

## CURRICULUM VITAE

**NAME:** William W. Hager

**PRESENT POSITION:** Distinguished Professor

**HOME ADDRESS:** 462 Little Hall  
Gainesville, Florida 32611

**DEGREES:** Ph.D., Massachusetts Institute of Tech. - 1974  
M.S., Massachusetts Institute of Tech. - 1971  
B.S., Harvey Mudd College - 1970

**RESEARCH INTERESTS:** Numerical analysis, optimization, optimal control, lightning.

### **PROFESSIONAL EXPERIENCE:**

Distinguished Professor, 2018–present.  
Co-director, Center for Applied Optimization, 1992–present.  
Professor, University of Florida, 1988–present.  
Professor, The Pennsylvania State University - 1986–1988.  
Associate Professor, The Pennsylvania State University - 1980–1986.  
Assistant Professor, Carnegie-Mellon University - 1976–1980.  
Assistant Professor, University of South Florida, 1974–1976.  
Consultant, Naval Surface Weapons Center, 1976–1980.

### **GOOGLE SCHOLAR:**

12,259 citations on November 14, 2018  
50 papers cited by at least 50 different papers (h-index)  
118 papers with at least 10 citations (i10-index)

### **OTHER INDICES:**

5199 citations by 3772 different articles in Science Citation Index  
2360 citations by 1910 different authors in Mathematical Reviews Citation Database.

## **AWARDS AND FELLOWSHIPS**

1. Chinese Operations Research Society Best Paper Prize awarded in 2018 for the paper “Alternating Direction Approximate Newton Method for Partially Parallel Imaging” by William W. Hager, Cuong Ngo, Maryam Yashtini, and Hongchao Zhang, Journal of Operations Research Society of China, 3 (2015), pp. 139-162.
2. SIAM Fellow, 2015–.
3. Colonel Allan R. and Margaret G. Crow Term Professorship, 2015–2016.
4. University of Florida Research Foundation Professorship, 2008–2011.
5. Naval Ordnance Laboratory Postdoctoral Fellowship, 1974 (not accepted)..
6. National Science Foundation Fellowship, 1970-1973..

## **GRANTS:**

1. “Plasticity theory and the finite element method”, National Science Foundation, Award 7509457, 1976–1977, \$6,200.
2. Supported by Office of Naval Research Grant N00014-76-C0369, 1977, George Fix, PI.
3. Supported by Office of Naval Research Grant NR041-543, 1978-1979, George Fix, PI.
4. “Optimal control and finite elements, National Science Foundation, Award 7825526, 1979–1981, \$37587 (with G. Knowles).
5. “Control systems governed by partial differential equations,” National Science Foundation, Award 8101892, 1981–1984, \$111,427, (with W. Mills and G. Chen).
6. “Optimization and numerical analysis,” National Science Foundation, Award 8401758, 1984–1986, \$41,000.
7. “Numerical techniques in control and optimization,” National Science Foundation, Award 8520926, and Air Force Office of Scientific Research Award AFOSR-ISSA-860091, 1986–1989, \$122,770.
8. “Analysis and design of elastic materials,” National Science Foundation Grant DMS8602006 (1986-1988) and Office of Naval Research grant N00014-86-K-0498 (joint grants), \$36,690, (with R. Rostamian).
9. Supported by NASA grant NGL 39-009-003 and by NSF grant ATM 831193, 1987-1988, John Nisbet PI.
10. Coauthor of SCREMS proposal DMS 8704431, \$62,000 (Jerry Bona and William Pritchard PIs).
11. “Optimal Control, Optimal Design, Composite Materials, Layered Materials,” U.S. Army Innovative Research Grant, 1988, \$37,500.

12. "Analysis and optimization of elastic materials," Army Research Office, September, 1989, to September, 1991, \$75,000.
13. "Numerical techniques in control and optimization," National Science Foundation, Award 8903226, June, 1989 to June, 1990, \$15,000.
14. "Numerical techniques in control and optimization," National Science Foundation, Award 9022899, May, 1990 to May 1991, \$24,000.
15. Modeling and measurement of lightning," National Science Foundation, Award 9115752, June, 1991 to June, 1993, \$100,000.
16. "Numerical techniques in control and optimization," National Science Foundation, Award 8520926, June, 1991, to June 1992, \$24,272.
17. "Conference on large-scale optimization," National Science Foundation, January, 1993 to January, 1994, \$15,000.
18. "Conference on large-scale optimization," Army Research Office, January, 1993, to January, 1994, \$10,000 (with D. Hearn).
19. "Lipschitz stability and its application to numerical analysis in optimal control," National Science Foundation, May, 1994 to May 1997, Award 9404431, \$95,940.
20. "Conference on Network Optimization," National Science Foundation, Award 9522573, January, 1996, to January, 1997, \$15,000 (with P. Pardalos and D. Hearn).
21. "Conference on optimal control: Theory, algorithms, and applications," National Science Foundation, January, 1997, to January, 1998, \$7,500.
22. "Discrete approximations in variational problems," National Science Foundation, Award 9704912, July, 1997, to July 2000, \$135,000.
23. "Innovative sparse matrix algorithm," National Science Foundation, Award 9803599, July, 1998, to July, 2001, \$192,729, (with Tim Davis).
24. "Modeling and Optimal Design in Micro-optics," National Science Foundation, Award 9815798, March, 1999, to March, 2002, \$17,100 (with Gang Bao and Shari Moskow).
25. "Sparse matrix algorithms and their application to dual active set techniques in optimization," National Science Foundation, Award 0203270, July, 2002, to July 2006, \$510,000 (with Tim Davis).
26. "University of Florida 2003/2004 Special Year in Mathematics," National Science Foundation, Award 0324609, September, 2003, to September, 2004, \$30,000 (with Y. Chen, S. Moskow, T. Davis, and J. Gopalakrishnan).
27. "SCREMS: Developing Computational Mathematics at the University of Florida," National Science Foundation, Award 0619080, July, 2006, to July, 2009, \$81,000 (with J. Gopalakrishnan, S. Moskow, T. Davis, B. Mair).

28. “MSPA-ENG: Scalable Sparse Matrix Algorithms and Software for Nonlinear Optimization,” National Science Foundation, Award 0620286, August, 2006, to August, 2009, \$460,000 (with T. Davis).
29. “CMG COLLABORATIVE RESEARCH in Measurement and Analysis of Thunderstorm Electrification and Lightning,” National Science Foundation, Award 0724750, September, 2007, to August, 2011, \$426,368 (Joint project with New Mexico Tech receiving \$619,477 in DMS 0724771 for instrumentation development, Hager is overall project PI).
30. “A Computational Approach for Near-Optimal Path Planning and Guidance for Systems with Nonholonomic Constraints,” Army Research Office, Award 55173-CI, January, 2009, to September, 2009, \$50,000 (with Anil Rao).
31. “Next-Generation Framework for Real-Time Solutions of Nonlinear Optimal Control Problems,” Office of Naval Research, Award N000141110068, November 1, 2010, to September 30, 2013, \$551,728 (with Anil Rao).
32. “A Computational Framework for Rapid, Reliable, and Robust Solutions to Complex Constrained Nonlinear Optimal Control Problems,” Defense Advanced Research Projects Agency (DARPA), October 24, 2011, to October 23, 2014, \$988,194 (with Anil Rao).
33. “Collaborative Research: Fast TV-Regularized Large-Scale and Ill-Conditioned Linear Inversion with Application to PPI,” National Science Foundation, September 15, 2011, to September 14, 2014, \$241,579 (with Yunmei Chen).
34. “Third University of Florida SIAM Gators Conference,” National Science Foundation, March 15, 2014, to March 14, 2016, \$15,300 (with Yunmei Chen, Maia Martcheva, and Scott McKinley).
35. “Innovations in Large-Scale Sparse Optimization and Applications,” Office of Naval Research (Mathematics), March 1, 2015, to February 28, 2018, \$479,869 (with Anil Rao).
36. “Fast Sparse Nonlinear Optimization and its Application to Optimal Control,” National Science Foundation DMS, July 15, 2015, to June 30, 2018, \$294,061 (with Anil Rao).
37. “Pseudospectral Optimal Control for Flight Trajectory Optimization,” (Phase 1) US Navy, June 16, 2015, to January 15, 2017, \$72,500 (with Anil Rao).
38. “Solution of Optimal Control Problems for Boost Glide High-Speed Applications,” Air Force Research Laboratory, September 9, 2015, to December 7, 2017, \$358,843 (with Anil Rao).
39. “Pseudospectral Optimal Control for Flight Trajectory Optimization,” (year 1 of phase 2) Office of Naval Research, January 5, 2017, to January 4, 2018, \$143,904 (with Anil Rao).
40. “Pseudospectral Optimal Control for Flight Trajectory Optimization,” (year 2 of phase 2) Office of Naval Research, January 5, 2018, to January 4, 2019, \$151,676 (with Anil Rao).

41. “Innovations in the use of Second Derivatives in Large-Scale Sparse Optimization,” Office of Naval Research, March 1, 2018, to February 28, 2019, \$91,735.
42. “Polyhedral Techniques for Fast Sparse Nonlinear Optimization and their Application to Nonsmooth Optimal Control,” National Science Foundation, August 1, 2018, to July 31, 2021, \$200,000.

### **HONORARY SOCIETIES:**

### **ORGANIZATIONS:**

Society for Industrial and Applied Mathematics  
 Mathematical Programming Society  
 American Geophysical Union

### **EDITORIAL BOARDS:**

SIAM Journal on Optimization (Associate editor, 2013–)  
 Computational Optimization and Applications (Managing editor, 1992–)

### **OTHER PROFESSIONAL ACTIVITIES:**

1. Participated in several international meetings in Poland, Bulgaria, China, Korea, Romania; 5 conferences at Oberwolfach.
2. Invited Professor at the Institut de Recherche d’Informatique et d’Automatic, Rocquencourt, France, October–December, 1975 (now INRIA).
3. Invited Professor at Systems Research Institute, Polish Academy of Sciences, September 1–15, 1977, and September 3–12, 1979.
4. Invited Professor, Mathematics Research Center, University of Montreal, May, 1977.
5. Invited Professor, Department of Mathematics, Colorado State University, Fort Collins, Colorado, Spring Term, 1980.
6. Advisor, Personnel Committee for appointments in applied mathematics, Pennsylvania State University, 1980–1981.
7. Liaison Committee between the Mathematics Department and the Dean, Pennsylvania State University, 1980–1982.
8. Personnel Committee, Pennsylvania State University, 1981–1985.
9. Applied Analysis Chairman, Pennsylvania State University, 1983–1986.
10. Numerical Analysis Chairman, Pennsylvania State University, 1987–1988.
11. Graduate Affairs Committee, Pennsylvania State University, 1981–1984.
12. Computer Committee, Pennsylvania State University, 1982–1988.

13. Editor-in-Chief of the journal Computational Optimization and Applications, 1992–present.
14. Program Director for SIAM Activity Group on Signals, Systems, and Control, 1998–2001.
15. Co-chair of the 2001 SIAM Control Conference.
16. Organized four conferences (Large-scale optimization, network optimization, optimal control, and multiscale optimization) between 1993 and 2004, published a book with each conference consisting of presented papers.
17. In 2013, organized a minisymposium for the SIAM Annual Meeting entitled Recent Advances in Computational Algorithms for Image Analysis and a minisymposium for the SIAM Control Conference entitled Direct Transcription Methods in Optimal Control.
18. With the students in UF’s SIAM student chapter, the SIAM Gators, we have organized the Third SIAM Gators Student Conference, March 27–29, 2014.
19. With Hongchao Zhang, organized two sessions at the International Symposium on Mathematical Programming, July 12–17, 2015, entitled Recent Advances in Computational Optimization.
20. CBMS Principal Lecturer for Computational Methods in Optimal Control, July 23–27, 2018, Jackson State University.

## **REVIEWING & REFEREEING ACTIVITIES**

100 reviews written of articles that appear in Mathematical Reviews. Have served on numerous NSF panels; evaluate proposals for NSF, Army, DOE, Hong Kong Research Grants Council, and European agencies; review about 1 journal article per month. In addition, the following books have been reviewed:

1. Functional Analysis and Linear Control Theory by J.R. Leigh, SIAM Review, 24 (1982), 349.
2. Mathematical Programming and Control Theory by B.D. Craven, SIAM Review, 22 (1980), 377-378.
3. Optimal Processes on Manifolds by Roll Nottrot, SIAM Review, 27 (1985), 104.
4. Numerical Analysis of Variational Inequalities by R. Glowinski, J.L. Lions, and R. Tremolieres, Bulletin of the American Mathematical Society, 8 (1983), 100-102.
5. Analysis of Global Expansion Methods: Weakly Asymptotically Diagonal Systems, by L.M. Delves and T.L. Freeman, SIAM Review, 25 (1983), 123-124.
6. Computational Functional Analysis by Remon E. Moore, SIAM Review, 28 (1986), 260.
7. A Rational Finite Element Basis by G. Wachspress, Mathematical Reviews.

8. An Introduction to the Mathematical Theory of Finite Elements by J.T. Oden and J.N. Reddy, Mathematical Reviews.
9. Advances in Nonlinear Parameter Optimization by Rudiger Schmidt, Mathematical Reviews.

**MENTIONED IN LISTINGS:**

Men and Women of Science, Marquis Who's Who, and other related listings.

**THESES AND DISSERTATIONS DIRECTED:**

1. George D. Ianculescu, Ph.D., 1979, "Semi-dual approximations for convex optimal control problems".
2. Dwayne L. Presler, Ph.D., 1984, "A dual approach to minimax".
3. Holly Hirst, Ph.D., 1989, "n-step quadratic convergence in the conjugate gradient method".
4. Wei-Chang Shann, Ph.D., 1991, "Finite element methods for Maxwell's equations with stationary magnetic fields".
5. Purandar Sarmah, Ph.D., 1993, "Application of eigenvalue and eigenvector sensitivity in eigencomputations".
6. Chun-Liang Shih, Ph.D., 1995, "Active set strategies in optimization".
7. Soon Chul Park, Ph.D., 1999, "Two-set graph partitioning".
8. Shu-Jen Huang, Ph.D., 2005, "Multiscale Discretization of Electric-Field Equations" (senior lecturer at University of Florida).
9. Hongchao Zhang, Ph.D., 2006, "Large-scale optimization," SIAM Best Student Paper Prize, 2006 (Industrial Postdoc at IMA, 2006–2008, associate professor at Louisiana State University).
10. Beyza Aslan, Ph.D., 2007, "Continuous approach to the lightning discharge" (associate professor at University of North Florida).
11. Jiangtao Luo, Ph.D., 2009, "Functional mapping of dynamic systems" (assistant professor at University of Nebraska).
12. Dzung Phan, Ph.D., 2010, "Topics in global optimization: ellipsoidal bisection, graph partitioning and sparse reconstruction" (research scientist at IBM Watson Research Center).
13. Delphine Mico-Umutesi, Ph.D., 2013, "Estimating the violation of the KKT conditions" (Decision Support Group, Intel).
14. Hongyan Hou, Ph.D., 2013, "Convergence analysis of orthogonal collocation methods for unconstrained optimal control" (postdoc, Carnegie Mellon University).
15. James Hungerford, Ph.D., 2013, "The vertex separator problem and edge-concave quadratic programming," (postdoc, University of Pisa).

16. Wei Feng, Ph.D., 2013, “Charge transport analysis for lightning,” (Gleim Publications, Gainesville).
17. Jie Li, Ph.D., 2014, “Multiset graph partitioning”.
18. Maryam Yashtini, Ph.D., 2014, “Fast TV-regularized large-scale and ill-conditioned linear inversion with application to partially parallel MRI,” (NSF IMPACT postdoc, Georgia Tech, currently, Assistant Professor Georgetown University).
19. Jiajie Zhu, Ph.D., 2015, “Efficient Sparse Optimization Algorithms: Designing Non-convex and Distributed Algorithms for Machine Learning and Engineering Applications,” (postdoc, Boston College).

### **DEPARTMENTAL SERVICE:**

Computer Committee, 1989  
 Search Committee, 1989-1990  
 Search Committee, 1994-1995  
 Hiring plan committee (2000–present)  
 Group proposals committee (2009–present)  
 Computer committee (2009–present)  
 Graduate committee (2009–2011)  
 Numerical analysis PhD exam committee (1997–present)

### **UNIVERSITY SERVICE:**

Dean’s Advisory Committee and College Computer Committee, 1989-1990

### **TALKS, LECTURES, AND INVITED ADDRESSES AT MEETINGS**

1. “Duality, regularity, and approximation of state constrained control problems,” American Mathematical Society Summer Meeting, August 1978.
2. “Inequalities approximation,” Symposium in honor of Richard J. Duffin, Mellon Institute of Science, July 1978.
3. “Semi-dual approximations in optimal control,” Texas Institute for Computational Mechanics, 1979.
4. “Semi-dual approximations in optimal control, Ninth IFIP conference on Optimization Techniques, Warsaw, Poland, September 1979.
5. “Dual methods in optimal control,” Pavia, Italy, September 1979.
6. “Perturbation theory and error estimates in numerical analysis,” ORSA-TIMS Conference, October 1979.
7. “Semi-dual approximations in optimal control,” Third IMACS International Symposium on Computer Methods for Partial Differential Equations, Lehigh University, June 20-22, 1979.
8. “Perturbations in eigenvalues,” Workshop on Numerical Techniques for Systems Engineering Problems, University of Kentucky, June 1980.



9. "Semi-dual approximations," International Conference on Mathematical Methods in Operations Research, Sofia, Bulgaria, November 1980.
10. "Discontinuous Galerkin methods for ordinary differential equations," Oberwolfach, Germany, 1980.
11. "Minimax problems in optimal control," ICASE-NASA Langley Research Center Workshop on Control and Identification of Distributed Parameter Systems, Hampton, Virginia, April 1981.
12. "Solving dual finite element problems," The Finite Element Circus, University of Texas, November 1982.
13. "Penalty Techniques," Optimization Days, Montreal, May 1982.
14. "Numerical techniques for dual finite element problems," The Finite Element Circus, Duke University, April 1985.
15. "Penalty Methods," The Finite Element Circus, University of Chicago, December 1983.
16. "Preconditioning for the finite element method," The Finite Element Circus, Duke University, April 1985.
17. "Minimax, augmented Lagrangians, constrained optimization, and optimal coatings," SIAM Summer Meeting, Pittsburgh, June 1985.
18. "Optimal coatings, bang-bang controls, and gradient techniques," 22nd Annual Technical Meeting of the Society for Engineering Science, The Pennsylvania State University, October 1985.
19. "Dual techniques for constrained optimization," The 24th IEEE Conference on Decision and Control, Fort Lauderdale, Florida, December 1985.
20. "Numerical techniques in optimal control," Workshop in optimal control, West Virginia University, April 1987.
21. "Inf-Sup parameters in numerical analysis," 833rd AMS meeting, Kent State University, April 1987.
22. "A globally convergent algorithm for constrained optimization," SIAM Conference of Optimization, Houston, May 1987.
23. "Dual techniques for constrained optimization," Workshop on Applications and Algorithms for Optimal Control and Parameter Identification, Trier University, Germany, June 1987.
24. "A globally convergent algorithm for constrained optimization," First International Conference on Industrial and Applied Mathematics, Paris, June-July 1987.
25. "Reflection and refraction of elastic waves for stratified materials," IFIP-TC7, Santiago de Compostela, Spain, July 1987.
26. "Active constraints in optimization," 10th Symposium on Mathematical Programming with Data Perturbations, George Washington University, Washington, DC, May 1988.

27. "Multiplier methods for nonlinear optimal control," Finite Element Circus, Purdue University, March-April 1989.
28. "Updating the inverse of a matrix," Conference on Linear Algebra and its Applications, Northern Illinois University, April 1989.
29. "Multiplier methods for nonlinear optimal control," SIAM Conference on Control in the 1990s, San Francisco, May 1989.
30. "Dual techniques for constrained optimization II," International conference on optimization and control, Trier, Germany June 1989.
31. "Estimating matrix condition numbers," SIAM Annual Meeting, San Diego, July 1989.
32. "Simulations for the electric fields in a thunderstorm," National Center for Atmospheric Research, Boulder, Colorado, July 1989.
33. "Optimal penalties," Conference on Finite Elements, University of Maryland/Baltimore County, November 1989.
34. "Dual techniques for constrained optimization II," 28th IEEE Conference on Decision and Control, Tampa, December 1989.
35. "Dual techniques in optimization and control," North Carolina State University, April 5, 1990.
36. "Sensitivity in optimal control," presented at the conference Optimal Control of Partial Differential Equations, April 11, 1990, Irsee, Germany.
37. "Dual techniques in optimization," University of North Florida, April 27, 1990.
38. "Sensitivity in nonlinear optimal control," Colorado State University, May 18, 1990.
39. "A dual method for constrained optimization," Florida Institute of Technology, March 1, 1991.
40. "Dual active sets and constrained optimization," Applied Mathematical Programming, London, January 15, 1991.
41. "The dual active set algorithm," presented at the Conference on Numerical Optimization Methods in Differential Equations and Control, North Carolina State University, July, 1991.
42. "Lipschitzian stability in nonlinear control and optimization," presented at the second annual Ulam Mathematics Conference, March, 1991.
43. "The dual active set algorithm," ICIAM conference, Washington D.C., July, 1991.
44. "Numerical methods in optimal control," SIAM meeting in Seattle, August, 1993.
45. "The dual active set algorithm for linear programming, Mathematical Programming Society Triennial Conference, Ann Arbor, MI. August, 1994.

46. "Numerical methods in optimal control," April, 1995, SIAM Conference on Control.
47. " $L^\infty$  stability analysis for control problems with state constraints," July, 1995, IFIP Conference, Warsaw.
48. "Convergence of algorithms for state constrained optimal control," October, 1995, SIAM annual meeting, Charlotte.
49. "An Analysis of the Errors in the Location, Current, and Velocity of Lightning," December, 1995, Fall meeting of the American Geophysical Union.
50. "Stability analysis for state constrained control," SIAM Conference on Optimization, Victoria, May, 1996.
51. "Stability analysis for state constrained control," SIAM Annual Meeting, St. Louis, July, 1996.
52. "Active Set Strategies and the LP Dual Active Set Algorithm," INFORMS conference, Atlanta, October, 1996.
53. "Stability in the Presence of Degeneracy and Error Estimation," Nineteenth Symposium on Mathematical Programming with Data Perturbations, George Washington University, Washington, DC, May 22-23, 1997.
54. "The LP Dual Active Set Algorithm," Conference on High Performance Computing, Naples, June 4-6, 1997.
55. "Discrete approximations for state constrained control problems," 18th IFIP TC7 Conference on System Modeling and Optimization, Detroit, July, 1997.
56. "Euler approximation in state constrained optimal control," International conference on dynamics and control, Mexico, November, 1997.
57. "The wave annihilation technique and the design of nonreflective coatings," Conference on Differential Equations, Vanderbilt University, November, 1997.
58. "Euler approximation in state constrained optimal control," Finite element conference, Cornell University, October, 1997.
59. "A discrete model for the lightning discharge," Annual meeting of the American Geophysical Union, San Francisco, December, 1997.
60. "A new approach to Lipschitz continuity in state constrained optimal control," Twentieth Symposium on Mathematical Programming with Data Perturbations, George Washington University, Washington, DC, May 21-22, 1998.
61. "Uniform convergence and mesh independence of Newton's method for discretized variational problems," SIAM Conference on Control and Its Applications, Jacksonville, FL, May 7-9, 1998.
62. "The Euler approximation in state constrained optimal control," SIAM Conference on Control and Its Applications, Jacksonville, FL, May 7-9, 1998.
63. "A new approach to Lipschitz continuity in state constrained optimal control," SIAM Conference on Control and Its Applications, Jacksonville, FL, May 7-9, 1998.

64. "The wave annihilation technique and the design of nonreflective coatings," Fourth International Conference on Mathematical and Numerical Aspects of Wave Propagation, Golden, CO, June 1–5, 1998.
65. "Graph partitioning and continuous quadratic programming," DIMACS Conference on Semidefinite Programming and Its Applications to Large-Scale Discrete Optimization, Princeton, January 7–9, 1999.
66. "Runge-Kutta methods in optimal control," 1999 ASME Mechanics and Materials Conference, Symposium on Nonsmooth/Nonconvex Mechanics, Virginia Tech, June 28–29, 1999.
67. "Runge-Kutta discretizations of optimal control problems," Advances in Systems Theory, MIT, October 15–16, 1999.
68. "Iterative methods for nearly singular linear systems," Strang Fest, MIT, December 3–4, 1999.
69. "Graph partitioning and continuous quadratic programming," Workshop on Graph Partitioning & Applications: Current and Future Directions, October 14, 1999, Army High Performance Computing Research Center, Minneapolis, MN.
70. "Graph partitioning and continuous quadratic programming," International Workshop on Constrained Optimization, University of New South Wales, Australia, December 13–17, 1999.
71. "Numerical analysis in optimal control," Conference on Optimal Control, Oberwolfach, Germany, June 4–10, 2000.
72. "The wave annihilation technique and the design of nonreflective coatings," Year 2000 International Conference on Dynamical Systems and Differential Equations, Atlanta, June, 2000.
73. "Minimizing a quadratic over a sphere," SIAM Annual Meeting, Puerto Rico, July, 2000.
74. "Minimizing a quadratic over a sphere," Mathematical Programming Society Symposium, Atlanta, August, 2000.
75. "Computing Derivatives in Discretized Control Problems," SIAM Control Conference, July, 2001.
76. "LPDASA and LP bounds for the quadratic assignment problem," Workshop on Novel Approaches to Hard Discrete Optimization, Fields Institute, Toronto, April, 2001.
77. "The dual active set algorithm in control and optimization," Analysis and optimization of differential systems, Constanta, Romania, September, 2002.
78. "The dual active set algorithm in control and optimization," Conference on Quantum Control, Univ. Montreal, October, 2002.
79. "The dual active set algorithm in control and optimization," Regional AMS conference, Orlando, November, 2002.

80. "A multilevel implementation of LPDASA," SIAM Optimization Conference, June, 2002.
81. "A Sparse Multilevel Implementation of the LP Dual Active Set Algorithm," International Symposium on Mathematical Programming, August, 2003.
82. "Dual multilevel optimization," Conference on multiscale optimization, methods and applications, UF, February, 2004.
83. "Dual Active Set Algorithm, INFORMS Annual Meeting," Denver, October, 2004.
84. "Global Convergence of SSM for Minimizing a Quadratic Over a Sphere," SIAM Annual Meeting, Portland, July, 2004.
85. "Recent advances in box constrained optimization," International Conference on Numerical Optimization and Numerical Linear Algebra, Lhasa, Tibet, August 8–12, 2005.
86. "Recent advances in box constrained optimization," 22nd IFIP TC 7 Conference on System Modeling and Optimization, Turin, Italy, July 18–22, 2005.
87. "Box Constrained Optimization," SIAM Optimization Conference, Stockholm, Sweden, May 16-19, 2005.
88. "Optimization problems arising in wireless communication," Optimization and Wireless Communication Conference, Kyungpook National University, Dague, Korea, July 5–6, 2006.
89. "Sphere constrained optimization", SIAM Annual Meeting, Boston, July, 2006.
90. "Asymptotic convergence analysis of a new class of proximal point methods", Joint Mathematics Meetings, New Orleans, January 5–8, 2007.
91. "Quadratic programming techniques for graph partitioning," 2nd International Conference on Complementarity, Duality and Global Optimization in Science and Engineering, Gainesville, FL, February 28 – March 2, 2007.
92. "An Affine-scaling Interior-point CBB Method for Box-Constrained Optimization," 6th International Conference on Industrial and Applied Mathematics, Zurich, July 16–20, 2007.
93. "A Generalized Eigenproblem for the Laplacian and its Application to the Lightning Discharge," 23rd IFIP TC 7 Conference on System Modeling and Optimization, Cracow, Poland, July 23-27, 2007.
94. "Quadratic Programming Techniques for Graph Partitioning," 46th Workshop at the International School of Mathematics G. Stampacchia, Erice, Italy, July 31 – August 9, 2007.
95. "Quadratic Programming Techniques for Graph Partitioning, Nonconvex programming, local and global approaches," Rouen, France, December 17–21, 2007.

95. “Quadratic Programming Techniques for Graph Partitioning, Nonconvex programming, local and global approaches,” Rouen, France, December 17–21, 2007.
96. “Quadratic programming techniques in graph partitioning,” SIAM Optimization Conference, Boston, May 10–13, 2008.
97. “Analysis of lightning charge transport,” SIAM Annual Meeting, San Diego, July 7–11, 2008.
98. “Exploiting structure in sparse optimization,” Conference on Continuous Optimization, Campinas, Brazil, July 28–31, 2008.
99. “Discrete Approximations in Optimal Control,” The Banach Center Conference on 50 Years of Optimal Control, Bedlewo, Poland, September 15–20, 2008.
100. “An Affine-scaling Interior-point CBB Method and Applications,” The Second SIAM Gators Student Conference, Gainesville, FL, March 3–5, 2009.
101. “Discharging Structure of a Mountain Thunderstorm,” SIAM Gator Seminar, Gainesville, FL, January 27, 2009.
102. “An Affine-scaling Interior-point CBB Method and Applications,” International Conference on Engineering and Computational Mathematics, The Hong Kong Polytechnic University, 27–29 May, 2009.
103. “Direct Trajectory Optimization and Costate Estimation of General Optimal Control Problems Using a Radau Pseudospectral Method,” SIAM Conference on Control and Its Applications, Denver, July 6–8, 2009.
104. “An Affine-scaling Interior-point Method and Its Application to Support Vector Machines,” NSF CMMI Research and Innovation Conference, June 22–25, 2009.
105. “An Affine-scaling Interior-point CBB Method and Support Vector Machines, International Symposium on Mathematical Programming, University of Chicago, August 24–28, 2009.
106. “Pseudospectral methods in optimal control,” Linear and Numerical Linear Algebra: Theory, Methods, and Applications at Northern Illinois University, August 12–14, 2009.
107. “Analysis of interesting flashes during a thunderstorm near Langmuir Laboratory on 24 August 2007,” American Geophysical Union, Fall Annual Meeting, December 14–18, 2009.
108. “Pseudospectral Methods in Optimal Control presented at the Conference on Control and Optimization with Differential-Algebraic Constraints,” Banff International Research Station for Mathematical Innovation and Discovery, October 24–29, 2010. One of two (out of 40) talks selected for video taping and for posting on the conference web page.
109. “Gradient-based Methods for Sparse Recovery,” SIAM Annual Meeting, Minisymposium on Recent Advances in Optimization Methods and Applications, Pittsburgh, 2010.

110. “An Affine-scaling Interior-point BB Method for Polytope Constrained Optimization,” SIAM Conference on Optimization, Darmstadt, Germany, May 16–19, 2011.
111. “An Affine-scaling Interior-point BB Method for Polytope Constrained Optimization,” International Congress on Industrial and Applied Mathematics (ICIAM), Vancouver, July 18–22, 2011.
112. “Charge retrieval for distant and nearby flashes using the Langmuir Electric Field Array (LEFA),” Fall Meeting, American Geophysical Union, San Francisco, December 5–9, 2011.
113. “Limited Memory Nonlinear Conjugate Gradients,” International Symposium on Mathematical Programming, Berlin, August 19-24, 2012.
114. “A Primal-Dual Active Set Algorithm for Nonlinear Optimization with Polyhedral Constraints,” International Symposium on Mathematical Programming, Berlin, August 19-24, 2012.
115. “Convergence of a Gauss Pseudospectral Method for Optimal Control,” AIAA Guidance, Navigation, and Control Conference, Minneapolis, August 13-16, 2012.
116. “Charge Distribution in an Intracloud Flash,” Fall Meeting, American Geophysical Union, San Francisco, December 3-7, 2012.
117. “A primal-dual active set algorithm for nonlinear optimization with polyhedral constraints,” International Symposium on Continuous Optimization, Lisbon, July 27 – Aug 1, 2013.
118. “A dual active set algorithm for projection on a polyhedron, SIAM Optimization Conference,” San Diego, May 12–14, 2014.
119. “Convergence of an hp-collocation method for optimal control,” Southeastern-Atlantic Regional Conference on Differential Equations, Memphis, October 11–12, 2014.
120. “The Polyhedral Projection Problem,” 17th British-French-German Conference on Optimization, London, June 15-17, 2015.
121. “Convergence Rate for Gauss Collocation in Unconstrained Optimal Control,” SIAM Conference on Control and its Applications, Paris, July 8-10, 2015.
122. “The Polyhedral Projection Problem,” International Symposium on Mathematical Programming, Pittsburgh, July 12-17, 2015.
123. “Inexact Alternating Direction Method of Multipliers for Separable Convex Optimization,” Florida Day on Inverse Problems and Imaging, University of Central Florida, February 5, 2016.
124. “Pseudospectral Methods in Optimal Control,” Plenary talk at the Southeastern-Atlantic Regional Conference on Differential Equations, Florida Gulf Coast University, November 6, 2016, <http://lebesgue.fgcu.edu/SEARCDE2016/>.

125. "An Active Set Algorithm for Nonlinear Optimization with Polyhedral Constraints," The Fifth International Conference on Continuous Optimization, Tokyo, August 9, 2016.
126. "Convergence Rate for a Gauss Collocation Method Applied to Constrained Optimal Control," Finite Element Circus, Worcester Polytechnic Institute, October 15, 2016.
127. "Implementation of an Active Set Algorithm for Nonlinear Optimization with Polyhedral Constraints," SIAM Optimization Conference, Vancouver, May 22, 2017.
128. "Pseudospectral Methods in Optimal Control," SIAM Control Conference, Pittsburgh, July 10, 2017.
129. "Optimization with polyhedral constraints," plenary talk at the West Coast Optimization Conference, September 16, 2017.

### **COLLOQUIA**

1. "Tridiagonalization of matrices," University of Toronto, February 1979.
2. "Perturbations in eigenvalues," Kent State University, April 1979.
3. "Variational inequalities," The Pennsylvania State University, June 1979.
4. "The approximation of variational inequalities," University of Kentucky, March 1980.
5. "Duality, Min-max, and submarines, The Pennsylvania State University, March 1980.
6. "The approximation of variational inequalities," University of Montreal, May 1982.
7. "Numerical techniques in optimal control," Rutgers University, November 1982.
8. "A fundamental parameter in numerical analysis," University of West Virginia, May 1985.
9. "Reflection and refraction of waves for stratified materials," University of Maryland Baltimore County, April 1987.
10. "Inf-Sup parameters in numerical analysis," Massachusetts Institute of Technology, April 1987.
11. "Thunderstorms and coatings," Florida State University, February 1988.
12. "Thunderstorms," University of Texas at Arlington, February 1988.
13. "Dual techniques for constrained optimization, theory, and practice," Johns Hopkins University, December 1988.
14. "Dual techniques in optimization and control," North Carolina State University, April 5, 1990.
15. "Dual techniques in optimization," University of North Florida, April 27, 1990.



16. “Sensitivity in nonlinear optimal control,” Colorado State University, May 18, 1990.
17. “The analysis of nonlinear approximations in optimal control,” Michigan State University, November, 2001.
18. “Modeling and Computation of Thunderstorm Electrification and Lightning at the Kennedy Space Center,” Global Hydrology and Climate Center, NASA Marshall Space Flight Center, Huntsville, AL, September, 2005.
19. “Recent advances in box constrained optimization”, Computational Mathematics Colloquium, University of Waterloo, February 5, 2007.
20. “Optimization Problems Arising in Wireless Communication”, Northern Illinois University, October 26, 2007.
21. “Numerical techniques in optimal control,” SIAM Seminar, Louisiana State University, October 19, 2011, Baton Rouge, LA.
22. “Optimization with polyhedral constraints,” Johns Hopkins University, October 19, 2017.

**PUBLICATIONS:** (Published, accepted, submitted)

1. *Dynamics of a nonlinear spatial trade model*, Int. J. Systems Sci. **3** (1972), 427–438.
2. *The Ritz-Trefftz method for state and control constrained optimal control problems*, SIAM J. Numer. Anal. **12** (1975), 854–867.
3. *Free boundaries and finite elements in one dimension*, Math. Comp **29** (1975), 1020–1031.
4. (with S. Mitter), *Lagrange duality theory for convex control problems*, SIAM J. Control Optim. **14** (1976), 843–856.
5. *Rates of convergence for discrete approximations to unconstrained control problems*, SIAM J. Numer. Anal. **13** (1976), 449–472.
6. (with L. Horowitz), *Convergence and stability properties of the discrete Riccati operator equation and the associated optimal control and filtering problems*, SIAM J. Control. Optim. **14** (1976), 295–312.
7. *State constrained convex control problems, part I: Duality and regularity*, Seminaires IRIA (1976), 71–80.
8. *State constrained convex control problems, part II: Approximation*, Seminaires IRIA (1976), 81–94.
9. *Convergence and stability properties of the discrete Riccati operator equation*, Seminaires IRIA (1976), 95–112.
10. (with F. Brezzi and P. Raviart), *Error estimates for the finite element solution of variational inequalities, part I: Primal theory*, Numer. Math. **28** (1977), 431–443.

11. (with F. Brezzi and P. Raviart), *Error estimates for the finite element solution of variational inequalities, part II: Mixed methods*, Numer. Math. **31** (1978), 1–16.
12. (with J. Rogers), *Minimum drag surfaces*, Applied Math. Optim. **4** (1978), 197–207.
13. *Lipschitz continuity for constrained processes*, SIAM J. Control Optim. **17** (1979), 321–338.
14. *Convex control and dual approximations*, Control Cybernet **8** (1979, Part I: 5–22, Part II: 73–86).
15. C.V. Coffman and G.J. Fix (eds.), *Inequalities and approximation*, Constructive Approaches to Mathematical Models, (1979), Academic Press, New York, 189–202.
16. (with G. Ianculescu), *Semi-dual approximations in optimal control: Quadratic cost*, Free Boundary Problems, Vol. II (1980), 1st Naz. Alta Mat. Francesco Severi, Rome, 321–332.
17. *The implicit truncation method*, Free Boundary Problems, Vol. II (1980), 1st Naz. Alta Mat. Francesco Severi, Rome, 333–345.
18. (with R. Pederson), *Perturbations in eigenvalues*, Linear Algebra Appl. **42** (1982), 39–55.
19. (with M. Delfour and F. Trochu), *Discontinuous Galerkin methods for ordinary differential equations*, Math. Comp. **36** (1981), 455–473.
20. *Condition estimates*, SIAM J. Sci. Stat. Comput. **5** (1984), 311–316.
21. (with G. Ianculescu), *Dual approximations in optimal control*, SIAM J. Control Optim. **22** (1984), 423–465.
22. *Approximations to the multiplier method*, SIAM J. Numer. Anal. **22** (1985), 16–46.
23. *Dual techniques for constrained optimization*, Proceeding of the 24th IEEE Conference on Decision and Control, Fort Lauderdale, Florida, December, (1985), 616–621.
24. (with R. Rostamian), *Optimal coatings, bang-bang controls, and gradient techniques*, Optimal Control: Applications and Methods **8** (1987), 1–20.
25. *The generalized fast Fourier transform and the Jenkins-Traub algorithm*, Numerische Mathematik **50** (1987), 253–261.
26. (with D.L. Presler), *Dual techniques for minimax*, SIAM J. Control Optim. **25** (1987), 660–685.
27. (with R. Rostamian), *Coating reflectivity*, Proceedings of the IFIP WG 7.2 Conference on Control Systems Governed by Partial Differential Equations, Gainesville, Florida, 1986, Lecture Notes in Control and Information Sciences **97** (1987), 247–258.

28. *Dual techniques for constrained optimization*, J. Optim. Theory Appl. **55** (1987), 37–71.
29. *Applied Numerical Linear Algebra*, Prentice-Hall, Englewood Cliffs, New Jersey, 1988.
30. R. Vichnevetsky and R.S. Stepleman (eds.), *INF-SUP parameters in numerical analysis*, Advances in Computer Methods for Partial Differential Equations - VI, (1987), IMACS, 278–280.
31. *Bidiagonalization and diagonalization*, Comput. Math. Appl. **14** (1987), 561–572.
32. *Invariant imbedding and the reflection of elastic waves*, Proceedings of the IFIP WG 7.2 Conference on Control Systems Governed by Partial Differential Equations, Santiago de Compostela (July 6–9, 1987) Lecture Notes in Control and Information Sciences **114**, 144–155.
33. *A derivative-based bracketing scheme for univariate minimization*, Comp. Math. Appl. **18** (1989), 779–795.
34. (with N. Ghosh), *A derivative-free bracketing scheme for univariate minimization*, Computers and Mathematics with Applications **20** (1990), 23–34.
35. (with J. Nisbet and J. Kasha), *The evolution and discharge of electric fields within a thunderstorm*, J. Comput. Phys. **82** (1989), 193–217.
36. (with R. Rostamian), *Reflection and refraction of elastic waves for stratified materials*, Wave Motion **10** (1988), 333–348.
37. *Updating the inverse of a matrix*, SIAM Rev. **31** (1989), 221–239.
38. (with P. Pardalos), *Active constraints in optimization*, Journal of Optimization Theory and Applications **68** (1991), 499–511.
39. (with R. Rostamian), *Homogenization for degenerate equations of elasticity*, Asymptotic Analysis **1** (1988), 283–302.
40. *NAPACK (numerical algebra software package)*, copyright 1987, W.W. Hager.
41. (with R. Rostamian), *Plane Waves, optimization, and homogenization in elasticity*, Smart Materials, Structures, and Mathematical Issues, Technomic, Lancaster, PA, 1989, 183–197.
42. *Simulations of electric fields within a thunderstorm*, Journal of the Atmospheric Sciences **46** (1989), 3542–3558.
43. *Dual techniques for constrained optimization, II*, Proceedings of 28th IEEE Conference on Decision and Control, Tampa, Florida, 1989, 364–369.
44. (with R. Rostamian), *Total absorption in elastic media*, Transactions of the Seventh Army Conference on Applied Mathematics and Computing, West Point, New York, June, 1989, 85–103.
45. *Multiplier methods for nonlinear optimal control*, SIAM Journal on Numerical Analysis **27** (1990), 1061–1080.

46. *Discretization error in optimal control*, Lecture Notes in Control and Information Sciences, Vol. 149, K.-H. Hoffmann and W. Krabs, eds., “Optimal Control of Partial Differential Equations”, Springer-Verlag, Berlin (1991), 120–128.
47. *Newton’s method*, McGill’s Survey of Science: Physical Science, Salem Press (1992), 1516–1522.
48. *Finite element methods*, McGill’s Survey of Science: Physical Science, Salem Press (1992), 886–891.
49. *The dual active set algorithm*, Advances in Optimization and Parallel Computing, P.M. Pardalos, ed., North Holland, Amsterdam, (1992), 137–142.
50. (with A. Dontchev), *On Robinson’s implicit function theorems*, Proceedings of the Conference on Set-Valued Analysis and Differential Inclusions, Pamporovo, Sept., 1990, Birkhauser, 1992.
51. (with P. Pardalos and R. Horst), *Mathematical programming, a computational perspective*, Handbook of Statistics, Volume 9, Computational Statistics 1993, 201–278.
52. (with D. Hearn), *The dual active set algorithm applied to quadratic networks*, Computational Optimization and Applications **1** (1993), 349–373.
53. (with A. Dontchev), *Lipschitzian stability in nonlinear control and optimization*, SIAM Journal on Control and Optimization **31** (1993), 569–603.
54. W. W. Hager, D. W. Hearn and P. M. Pardalos (eds.), *Large scale optimization, State of the art*, Papers from the conference held at the University of Florida, Gainesville, Florida, February 15–17, 1993 (1994), Kluwer Academic Publishers, Dordrecht.
55. *Analysis and implementation of a dual algorithm for constrained optimization*, Journal of Optimization Theory and Applications **79** (1993), 427–462.
56. (with A. Dontchev), *An inverse mapping theorem for set-valued maps*, Proceedings of the American Mathematical Society **121** (1994), 481–489.
57. (with A. Dontchev), *Implicit functions, Lipschitz maps, and stability in optimization*, Mathematics of Operations Research **19** (1994), 753–768.
58. (with A. Dontchev), *Euler approximation of the feasible set*, Numerical Functional Analysis and Optimization **15** (1994), 245–261.
59. (with A. Dontchev, A. Poore, and B. Yang), *Optimality, stability, and convergence in nonlinear control*, Applied Mathematics and Optimization **31** (1995), 297–326.
60. (with D. Wang), *An analysis of errors in the location, current, and velocity of lightning*, Journal of Geophysical Research **100** (1995), 25,721–25,729.
61. (with P. M. Pardalos and Y. Li), *Linear programming approaches to the convex hull problem in  $R^n$* , Comput. Math. Appl. **29** (1995), 23–29.

62. (with A. Dontchev), *Implicit functions defined by generalized equations*, World Congress of Nonlinear Analysis 1992 (1996), Walter de Gruyter, Berlin, 2289–2298.
63. P. M. Pardalos, D. W. Hearn, and W. W. Hager (eds.), *Network Optimization* (1997), Springer, Berlin, New York.
64. (with N. Ghosh and P. Sarmah), *The application of eigenpair stability to block diagonalization*, SIAM Journal on Numerical Analysis **34** (1997), 1255–1268.
65. (with A. L. Dontchev), *Lipschitzian stability for state constrained nonlinear optimal control*, SIAM Journal on Control and Optimization **36** (1998), 696–718.
66. A discrete model for the lightning discharge, *Journal of Computational Physics* **144** (1998), 137–150.
67. R. De Leone, A. Murli, P. M. Pardalos, and G. Toraldo (eds.), *The LP dual active set algorithm*, High Performance Algorithms and Software in Nonlinear Optimization (1998), Kluwer, Dordrecht, 243–254.
68. *Stabilized sequential quadratic programming*, *Computational Optimization and Applications* **12** (1999), 253–273.
69. (with S. Gowda), *Stability in the presence of degeneracy and error estimation*, *Mathematical Programming* **85** (1999), 181–192.
70. (with T. Davis), *Modifying a sparse Cholesky factorization*, *SIAM Journal on Matrix Analysis and Applications* **20** (1999), 606–627.
71. (with R. Rostamian and D. Wang), *The wave annihilation technique and the design of nonreflective coatings*, *SIAM Journal on Applied Mathematics* **60** (2000), 1388–1424.
72. William W. Hager and Panos M. Pardalos (eds.), *Optimal Control: Theory, Algorithms, and Applications*, Papers from the conference at the University of Florida, Gainesville, FL, February 27 to March 1, 1997 (1998), Kluwer Publications, Dordrecht.
73. (with A. L. Dontchev), *A new approach to Lipschitz continuity in state constrained optimal control*, *Systems and Control Letters* **35**, 137–143.
74. (with A. L. Dontchev), *The Euler approximation in state constrained optimal control*, *Mathematics of Computation* **70** (2001), 173–203.
75. (with Y. Krylyuk), *Graph partitioning and continuous quadratic programming*, *SIAM Journal on Discrete Mathematics* **12** (1999), 500–523.
76. (with A. L. Dontchev and V. M. Veliov), *Uniform convergence and mesh independence of Newton’s method for discretized variational problems*, *SIAM Journal on Control and Optimization* **39** (2000), 961–980.
77. *Iterative methods for nearly singular linear systems*, *SIAM Journal on Scientific Computing* **22** (2000), 747–766.

78. (with A. L. Dontchev and V. M. Veliov), *Second-order Runge–Kutta approximations in constrained optimal control*, SIAM Journal on Numerical Analysis **38** (2000), 202–226.
79. *Runge-Kutta methods in optimal control and the transformed adjoint system*, Numerische Mathematik **87** (2000), 247–282.
80. *Minimizing a quadratic over a sphere*, SIAM Journal on Optimization **12** (2001), 188–208.
81. T. E. Djaferis and I. C. Schick (eds.), *Runge-Kutta discretizations of optimal control problems*, System Theory, Modeling, Analysis, and Control, (2000), Kluwer, Norwell, MA, 233–244.
82. (with A. L. Dontchev and V. M. Veliov), *On Quantitative Stability in Optimization and Optimal Control*, Set-Valued Analysis **8** (2000), 31–50.
83. (with T. Davis), *Multiple-rank modifications of a sparse Cholesky factorization*, SIAM Journal on Matrix Analysis and Applications **22** (2001), 997–1018.
84. (with A. L. Dontchev and K. Malanowski), *Error bounds for the Euler approximation of a state and control constrained optimal control problems*, Numerical Functional Analysis and Optimization **21** (2000), 653–682.
85. (with S. C. Park and T. A. Davis), *Block exchange in graph partitioning*, in Approximation and Complexity in Numerical Optimization: Continuous and Discrete Problems (2000), Kluwer, 299–307.
86. *Minimizing the profile of a matrix*, SIAM Journal on Scientific Computing **28** (2002), 1799–1816.
87. K.-H. Hoffmann, I. Lasiacka, G. Leugering, J. Sprekels and F. Troeltzsch (eds.), *Numerical analysis in optimal control*, Conference on Optimal Control of Complex Structures (2001), International Series of Numerical Mathematics, Vol. 139, Birkhauser Verlag, Basel/Switzerland, 83–93.
88. (with Y. Krylyuk), *Multiset graph partitioning*, Mathematical Methods of Operations Research **55** (2002), 1–10.
89. *The dual active set algorithm and its application to linear programming*, Computational Optimization and Applications **21** (2002), 263–275.
90. *The dual active set algorithm and the iterative solution of linear programs*, in Novel Approaches to Hard Discrete Optimization, P. M. Pardalos and H. Wolkowicz, Eds., Fields Institute Communications **37** (2003), 95–107.
91. (with H. Zhang), *A nonmonotone line search technique and its application to unconstrained optimization*, SIAM Journal on Optimization **14** (2004), 1043–1056.
92. (with T. Davis), *A sparse proximal implementation of the LP dual active set algorithm*, Mathematical Programming **112** (2008), 275–301.
93. (with S. C. Park), *Global convergence of SSM for minimizing a quadratic over a sphere*, Mathematics of Computation **74** (2005), 1413–1423.

94. (with S. C. Park), *The gradient project method with exact line search*, Global Optimization **30** (2004), 103–118.
95. (with H. Zhang), *A new conjugate gradient method with guaranteed descent and an efficient line search*, SIAM Journal on Optimization **16** (2005), 170–192.
96. (with H. Zhang), *Algorithm 851: CG\_DESCENT, A conjugate gradient method with guaranteed descent*, ACM Transaction on Mathematical Software **32** (2006), 113–137.
97. (with H. Zhang), *A survey of nonlinear conjugate gradient methods*, Pacific Journal of Optimization **2** (2006), 35–58.
98. (with H. Zhang), *A projected adaptive cyclic Barzilai-Borwein method for box constrained optimization*, in Multiscale Optimization Methods and Applications (2005), Springer, 387–392.
99. (with H. Zhang), *Self-adaptive inexact proximal point methods*, Computational Optimization and Applications **39** (2008), 161–181.
100. (with Shu-Jen Huang, Panos M. Pardalos, Oleg A. Prokopyev, eds.), *Multiscale Optimization Methods and Applications*, Springer (2006).
101. (with Y. Jiang and J. Li), *The Geometric Mean Decomposition*, Linear Algebra and Its Applications **396** (2005), 373–384.
102. (with Y. Jiang and J. Li), *Joint transceiver design for MIMO communications using Geometric Mean Decomposition*, IEEE Transactions on Signal Processing **53** (2005), 3791–3803.
103. (with Y. Jiang and J. Li), *The generalized triangular decomposition*, Mathematics of Computation **77** (2008), 1037–1056.
104. (with Y. Jiang and J. Li), *Uniform channel decomposition for MIMO communications*, IEEE Transactions on Signal Processing **53** (2005), 4283–4294.
105. (with Y. Jiang and J. Li), *Tunable channel decomposition for MIMO communications using channel state information*, IEEE Transactions on Signal Processing **54** (2006), 4405–4418.
106. (with T. Davis), *Dual Multilevel Optimization*, Mathematical Programming **112** (2008), 403–425.
107. (with T. Davis), *Row modifications of a sparse Cholesky factorization*, SIAM Journal on Matrix Analysis and Applications **26** (2005), 621–639.
108. (with Y. Liu and T. F. Wong), *Optimization of Generalized Mean Square Error in Signal Processing and Communication*, Linear Algebra and Its Applications **416** (2006), 815–834.
109. (with Y. Liu and T. F. Wong), *Training signal design for estimation of correlated MIMO channels with colored interference*, IEEE Transactions on Signal Processing **55** (2007), 1486–1497.

110. (with H. Zhang), *Recent advances in bound constrained optimization*, System Modeling and Optimization, F. Ceragioli, A. Dontchev, H. Furuta, K. Marti, and L. Pandolfi, eds. Springer (2006), 67–82.
111. (with H. Zhang), *A new active set algorithm for box constrained optimization*, SIAM Journal on Optimization **17** (2006), 526–557.
112. (with Y-H. Dai, K. Schittkowski, and H. Zhang), *The cyclic Barzilai-Borwein method for unconstrained optimization*, IMA Journal on Numerical Analysis **26** (2006), 604–627.
113. (with B. C. Aslan and S. Moskow), *A Generalized Eigenproblem for the Laplacian*, Journal of Mathematical Analysis and Applications **341** (2008), 1028–1041.
114. (with R. G. Sonnenfeld, B. C. Aslan, G. Lu, W. P. Winn, and W. L. Boeck), *Analysis of Charge Transport During Lightning Using Balloon Borne Electric Field Sensors and LMA*, Journal of Geophysical Research **112** (2007), doi: 10.1029/2006JD008187.
115. (with T. A. Davis), *Dynamic supernodes in sparse Cholesky update/downdate and triangular solves*, ACM Transactions on Mathematical Software **35** (2009).
116. (with Y. Chen, T. A. Davis, and S. Rajamanickam), *Algorithm 877: CHOLMOD, supernodal sparse Cholesky factorization and update/downdate*, ACM Transactions on Mathematical Software **35** (2009).
117. (with H. Zhang), *Asymptotic Convergence Analysis of a New Class of Proximal Point Methods*, SIAM Journal on Control and Optimization **46** (2007), 1683–1704.
118. (with J. Luo), *Optimization of Generalized Mean Square Error in Noisy Linear Estimation*, SIAM Journal on Matrix Analysis and Applications **30** (2008), 783–804.
119. (with M. Barrault, E. Cancès, and C. Le Bris), *Multilevel domain decomposition for electronic structure calculations*, Journal of Computational Physics **222** (2007), 86–109.
120. (with G. Bencteux, E. Cancès, and C. Le Bris), *Analysis of a Quadratic Programming Decomposition Algorithm*, SIAM Journal on Numerical Analysis **47** (2010), 4517–4539.
121. (with B. Aslan), *The Change in Electric Potential Due to Lightning*, Mathematical Modeling and Numerical Analysis **42** (2007), 887–901.
122. (with H. Zhang and B. Mair), *An Affine-scaling Interior-point CBB Method for Box-Constrained Optimization*, Mathematical Programming **119** (2009), 1–32.
123. (with T. A. Davis), *Dual Multilevel Optimization*, Mathematical Programming **112** (2008), 403–425.
124. (with T. A. Davis), *A sparse proximal implementation of the LP dual active set algorithm*, Mathematical Programming **112** (2008), 275–301.



125. (with D. T. Phan), *An ellipsoidal branch and bound algorithm for global optimization*, SIAM Journal on Optimization **20** (2009), 740–758.
126. (with J. Luo), *A differential equation model for functional mapping of a virus-cell dynamic system*, Journal of Mathematical Biology **61** (2010), 1–15.
127. (with D. Garg, M. A. Patterson, C. Francolin, C. L. Darby, G. T. Huntington, and A. V. Rao), *Direct Trajectory Optimization and Costate Estimation of Finite-Horizon and Infinite-Horizon Optimal Control Problems Using a Radau Pseudospectral Method*, Computational Optimization and Applications (2009), doi 10.1007/s10589-009-9291-0.
128. (with B. C. Aslan, R. G. Sonnenfeld, T. D. Crum, J. D. Battles, M. T. Holborn, and R. Ron), *Three Dimensional Charge Structure of a Mountain Thunderstorm*, Journal of Geophysical Research (2010), doi 10.1029/2009JD013241.
129. (with D. T. Phan and H. Zhang), *Gradient-Based Methods for Sparse Recovery*, SIAM Journal on Imaging Sciences **4** (2011), 146–165.
130. (with D. Garg, M. A. Patterson, D. Benson, G. T. Huntington, and A. V. Rao), *A Unified Framework for the Numerical Solution of Optimal Control Problems Using Pseudospectral Methods*, Automatica **46** (2010), 1843–1851.
131. (with C. L. Darby and A. V. Rao), *An hp-Adaptive Pseudospectral Method for Solving Optimal Control Problems*, Optimal Control, Applications and Methods **32** (2011), 476–502.
132. (with M. D. Gonzalez-Lima and H. Zhang), *An Affine-scaling Interior-point Method for Continuous Knapsack Constraints with Application to Support Vector Machines*, SIAM Journal on Optimization **21** (2011), 361–390.
133. (with C. L. Darby and A. V. Rao), *A variable-order hp-adaptive pseudospectral method for solving optimal control problems*, Journal of Spacecraft and Rockets **48** (2011), 433–445.
134. (with D. Garg and A. V. Rao), *Pseudospectral methods for solving infinite-horizon optimal control problems*, Automatica **48** (2011), 433–445.
135. (with Y. Chen, F. Huang, D. T. Phan, X. Ye, and Wotao Yin), *Fast Algorithm for Image Reconstruction with Application to Partially Parallel MR Imaging*, SIAM Journal on Imaging Sciences **5** (2012), 90–118.
136. (with D. T. Phan and H. Zhang), *An exact algorithm for graph partitioning*, Mathematical Programming **137** (2012), 531–556.
137. (with H. Zhang), *The Limited Memory Conjugate Gradient Method*, SIAM Journal on Optimization **23** (2013), 2150–2168.
138. (with Y. Chen, M. Yashtini, X. Ye, and H. Zhang), *Bregman Operator Splitting with Variable Stepsize (BOSVS) for Total Variation Image Reconstruction*, Computational Optimization and Applications **54** (2012), 317–342.
139. (with R. G. Sonnenfeld, W. Feng, T. Kanmae, H. C. Stenbaek-Nielsen, M. G. McHarg, R. K. Haaland, S. A. Cummer, G. Lu, and J. L. Lapierre), *Charge*

- Transport Associated with Sprites over a North Texas Mesoscale Convective System*, Journal of Geophysical Research **117** (2012), 18 (doi: 10.1029/2012JD018309).
140. (with M. Yashtini, Y. Chen, and X. Ye), *Partially parallel MR image reconstruction using sensitivity encoding*, 2012 IEEE International Conference on Image Processing (2012), 2077–2080.
141. (with J. T. Hungerford), *Optimality conditions for maximizing a function over a polyhedron*, Mathematical Programming **145** (2014), 179–198.
142. (with H. Zhang), *An Affine Scaling Method for Optimization Problems with Polyhedral Constraints*, Computational Optimization and Applications **59** (2014), 163–183.
143. (with R. G. Sonnenfeld), *Electric Field Reversal in Sprite Electric Field Signature*, Monthly Weather Review **141** (2013), 1731–1735.
144. (with W. Feng), *Charge Rearrangement Deduced from Nearby Electric Field Measurements of an Intracloud Flash with K-Changes*, Journal of Geophysical Research **118** (2013), 19 (doi: 10.1002/jgrd.50782).
145. (with J. T. Hungerford), *Continuous quadratic programming formulations of optimization problems on graphs*, European Journal of Operational Research **240** (2015), 328–337.
146. (with T. A. Davis and J. T. Hungerford), *An efficient algorithm for the separable convex quadratic knapsack problem*, ACM Transactions on Mathematical Software **42** (2016), 1–25.
147. (with M. Yashtini and H. Zhang), *An  $O(1/k)$  convergence rate for the variable stepsize Bregman operator splitting algorithm*, SIAM Journal on Numerical Analysis **54** (2016), 1535–1556.
148. (with D. Mico-Umutesi), *Error estimation in nonlinear optimization*, Journal of Global Optimization **59** (2014), 327–341.
149. (with C. C. Francolin, D. A. Benson and A. V. Rao), *Costate approximation in optimal control using integral Gaussian quadrature orthogonal collocation methods*, Optimal Control Applications and Methods **36** (2015), 381–397.
150. (with M. A. Patterson and A. V. Rao), *A  $ph$  mesh refinement method for optimal control*, Optimal Control Applications and Methods **36** (2015), 398–421.
151. (with D. T. Phan and J. Zhu), *Projection Algorithms for Nonconvex Minimization with Application to Sparse Principal Component Analysis*, Journal of Global Optimization **65** (2016), 657–676.
152. (with C. Ngo, M. Yashtini, and H. Zhang), *Alternating direction approximate Newton algorithm for ill-conditioned inverse problems with application to parallel MRI*, Journal of the Operations Research Society of China, Special Issue on Sparse and Low-rank Optimization **3** (2015), 139–162.

153. (with F. Liu and A. Rao), *Adaptive Mesh Refinement Method for Optimal Control Using Nonsmoothness Detection and Mesh Size Reduction*, Journal of the Franklin Institute **352** (2015), 4081–4106.
154. (with H. Zhang), *Projection onto a Polyhedron that Exploits Sparsity*, SIAM Journal on Optimization **29** (2016), 1773–1798.
155. (with J. T. Hungerford and I. Safro), *A Multilevel Bilinear Programming Algorithm for the Vertex Separator Problem*, Computational Optimization and Applications **69** (2018), 189–223.
156. (with H. Hou and A. Rao), *Lebesgue Constants Arising in a Class of Collocation Methods*, IMA Journal of Numerical Analysis **37** (2017), 1884–1901.
157. (with H. Hou and A. Rao), *Convergence Rate for a Gauss Collocation Method Applied to Unconstrained Optimal Control*, Journal of Optimization Theory and Applications **169** (2016), 801–824.
158. (with F. Liu and A. Rao), *Adaptive Mesh Refinement Method for Optimal Control Using Legendre Polynomial Coefficient Decay Rate and Mesh Re-Initialization*, IEEE Transactions on Control Systems Technology (2018), 1475–1483.
159. (with H. Zhang), *An Active Set Algorithm for Nonlinear Optimization with Polyhedral Constraints*, Science China Mathematics, ICIAM special issue **59** (2016), 1525–1542.
160. (with H. Zhang), *Inexact alternating direction multiplier methods for separable convex optimization*, arXiv:1604.02494 (2016, submitted).
161. (with H. Hou, S. Mohapatra, and A. Rao), *Convergence rate for an hp collocation method applied to unconstrained optimal control*, arXiv:1605.02121 (2016, submitted).
162. (with J. Liu, S. Mohapatra, A. Rao, and X.-S. Wang), *Convergence Rate for a Gauss Collocation Method Applied to Constrained Optimal Control*, SIAM Journal on Control and Optimization **56** (2018), 1386–1411.

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