2/04/9/15/04.

"Navier-Stokes Solvers and Generalizations for Reacting Flow Problems," Department of Energy, 9/1/04 – 8/31/07.

"Fast Algorithms for Models of Incompressible Flow," National Science Foundation, 9/15/07 – 8/31/10.

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"Navier-Stokes Solvers and Generalizations for Reacting Flow Problems," Department of Energy, 9/1/08 – 8/31/11.

"Computational Methods for Parameter-Dependent Partial Differential Equations," National Science Foundation, 8/1/11 – 7/31/14.

"Computational Methods for Stochastic Eigenvalue Problems," National Science Foundation, 9/1/14 – 8/31/17.

"Fast Computational Algorithms for Partial Differential Equations and Uncertainty Quantification," Department of Energy, 1/1/13 – 6/30/16, 7/1/16 – 6/30/19 ($865,131).

"Tokamak Disruption Simulation," Department of Energy, 9/1/17 – 8/31/22 ($250,000).

Awards

SIAM Fellow, 2009.

Designated "Highly Cited Author" by Thomson ISI, 2004.

"Presidential Young Investigator Award: Research in Sparse Matrix Methods," National Science Foundation, 1989 – 1994.

Recent Invited Talks

Plenary speaker, SIAM Conference on Applied Linear Algebra, Atlanta, GA, October 2015.

Householder Symposium XIX, Spa, Belgium, June 2014.

Conference on Modeling Revisited and Model Reduction, Chateau Liblice, Workshop in Numerical Solution of PDE Eigenvalue Problems, Oberwolfach, Germany, November 2013.

Conference on Bifurcation Theory, Numerical Linear Algebra and Applications (in honor of Alastair Spence), University of Bath, England, July 2013.

Workshop on Numerical Methods for Uncertainty Quantification, Hausdorff Center for Mathematics, University of Bonn, Germany, May 2013.

Workshop on Efficient Numerical Methods for Partial Differential Equations, Urumqi, China, August 2012.

Workshop on Linear Algebra Aspects of Solving PDEs with Random Data, University of Manchester, England, January 2012.

Workshop on Uncertainty Quantification, The Royal Society of Edinburgh, Edinburgh, Scotland, May 2010.

Thirty-Fourth Woudschoten Conference on Scientific Computing, Zeist, The Netherlands, October 2009.

Distinguished Colloquium Series, Institute of Applied Mathematics and Pacific Institute for the Mathematical Sciences, University of British Columbia, September 2007

Third Montreal Scientific Computing Days, organized by McGill University and The University of Montreal, February 2006.

Workshop on Algorithms for Models of Fluid flow, University of Manchester, England, July 2005.

Householder Symposium, Champion, PA, May 2005

Brown University, Workshop on Advances and Challenges in Time-Integration of PDE's, Brown University, August 2003.

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Workshop on Solution Algorithms for Saddle Point Problems, Santa Fe, NM, December 2003.

Plenary speaker, Meeting in honor of the 50th anniversary of the conjugate gradient method, Zürich, Switzerland, February 2002.

Invited speaker, 19th Biennial Conference on Numerical Analysis, University of Dundee, June 2001.

Advising

1987, E. Agròn, Ordering Techniques for the Preconditioned Conjugate Gradient Method on Parallel Computers, (M.S. December 1987).

1992, D. Lee, Use of Linear Algebra Kernels to Build an Efficient Finite Element Solver, (M.S. May 1992).

1992, X. Guo, Multilevel Preconditioners: Analysis, Performance Enhancements and Parallel Algorithms (Ph.D. May 1992).

1993, M. Chernesky, Iterative Solution of Discrete Convection-Diffusion Problems (Ph.D. December 1993).

1998, S. Arteaga, Nonlinear and Parallel Algorithms for Finite Element Discretizations of the Incompressible Navier-Stokes Equations (Ph.D. June 1998).

1998, A. Hirsa, Numerical Algorithms for the Convection-Diffusion Equation and Option Pricing (Ph.D. June 1998, directed jointly with D. Madan).

1998, Y.-T. Shih, Upwind Finite Element Solutions for Convection-Diffusion Problems (Ph.D. December 1998).

2002, I. Zavorine, Analysis of GMRES Convergence by Spectral factorization of the Krylov Matrix (Ph.D. June 2001, directed jointly with D. O'Leary).

2003, C.-T. Wu, On the Implementation of an Accurate and Efficient Solver for Convection-Diffusion Equations (Ph.D. December 2003).

2007, R. Shuttleworth, Block Preconditioners for the Navier-Stokes Equations (Ph.D., May 2007).

2008, D. Furnival, Iterative Methods for the Stochastic Diffusion Problem (Ph.D., August 2008).

2008, A. Lott, Fast Solvers for Models of Fluid Flow with Spectral Elements (Ph.D., August 2008).

2009, F. Xue, Numerical Solution of Eigenvalue Problems with Spectral Transformations, (Ph.D., August 2009).

2012, C. Miller, "Fast Algorithms for the Solution of Stochastic Partial Differential Equations" (Ph.D., May 2012).

2012, M. Wu, "Linear Stability Analysis using Lyapunov Inverse Iteration" (Ph.D., May 2012).

2014, E. Phillips, "Fast Solvers and Uncertainty Quantification for Models of Magnetohydrodynamics", (Ph.D., August 2014).

2015, V. Forstall, "Iterative Solution Methods for Reduced-Order Models of Parameterized Partial Differential Equations", (Ph.D., December 2015).

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Editorial Activities

Editor-in-Chief, *SIAM Journal on Scientific Computing* (1999 – 2004).

Associate Editor, *SIAM Journal on Scientific Computing* (1990 – 1998, 2005 – present).

Associate Editor, *Mathematics of Computation* (1995 – 2007).

Special Editor, *SIAM Journal on Scientific Computing*, for papers presented at the Copper Mountain Conference on Iterative Methods, 1990, 1992, 1994.

Special Editor-in-Chief, *SIAM Journal on Scientific Computing*, for issues dedicated to iterative methods, Vol. 19, No. 1 (1999), Vol. 21, No. 5 (2000).

Other Recent Professional Service

Member, SIAM Journals Committee, 2016 – Present
Member, SIAM Finance Committee, 2005 – Present
Member, SIAM Committee on Science Policy, 2012 – 2014.

Member, Program Committee: Copper Mountain/Colorado Conference on Iterative Methods, 1990 – present (Chair 2004-2012).

Member, Householder Award Committee, 2005 – Present.

Member, Prize Committee for the SIAM Wilkinson Prize (awarded every four years for research in Numerical Analysis and Scientific Computing), 2005.

Co-Organizer, Workshop on "Perspectives on Incompressible Flows," University of Maryland, April 2003.