

October, 2017

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**EDUCATION**

<b>Educational Institution</b>	<b>Degree</b>	<b>Year</b>	<b>Address</b>
University of Illinois	PhD in Math	1975	Urbana, Illinois
University of Illinois	MS in Math	1972	Urbana, Illinois
University of Wisconsin	BS in Math	1970	Madison, Wisconsin

**PROFESSIONAL EXPERIENCE:**

- 2017-present Professor Emeritus of Applied Mathematics, Department of Applied Mathematics, University of Colorado at Boulder, Boulder, CO
- 1993-2017. Professor of Applied Mathematics, Department of Applied Mathematics, University of Colorado at Boulder, Boulder, CO
- 1989–1993. Director, Computational Math Group, University of Colorado at Denver, Denver, CO
- 1985–1993. Professor of Mathematics, Mathematics Department, University of Colorado at Denver, Denver, CO
- 1982–1987. Section Leader: Research and Mathematical Software Libraries Section, Los Alamos National Laboratories, Los Alamos, NM
- 1981–1989. Member of Technical Staff, Los Alamos National Laboratories, Los Alamos, NM.
- 1979–1981. Member of Technical Staff, Sandia Laboratories, Albuquerque, NM.
- 1976–1979. Member of Technical Staff, Sandia Laboratories, Livermore, CA.
- 1975–1976. Assistant Professor at Emory University, Department of Mathematics
- 1975–1976. Mathematical Consultant for U.S. Geological Survey, Denver, CO.
- 1973–1975. Research Assistant to Professor Paul Saylor, University of Illinois, Dept. of Computer Science

## **VISITING POSITIONS:**

- Visiting Professor, University of California at San Diego, Spring 1984.
- Ulam Scholar, Los Alamos National Laboratories, 1993–1994.
- Visiting Professor, University of Queensland, Brisbane, AU, Fall 1999.

## **RESEARCH INTERESTS:**

Numerical Linear Algebra  
Iterative Solution of Large Sparse Linear Systems  
Numerical Solution of Partial Differential Equations  
Parallel Computing

## **HONORS:**

- Golub Prize for work on Conjugate Gradient Methods, 1983
- Outstanding Researcher of the University, University of Colorado at Denver, 1990
- Ulam Scholar, Los Alamos National Laboratories, 1993–1994.
- Fellow of the Society of Industrial and Applied Mathematics, Class of 2009

## **PROFESSIONAL SERVICE:**

- Member of Rheinboldt Committee, Future Directions in Computational Mathematics, Algorithms, and Scientific Software, 1985.
- Activities for The Society of Industrial and Applied Mathematics
  - President, 2001-2002.
  - President-elect, 2000.
  - Past-President, 2003.
  - Vice President-at-Large, 1996–1999.
  - Chair of Science Policy Committee, 1997–2000, 2003-2004, member 1997 – present.
  - Master Program Committee, 1995–1996.
  - Council Representative to the Board of Trustees, 1991–1993.
  - Member of the Council, 1990–1995.
  - Publications Committee, 2004–2011.
- Chair, External Review Committee, Department of Mathematics, Iowa State University, November, 2001.
- External Review Committee, Department of Mathematics, Pennsylvania State University, September, 2003.
- Chair of the Review Panel of the Computational Sciences Program of the Helmholtz Association of National Research Centers, Germany, May 5, 2004.

- Member of the Review Panel, DOE ASCI Alliance Center, C-SAFE, University of Utah on October 5-6, 2004.
- Chair of the Review Panel, DOE ASCI Alliance Center, C-SAFE, University of Utah on October 3-4, 2005.
- Advisory Committee, DOE Office of Science, Advanced Scientific Computing Research, 2003-2011.
- Advisory Board, Bravarian Graduate School of Computational Engineering.
- Governing Board, Institute for Statistical and Mathematical Sciences (SAMSI), University of North Carolina, 2006–2008.
- Review Committee, Pacific Northwest National Laboratory, Fundamental and Computational Sciences Directorate, (2008 – 2012).
- Chair External review Committee, Department of Scientific Computing, Florida State University, (2012).
- Journal Editorships
  - Editor-in-Chief, SIAM Journal of Numerical Analysis, 1996-2000, 2007–2009.
  - Editor, SIAM Journal of Numerical Analysis, 1996–present.
  - Associate Editor, SIAM Journal of Multiscale Modelling, 2005-2010.
  - Associate Editor, Electronic Transactions in Numerical Analysis, 1994-present.
  - Associate Editor, Journal Numerical Linear Algebra, 1990 - present.
  - Guest Editor, SIAM Journal of Numerical Analysis, 1992-1994.
  - Associate Editor, SIAM Journal of Scientific Computing, 1991 - 1995, current guest editor.
  - Associate Editor, SIAM Journal of Matrix Analysis, 1990 – 1993.

#### **CONFERENCE ORGANIZATION:**

- Co-Chairman, Copper Mountain Conference Series on Iterative and Multigrid Methods, 1989 - 2002.
- Program Committee, Copper Mountain Conference Series on Iterative and Multigrid Methods, 2003-present.
- Organizing Committee, SIAM Annual Meeting, Los Angeles, CA, July 20-24, 1992.
- Chair, Workshop on First-order Systems Least-squares Functionals, Center for Non-linear Studies, Los Alamos National Laboratories, May 25-27, 1994.
- Organizing Committee, Workshop on Least-squares Finite Element Methods, Ohio Aerospace Institute, October 13-14, 1994.

- Organizer, Workshop on Least-squares Finite-element Methods, Oberwolfach, Germany, June 14, 2002.
- Organizer, Workshop on Multigrid Methods for Transport, Boulder, CO, October 1-2, 2009
- Co-Chair, Annual Workshop on Algebraic Multigrid Methods, Boulder, CO 2001–present

## Ph. D. STUDENTS

1. Jim Otto, *Multi-level methods for the solution of advection-dominated elliptic problems on composite grids*, 1992
2. Suely Oliveira, *Parallel multigrid methods for transport equations*, 1993.
3. Gaoming Yang, *Multigrid methods for the Boltzmann transport equation*, 1993.
4. Klaus J. Ressel, *Least-squares finite element solution of the neutron transport equation in diffusive regimes*, 1994.
5. Teri L. Barth, *Implementation of the conjugate gradient method using short multiple recursions*, 1996.
6. Barry. Lee, (co-advisor with S. McCormick) *Multilevel methods for first-order system least squares*, May 1996.
7. Markus Berndt, (co-advisor with S. McCormick) *Parallel multilevel adaptive methods*, May 1999.
8. Andrea. Codd, (co-advisor with S. McCormick) *First-order system least squares (FOSLS) for elliptic grid generation (EGG)*, May 2001.
9. Timothy Chartier, (co-advisor with S. McCormick) *Algebraic multigrid based on element interpolation (AMGe) and spectral AMGe*, May 2001.
10. B. Philip, (co-advisor with S. McCormick) *Asynchronous fast adaptive composite grid methods for elliptic problems on adaptively-refined curvilinear grids*, May 2001.
11. Hugh MacMillan, *First-order least-squares and electrical impedance tomography*, May 2001.
12. Ken Jarman, (Co-advisor with J. Oliveira) *Stochastic Immiscible Flow With Moment Equations.*, May 2001.
13. Brian Bloechle, (Co-Advisor with H. Rajaram) *On the Taylor Dispersion of Reactive Solutes in a Parallel-Plate Fracture-Matrix System*, May 2001.
14. Travis Austin, *Advances on least-squares methods for 3-d linear Boltzmann transport equation*, August 2001.

15. Luke Olson, *Multilevel least-squares finite elements methods for hyperbolic partial differential equations*, May 2003.
16. Allison Baker, (Co-advisor with E. Jessup) *A technique for accelerating the convergence of GMRES*, August 2003.
17. Scott MacLachlan, (co-advisor with S. McCormick) *Adaptive algebraic multigrid methods and homogenization*, May 2004.
18. Chad Westphal, *First-order system least squares for geometrically-nonlinear elasticity in nonsmooth domains*, August, 2004.
19. Oliver Röhrle, (co-advisor with S. McCormick) *Multilevel first-order system least squares for nonlinear PDEs*, December 2004.
20. Eunjung Lee, *FOSLL\* for eddy current problems with three-dimensional edge singularities*, August 2005
21. James Brannick, (co-advisor with S. McCormick) *Adaptive algebraic multigrid methods*, December 2005.
22. Brendan Sheehan, *Multigrid methods for isotropic neutron transport*, May, 2007.
23. Joshua Nolting *Efficiency-based local adaptive refinement for FOSLS finite elements*, May 2008.
24. Geoff Sanders, *Two extensions to adaptive smooth aggregation (aSA) multigrid: eigensolver initialization and nonsymmetric problems*, August 2008.
25. James Adler, *Nested Iteration and First Order Systems Least Squares on Incompressible Resistive Magnetohydrodynamics*, May 2009.
26. Christian Ketelsen, *Least-Squares Finite Element Methods for Quantum Electrodynamics*, August 2009.
27. Lei Tang, *Parallel Efficiency-based Adaptive Local Refinement*, December 2010.
28. Min Ho Park, (co-advisor with S. McCormick) *Relaxation-corrected Bootstrap Algebraic Multigrid (rBAMG)*, December 2010.
29. Kuo Liu, *Hybrid First-Order System Least-Squares Finite Element Methods With The Application To Stokes And Navier-Stokes Equations* , December 2012.
30. Toby Jones, (co-advisor with S. McCormick), *Algebraic Multigrid Methods for Parallel Computing, Systems, and Graphs*, December 2013
31. Jose Garcia, *Fluid Dynamics of Large Scale Circulation in the Ocean using First Order System Least Square (FOSLS) Finite Element Method*, May 2014.

32. Chris Leibs, *First-Order Systems Least-Squares Finite Element Methods and Nested Iteration for Electromagnetic Two-Fluid Kinetic-Based Plasma Models*, PhD Thesis, University of Colorado at Boulder, December, 2014.
33. David Appelhans, *Trading Computation for Communication: A Low Communication Algorithm for the Parallel Solution of PDEs Using Range Decomposition, Nested Iteration, and Adaptive Mesh Refinement*, PhD Thesis, University of Colorado at Boulder, December, 2014.
34. Ben O'Neill *Multigrid Reduction in Time for Nonlinear Parabolic Problems*, PhD Thesis, University of Colorado at Boulder, August, 2017.
35. Jeff Allen *Ice-Sheet Models Using a Fluidity-Based FOSLS Approach to Nonlinear-Stokes Flow*, PhD Thesis, University of Colorado at Boulder, August, 2017.
36. Alyson Fox *Algebraic Multigrid(AMG) for Graph Laplacian Linear Systems: Extensions of AMG for Signed, Undirected and Unsigned, Directed Graphs*, PhD Thesis, University of Colorado at Boulder, August, 2017.
37. Wayne Mitchell *Studying Convergence of Nested Iterations with Range Decomposition*, PhD Thesis, University of Colorado at Boulder, August, 2017.

#### **RECENT INVITED LECTURES:**

- Invited Speaker, DOE Applied Mathematics PI Meeting, Berkeley, CA, May 3, 2010.
- Invited Speaker, IMA Workshop on Numerical Solutions of Partial Differential Equations, University of Minnesota, December 2, 2010
- Minisymposium Speaker, Numerical Discretization Error Estimation for Uncertainty Quantification, SIAM CS&E Conference, Reno, NV, March 2, 2011.
- Colloquium Speaker, Purdue University, April 13, 2011
- Plenary Speaker, Ninth International Conference of Numerical Analysis and Applied Mathematics 2011, ICNAAM 2011, Halkidiki, Greece, September 19, 2011
- Seminar Speaker, Lawrence Livermore National Laboratory, February 21, 2012
- Colloquium Speaker, National Renewable Energy Laboratory, Golden, CO, August 24, 2012.
- Minisymposium Speaker, SIAM Conference on Computational Science and Engineering, February 26, 2013.
- Invited Speaker, Eleventh International Conference of Numerical Analysis and Applied Mathematics 2013, ICNAAM 2013, Rhodes, Greece, September 2, 2013.
- Invited Speaker, Center for Exascale Radiation Transport, Texas A&M, TST Review Feb 28, 2013

- Plenary Speaker, ICES/USACM Workshop on Minimum Residual and Least Squares Finite Element Methods, Nov. 4, 2013, Austin, Texas.
- Invited Speaker, Center for Exascale Radiation Transport, Texas A&M, TST Review: May 6–7, 2014
- Minisymposium Speaker, SIAM Conference on Computational Science and Engineering, Salt Lake City, Utah, March 14–18, 2015.
- Invited Speaker, Center for Exascale Radiation Transport, Texas A&M, PSSAP Review, April 13–14, 2015.

#### REFEREED PUBLICATIONS:

1. T.A. Manteuffel, “The Tchebychev Iteration for Nonsymmetric Linear Systems,” *Numer. Math.*, 28, 307–327 (1977).
2. T.A. Manteuffel, “Adaptive Procedures for Estimating Parameters for the Nonsymmetric Tchebychev Iteration,” *Numer. Math.*, 31, 183–208 (1978).
3. T.A. Manteuffel, “An Incomplete Factorization Technique for Positive Definite Linear Systems,” *Math. Comp.*, Vol. 34, No. 150, 473–497 (1980).
4. T.A. Manteuffel, “An Interval Analysis Approach to Rank Determination in Linear Least Squares Problems,” *SISSC*, Vol. 2, No. 3, 335–348 (1981).
5. T.A. Manteuffel, “Optimal Parameters for Linear Second-Degree Stationary Iterative Methods,” *SIAM J. Numer. Analysis*, Vol. 19, No. 4, 833–839 (1982).
6. D.B. Grove, L.F. Konikow and T.A. Manteuffel, “Application of the Conjugate Gradient Method to Ground-Water Models,” *Journal of Ground Water Resources* (1982).
7. V. Faber and T.A. Manteuffel, “Necessary and Sufficient Conditions for the Existence of a Conjugate Gradient Method,” *SIAM J. Numer. Analysis*, Vol. 21, No. 2, 352–362 (1984).
8. R.C.Y. Chin, J. dePillis and T.A. Manteuffel, “ADI as a Preconditioning for Solving the Convection-Diffusion Equation,” *SISSC*, Vol. 5, No. 2, 281–299 (1984).
9. J.M. Hyman and T.A. Manteuffel, “Dynamic Acceleration of Nonlinear Iterations,” *Elliptic Problem Solvers II*, G. Birkhoff and A. Schoenstadt, eds., Academic Press, 1984.
10. T.A. Manteuffel and A.B. White, “Numerical Solution of Second-Order Boundary Value Problems on Nonuniform Meshes,” *Math. Comp.*, Vol. 47, No. 176, 511–535 (1986).
11. H.O. Kreiss, T.A. Manteuffel, B. Schwartz, B. Wendroff and A.B. White, “Supraconvergent Schemes on Irregular Grids,” *Math. Comp.*, Vol. 47, No. 176, 537–554 (1986).

12. V. Faber, T.A. Manteuffel, A.B. White and G.M. Wing, "Asymptotic Behavior of Singular Values and Singular Functions of Certain Convolution Operators," *Comp. and Maths. with Appls.*, Vol. 12A, No. 6, 733–747 (1986).
13. T.A. Manteuffel and A.B. White, "On the Efficient Numerical Solution of Systems of Second-Order Boundary-Value Problems," *SIAM J. Numer. Analysis*, Vol. 23, No. 5, 996–1006 (1986).
14. V. Faber and T.A. Manteuffel, "Orthogonal Error Methods," *SIAM J. Numer. Analysis*, Vol. 24, No. 1, 170–187 (1987).
15. R.C.Y. Chin and T.A. Manteuffel, "An Analysis of Block SOR for a Class of Matrices with Complex Spectrum," *SIAM J. of Numer. Analysis*, Vol 25, No. 3 (1988).
16. V. Faber and T.A. Manteuffel, "A Look at Transport Theory from the Viewpoint of Linear Algebra," *Transport Theory, Invariant Embedding and Integral Equations, Lecture Notes in Pure and Applied Mathematics* Vol. 115 (Nelson, Faber, Manteuffel, Seth and White, eds.) Marcel-Dekker, April 1989.
17. S.F. Ashby, T.A. Manteuffel and P.E. Saylor, "Adaptive Polynomial Preconditioning for Hermitian Indefinite Linear Systems," *BIT*, 29(4), pp. 583–609, 1989.
18. V. Faber, T.A. Manteuffel and S.V. Parter, "On the Theory of Equivalent Operators and Application to the Numerical Solution of Uniformly Elliptic Partial Differential Operators," *Advances in Applied Mathematics*, 11, pp. 109–163, 1989.
19. T.A. Manteuffel and S.V. Parter, "Preconditioning and Boundary Conditions," *SIAM J. of Numer. Anal.*, Vol. 27, No. 31, pp. 656–694, June 1990.
20. S. Ashby, T.A. Manteuffel and P. Saylor, "A Taxonomy of Conjugate Gradient Methods," *SIAM J. Numer. Analysis*, Vol. 27, No. 6, pp 1547-1568, Dec. 1990.
21. J. E. Morel and T.A. Manteuffel, "An Angular Multigrid Acceleration Technique for  $S_n$  Equations with Highly Forward-Peaked Scattering," *Nucl. Sci. Eng.*, Vol. 107, pg 330, 1990.
22. T.A. Manteuffel and A.B. White, "A Calculus of Difference Schemes for the Solution of Boundary Value Problems on Irregular Meshes," *SIAM J. of Numer. Anal.*, Vol. 29, No. 5, pp 1321-1346 1992.
23. C.I. Goldstein, T.A. Manteuffel and S.V. Parter, "Preconditioning and Boundary Conditions without  $H_2$  Estimates:  $L_2$  Condition Numbers and the Distribution of the Singular Values," *SIAM J. of Numer. Anal.*, Vol. 30, No. 2, pp 343–376, 1993.
24. S.F. Ashby, T.A. Manteuffel and J.S. Otto, "A Comparison of Chebychev and Least Squares Adaptive Polynomial Preconditioning for Hermitian Positive Definite Linear Systems," *SIAM J. Sci. and Stat. Comp.*, Vol. 13, No. 1, pp 1–29, (1992).



25. W.D. Joubert, T.A. Manteuffel, S.V. Parter and S.P. Wong, "Preconditioning Second-order Elliptic Operators: Experiment and Theory," Los Alamos National Laboratory Reports LA-UR-90-1615, April, 1990., *SIAM J. Sci. and Stat. Comp.*, Vol. 13, No. 1, pp 259-288, (1992).
26. T.A. Manteuffel and J.S. Otto, "Optimal Equivalent Preconditionings," *SIAM J. of Numer. Anal.* , Vol. 30, No. 3, pp. 790-812, June 1993.
27. V. Faber, F. Chung and T.A. Manteuffel, "An Upper Bound on the Diameter of a Graph from Eigenvalues Associated with its Laplacian," *SIAM J. of Dis. Math.*, Vol. 7, No. 3, pp443, (1994).
28. T.A. Manteuffel and J.S. Otto, "On the Roots of the Orthogonal Polynomials and Residual Polynomials Associated with a Conjugate Gradient Method," *Journal of Numerical Linear Algebra*, Vol. 1 (5), pp 449-475, (1994)
29. T.A. Manteuffel, S.F. McCormick, J.E. Morel, S. Oliveira and G. Yang, "A Parallel Version of a Multigrid Algorithm for Isotropic Transport Equations," *SIAM J. Sci. and Stat. Comp.*, Vol 15. No. 2, pp 474-493, (1994).
30. Z. Cai, R. Lazarov, T.A. Manteuffel and S. McCormick, "First-order System Least Squares for Second-Order Partial Differential Equations: Part I ", *SIAM J. Numer. Anal.*, Vol 31, No 6 (1994)
31. X. C. Hu, T.A. Manteuffel, S. F. McCormick and T. F. Russell, "Accurate Discretization for Singular Perturbations: The One-Dimensional Case", *SIAM J. Numer. Anal.*, Vol. 32, No. 1, pp 83-109, (1995)
32. T.A. Manteuffel, S.F. McCormick, J.E. Morel, S. Oliveira and G. Yang, "A Fast Multigrid Algorithm for Isotropic Transport Problems I: Pure Scattering," *SIAM J. Sci. and Stat. Comp.*, Vol. 16, NO. 3, pp. 601-635, May 1995.
33. T.A. Manteuffel, G. Starke and R. S. Varga, "Adaptive  $K$ -step Iterative Methods for Nonsymmetric Systems of Linear Equations", *Electr. Trans. Numer. Anal.*, Vol. 3, pp 50-65, (1995).
34. Z. Cai, T.A. Manteuffel and S. F. McCormick, "First-Order System Least Squares for Velocity-Vorticity-Pressure Form of the Stokes Equations, with Application to Linear Elasticity", *Electronic Transactions in Numerical Analysis*, Vol. 3, pp150-159, (1995).
35. T.A. Manteuffel, S.F. McCormick, J.E. Morel and G. Yang, " A Fast Multigrid Algorithm for Isotropic Transport Problems II: with Absorption," *SIAM J. Sci. and Stat. Comp.*, Vol. 17, No. 6, pp. 1449 - 1474, (1996).
36. V. Faber, W. Joubert and E. Knill and T.A. Manteuffel, "Minimal Residual Method Stronger Than Polynomial Preconditioning", *SIAM J. Mat. Anal.*, Vol. 17, No. 4 (1996).

37. T.A. Manteuffel and G. Starke, “On Hybrid Iterative Methods for Nonsymmetric Systems of Linear Equations”, *Numerische Math.*, Vol. 73, No. 4, pp. 489 - 506, (1996).
38. Z. Cai, T.A. Manteuffel and S. McCormick, “First-order System Least Squares for Second-Order Partial Differential Equations: Part II”, *SIAM J. Numer. Anal.*, Vol. 34, No. 2, (1997).
39. Z. Cai, T.A. Manteuffel and S. McCormick, “First-order System Least Squares for Stokes Equations with Application to Linear Elasticity”, *SIAM J. Numer. Anal.*, Vol. 34, No. 5, pp. 1727-1741 (1997)
40. M. Berndt, T. A. Manteuffel, and S. F. McCormick “Local error estimates and adaptive refinement for first-order system least squares (FOSLS) *E.T.N.A.*, Vol. 6, pp. 35–43 (1998).
41. Z. Cai, T.A. Manteuffel, S.F. McCormick and S. V. Parter, “First-order System Least-squares for the Pure Traction Problem in Planar Linear Elasticity”, *SIAM J. Numer. Anal.*, Vol. 35, No. 1, pp. 320-335 (1998).
42. T.A. Manteuffel and Klaus Ressel, “Least-squares finite-element solution of the neutron transport equation in diffusive regimes”, *SIAM J. Numer. Anal.*, Vol. 35, No. 2, (1998).
43. J.-M. Fiard, T.A. Manteuffel and S. McCormick, “First-order system least squares (FOSLS) for convection-diffusion problems: numerical results”, *SIAM J. Sci. Comp.*, Vol. 19 (1998), pp. 1958-1979.
44. P. Bochev, Z. Cai, T.A. Manteuffel and S. McCormick, “Analysis of velocity-flux least-squares principles for the Navier-Stokes equations: Part I”, *SIAM J. Numer. Anal.*, Vol. 35, No. 3, pp 990 - 1009 (1998).
45. P. Bochev, Z. Cai, T.A. Manteuffel and S. McCormick, “Analysis of velocity-flux least-squares principles for the Navier-Stokes equations: Part II”, *SIAM J. Numer. Anal.*, Vol. 36, No. 4, pp 1125-1144 (1999).
46. T. A. Manteuffel, K. J. Ressel and G. Starke, “A boundary functional for the least-squares finite element solution of the neutron transport equation”, *SIAM J. Numer. Anal.*, Vol. 37, No. 2, pp. 556–586 (2000).
47. T. A. Barth and T. A. Manteuffel, “Multiple recursion conjugate gradient methods, part I: sufficient conditions, *SIAM J. Matrix Anal. and Apps.*, Vol. 21, No. 3, pp. 768–796 (2000).
48. Z. Cai, C.-O. Lee, T. A. Manteuffel, and S. F. McCormick, “First-order system least squares for the Stokes and elasticity equations: further results”, *SIAM J. Sci. Comp.*, Vol. 21, pp. 1728-1739 (2000).

49. B. Lee, T. A. Manteuffel, S. F. McCormick, and J. Ruge, “First-order system least-squares (FOSLS) for the Helmholtz equation”, *SIAM J. Sci. Comp.*, Vol. 20, pp. 1927–1949, April 2000.
50. Z. Cai, C.-O. Lee, and T. Manteuffel, and S. F. McCormick, “First-order system least squares for planar linear elasticity: numerical results”, *SIAM J. Sci. Comp.*, Vol. 21, p. 1706-1727 (2000).
51. A. Cleary, R. Falgout, V. Henson, J. Jones, T. Manteuffel, S. F. McCormick, G. Miranda, and J. Ruge, “Robustness and scalability of algebraic multigrid (AMG)”, *SIAM J. Sci. Comp.* Vol. 21, No. 5, pp. 1886 - 1908, (2000)
52. S.-D. Kim, T.A. Manteuffel and S. McCormick, First-order system least squares (FOSLS) for spatial linear elasticity: pure traction, *SIAM J. Numer. Anal.*, Vol. 38, No. 5, pp. 1454-1482 (2000).
53. M. Brezina, A. Cleary, R. Falgout, V. Henson, J. Jones, J. Ruge, T. Manteuffel, S. F. McCormick, “Algebraic multigrid based on element interpolation (AMGe)”, *SIAM J. Sci. Comp.* Vol. 22, No. 5, pp. 1570-1592, (2001).
54. S. F. Ashby, M. J. Holst, T.A. Manteuffel and P. E. Saylor, “The Role of the Inner Product in Stopping Criteria for Conjugate Gradient Iterations”, *B.I.T.*, Vol 41, No. 1, (2001).
55. Z. Cai, T. A. Manteuffel, S. F. McCormick, “First-order system  $\mathcal{LL}^*$  (FOSLL\*): scalar elliptic partial differential equations”, *SIAM J. Numer. Anal.* Vol. 39, No. 4, pp. 1418 - 1445 (2001).
56. E. Chow, T. A. Manteuffel, C. Tong, B. K. Wallin, “Algebraic elimination of slide surface constraints in implicit structural analysis”, *Inter. J. for Numer. Meth. in Eng.*, 01, 1-21 (2002)
57. J. J. Heys, C. G. DeGroff, W. W. Orlando, T. A. Manteuffel, S. F. McCormick, “First-order system least squares for elasto-hydrodynamics with application to flow in compliant blood vessels”, *Biomed. Sci. Instr.* 38 (2002), pp. 277-282.
58. T. Chartier, R. Falgout, J. Jones, V. E. Henson, T. Manteuffel, S. F. McCormick, J. Ruge, and P. Vassilevski, “Spectral element AMGe”, *SIAM J. Sci. Comp.*, Vol. 25, No. 1, pp. 1-26, (2003).
59. P. N. Brown, B. Lee, T. A. Manteuffel, “A moment-parity multigrid preconditioner for the first-order least-squares formulation of the Blotzmann transport equations”, *SIAM J. Sci. Comp.*, Vol. 25, No. 2, pp. 513-533, (2003).
60. T. A. Manteuffel, S. F. McCormick and C. Pflaum, “Improved discretization error estimates for first-order system least-squares (FOSLS)”, *J. of Numer. Math.*, Vol. 11, pp. 163-177,(2003).

61. A. Codd and T. A. Manteuffel, and S. F. McCormick, “Multilevel first-order system least squares for nonlinear partial differential equations, with application to elliptic grid generation”, *SIAM J. Numer. Anal.*, Vol. 41, pp. 2197–2209,(2003).
62. A. Codd, T. A. Manteuffel, S. F. McCormick, and J. Ruge, “Multilevel first-order system least squares for elliptic grid generation: ellipticity and computational results”, *SIAM J. Numer. Anal.*, Vol. 41, pp. 2210–2232, (2003).
63. J. Heys, T. A. Manteuffel, S. F. McCormick and J. Ruge, “First-order system least-squares (FOSLS) for coupled fluid-elastic problems”, *J. Comp. Phys.*, 195(2): 560-575, (2004).
64. H. R. MacMillan, T. A. Manteuffel, and S. F. McCormick, “First-order system least squares and electrical impedance tomography: part I”, *SIAM J. Numer. Anal.*, Vol. 42, No. 2, pp. 461–483, (2004).
65. H. de Sterck, T. A. Manteuffel, S. F. McCormick, and L. Olson, “Least-Squares finite element methods for linear hyperbolic PDEs”, *SIAM J. Sci. Comp.*, Vol. 26, No. 1, pp. 31–54, (2004).
66. M. Brezina, R. Falgout, S. MacLachlan, T. A. Manteuffel, S. F. McCormick, and J. Ruge, “Adaptive smoothed aggregation (aSA)”, *SIAM J. Sci. Comp.*, Vol. 25, No. 6, pp. 1896–1920, (2004).
67. J. J. Heys, C. G. DeGroof, T. A. Manteuffel, S. F. McCormick, and H. Tufo, Modeling 3-d compliant blood flow with FOSLS, *Biomed Sci Instrum.* 40, pp. 193–199, (2004).
68. T. M. Austin, T. A. Manteuffel and S. F. McCormick, “A robust multilevel approach to minimizing  $H(\text{div})$  dominated functionals in an  $H^1$ -conforming finite element space”, *J. Numer. Lin. Alg. App.*, vol. 11, pp. 115-140, (2004).
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- Department of Energy, Applied Mathematical Sciences, Grant DE-FG02-89ER25082, “Copper Mountain Conference on Iterative Methods,” September 25, 1989–September 24, 1990, \$6,500.
- National Science Foundation Grant DMS-8920562 “ Math Sciences: Copper Mountain Conference on Iterative Methods,” March 15, 1990 – November 30, 1990, \$17,500.
- Sandia National Labs, “Research Fellowship: Jim Jones”, August 15, 1990 – May 31, 1992, \$31,510.
- Department of Energy, Applied Mathematical Sciences Grant DE-FG02-90ER25086, “Fast Algorithms for Transport Models”, June 1, 1990 – May 31, 1993, \$168,878.
- National Science Foundation Grant ASC-9015308, “Postdoctoral Research Associate: Wayne Joubert”, January 1, 1991 – June 30, 1993, \$39,730.
- National Science Foundation, DMS-9015259, “Multilevel Algorithms for Advanced Computers”, March 15, 1991 – August 31, 1993, \$450,000. (Principal Investigators; Thomas A. Manteuffel and Steven F. McCormick).
- National Science Foundation Grant ASC-9108785, ”Postdoctoral Research Associate: James Otto”, January 1, 1992 – February 28, 1994, \$39,790.
- Department of Energy, Applied Mathematical Sciences Grant DE-FG02-90ER25086, “Copper Mountain Conference on Iterative Methods”, October 1, 1991 – September 31, 1992, \$46,500.
- Department of Energy, Applied Mathematical Sciences Grant DE-FG03-93ER25165, “Fast Algorithms for Transport Models”, June 1, 1993 – May 31, 1994, \$100,801.
- Department of Energy, Applied Mathematical Sciences Grant DE-FG03-94ER25217, “Fast Algorithms for Transport Models”, July 1, 1994 – June 30, 1996, \$178,157.

- National Science Foundation, DMS-9312752, “Multilevel and Algebraic Iterative Methods in Large-Scale Computing”, August 8, 1994 – July 31, 1997, \$450,000. (Principal Investigators; Thomas A. Manteuffel, Steven F. McCormick and Thomas F. Russell).
- National Science Foundation, DMS-9706866, “Multilevel and Algebraic Iterative Methods in Large-Scale Computing”, September 1, 1997 – August 31, 2000, \$435,000. (PIs: Thomas A. Manteuffel, Steven F. McCormick and Thomas F. Russell)
- Department of Energy, Applied Mathematical Sciences Grant DE-FG03-94ER25217, “Fast Algorithms for Transport Models”, (PI: Tom Manteuffel, Co-PI: Steve McCormick) July 1, 1996 – June 30, 1999, \$312,896.
- IBM, Shared University Research Proposal, 12 node IBM - SP2, list price \$889,000.
- National Institute of Health, “Computational Biomechanics of Coupled Systems via FOSLS”, (PI: Victor Barocas), September 1, 1998 - August 31, 2000, \$146,340.
- Department of Energy, ASCI 2, “Scalable Algorithms for Massively Parallel Computers”, (PI: Tom Manteuffel, Co-PI: Steve McCormick, Charbel Farhat, K.C. Park) December 1, 1998 - October 31, 2001, \$1,890,000.
- Department of Energy, Applied Mathematical Sciences Grant DE-FG03-99ER25217, “First-order system least-squares (FOSLS): fundamentals and applications” , (PI: Tom Manteuffel, Co-PI: Steve McCormick) July 1, 1999 – June 30 2002, \$300,000.
- National Science Foundation, DMS-0084438, “First-order System Least Squares (FOSLS) for Partial Differential Equation”, (PI: Steve McCormick, Co-PI: Tom Manteuffel), October 1, 2000 – September 30, 2003, \$329,999.
- Sandia National Laboratories, grant no. 1100.12.1512B, “Fast and Accurate Numerical Solution of Maxwell Equations”, October 1, 2000 – September 31, 2006, \$382,865.
- DOE, SciDAC: Project title: Terascale optimal PDE systems (TOPS), grant no. : DE-FC02-01ER25479, (PI: Steve McCormick, Co-PI: Tom Manteuffel, Xiao-Chuan Cai), 7/01-6/06 Total Award \$1,580,000.
- Lawrence Livermore National Laboratory, “FAC, Adaptive AMG, and Compatible Relaxation for solving problems that arise in LLNL applications.” (PI; Steve McCormick, Co-PI: Tom Manteuffel), 7/03-3/04, Total award: \$124,662
- DOE, ASCR: “First-order system least-squares (FOSLS): fundamentals and applications.” grant no. DE-FG02-03ER25574. (PI: Tom Manteuffel, Co-PI: Steve McCormick) 9/15/03-9/14/06, Total award: \$489,246.
- NSF, Project: “hp-adaptive FOSLS methods for nonlinear problems with singularities”, grant no. DMS-0410318, (PI: Tom Manteuffel, Co-PI: Steve McCormick), 10/04 - 9/07, Total Award: \$350,000.

- IBM Shared University Research (SUR) Proposal, Gift of Linux Cluster: Occam (PI Henry Tufo, Co-PI: Tom Manteuffel), 10/04-9/05
- NSF MRI Grant, (PI: Henry Tufo, Co-PI: Tom Manteuffel, Steve McCormick, Xiao-Chuan Cai) 11/04 - 12/07, Total Award: \$1,200,000.
- NSF, Project title: CMG: Modelling River Basin Dynamics: Parallel Computing and Advanced Numerical Methods, (PI: Scott Peckham, PI: Tom Manteuffel, Co-PIs: Steve McCormick, and Greg Tucker), Grant no: EAR - 0621199, 9/15/06 - 8/31/10, Total award; \$900,000.
- DOE, Project title: Towards Optimal Petascale Simulation (TOPS), (PI: Steve McCormick, Co-PI: Tom Manteuffel, X.C. Cai), Grant no: , 9/15/06 - 9/14/11, Total award: \$900,000
- DOE, Project Title: First-order system least-squares (FOSLS) for nonlinear systems arising from DOE applications, (PI: Tom Manteuffel, Co-PI: Steve McCormick) 11/15/06 - 10/01/09, Total Award: \$623,499.
- NSF, Project Title: Petascale Multilevel Quantum Chromodynamics, (PI: Steve McCormick, Co-PI: Tom Manteuffel), 1/01/08 - 12/31/11, Total Award: \$488,704.
- NSF, Project Title: Enhanced Least-Squares Methods for PIV Analysis, (PI: Steve McCormick, Co-PI: Tom Manteuffel, 10/1/08 - 9/30/11, Total Award: \$150,000.
- DOE, Project Title: First-order system least-squares (FOSLS) for nonlinear systems arising from DOE applications, (PI: Tom Manteuffel, Co-PI: Steve McCormick) 10/01/10 - 1/31/14, Total Award: \$759,836.
- NSF, Project Title: Collaborative Research: Least-Squares Finite Element Methods for Data Assimilation in Large-Scale Simulations, (PI: Tom Manteuffel, Co-PI: Steve McCormick) 3/01/13 - 2/28/16, Total Award: \$262,000.
- DOE, Project Title: Center for Exascale Radiation Transport, (PI: Tom Manteuffel, Co-PI: Steve McCormick) (subcontract throughout Texas A & M) 10/01/13 - 09/30/18, Total Award: \$1,000,000.
- DOE, Project Title: First-order system least-squares (FOSLS) for nonlinear systems arising from DOE applications, (PI: Tom Manteuffel, Co-PI: Steve McCormick) 1/31/14 - 1/31/17, Total Award: \$750,094.