

# Vita

**Olvi L. Mangasarian**

[www.cs.wisc.edu/~olvi](http://www.cs.wisc.edu/~olvi)

## Personal Data:

Citizenship: U.S.A.  
Marital Status: Married, 3 children

## Education:

B.S.E. (Engineering) Princeton 1954  
M.S.E (Engineering) Princeton 1955  
Ph.D. (Applied Mathematics) Harvard 1959

## Professional Career:

**1958-59** Research Fellow, Harvard University  
**1959-67** Mathematician, Shell Development Company, Emeryville, California  
**1967-69** Associate Professor, Computer Sciences Department, University of Wisconsin-Madison  
**1969-2003** Professor, Computer Sciences Department, University of Wisconsin-Madison  
**1972-75** Chairman, Computer Sciences Department, University of Wisconsin-Madison  
**1975-76** Senior Research Fellow, Oxford University, England  
**1976-93** Professor, Industrial Engineering Department, University of Wisconsin-Madison  
**1982-2003** John von Neumann Professor  
**2002-** Research Scientist, Mathematics Department, University of California at San Diego  
**2003-** John von Neumann Professor Emeritus

## Major Areas of Interest:

Optimization  
Machine learning & data mining

## Professional Societies:

Mathematical Programming Society  
Society for Industrial and Applied Mathematics  
Institute for Operations Research and the Management Sciences

## Papers:

Papers in SIAM Journals, Mathematical Programming, Operations Research, INFORMS Journal on Computing, Data Mining and Knowledge Discovery and others. Recent papers available at: [www.cs.wisc.edu/~olvi](http://www.cs.wisc.edu/~olvi).

## Talks:

Recent talks in the US and overseas available at: [www.cs.wisc.edu/~olvi](http://www.cs.wisc.edu/~olvi).

## **Awards, Grants and Consulting Experience:**

2008 Best Academic Research Paper Award, The 2008 International Conference on Data Mining, July 14-17, 2008, Las Vegas, “Privacy-Preserving Classification of Horizontally Partitioned Data via Random Kernels”, joint with E. W. Wild. <ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/07-03.pdf>

2007 Computational Optimization and Applications Best Paper Award, “Absolute Value Programming”, Computational Optimization and Applications 36(1), January 2007, 43-53, <ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/05-04.pdf>

US Patent No.7,395,253 July 1, 2008: “Lagrangian Support Vector Machine”, joint with David R. Musicant. <http://www.cs.wisc.edu/dmi/lsvm/>

US Patent No.7,421,417 September 7, 2008: “Input Feature Selection for Support Vector machine Classification”, joint with Glenn M. Fung. <http://www.cs.wisc.edu/dmi/lpsvm/>

INFORMS Lanchester Prize for Mathematical Programming in Machine Learning and Data Mining, November 6, 2000. <http://www.informs.org/Prizes/LanchesterDetails.html#2000lanc>

University of Wisconsin Hilldale Award in the Physical Sciences 1995-96.

Department of Energy Computational Science Award, September 1994, for “Breast Cancer Diagnosis via Linear Programming”.

Sperry Univac 1980-81 Computer Science Professor of the Year.

Principal investigator or co-principal investigator on National Science Foundation grants, since 1968.

Investigator on ARO grants 1967-71, 1979-86 and AFOSR grants 1985-1995, 1997-2002.

Sometime consultant to the Argonne National Laboratories, the Ford Foundation, the Organization of American States and the World Bank.

## **Books and Proceedings:**

1. “Nonlinear Programming”, McGraw-Hill, New York 1969, Japanese Edition 1971, SIAM Classics in Applied Mathematics 10, Philadelphia 1994.
2. “Nonlinear Programming”, coeditor with J. B. Rosen and K. Ritter, Academic Press 1970.
3. “Nonlinear Programming 2”, coeditor with R. R. Meyer and S. M. Robinson, Academic Press 1975.
4. “Nonlinear Programming 3”, coeditor with R. R. Meyer and S. M. Robinson, Academic Press 1978.
5. “Nonlinear Programming 4”, coeditor with R. R. Meyer and S. M. Robinson, Academic Press 1981.
6. “Parallel Methods in Mathematical Programming”, coeditor with R. R. Meyer, Mathematical Programming B, Volume 42, Number 2, North Holland 1988.
7. “Symposium on Parallel Optimization 2”, coeditor with R. R. Meyer, SIAM Journal on Optimization 1(4), November 1991.
8. “Symposium on Parallel Optimization 3”, coeditor with R. R. Meyer, SIAM Journal on Optimization 4(4), November 1994.
9. “Symposium on Parallel Optimization 3: Neural Networks via Mathematical Programming”, coeditor with R. R. Meyer, Optimization Methods and Software 4(2), August 1994.
10. “Complementarity: Applications, Algorithms and Extensions”, coeditor with M. Ferris and J.-S. Pang, Kluwer Academic Publishers, Boston 2001.

11. "Linear Programming with MATLAB", with M. C. Ferris and S. J. Wright, MPS-SIAM Series on Optimization, SIAM, Philadelphia 2007.

**Editorial Responsibilities:**

1. Journal of Optimization Theory and Applications, Associate Editor
2. Optimization Methods and Software, Editorial Board Member

## Papers:

1. (with B. Budiansky) "Plastic stress concentration at a circular hole in an infinite sheet subjected to equal biaxial tension", J. of Applied Mechanics 27, Series E, 1960, 59-64.
2. "Stresses in the plastic range around a normally loaded circular hole in an infinite sheet", J. of Applied Mechanics 27, Series E, 1960, 65-73.
3. "Duality in nonlinear programming", Quart. of Applied Math. 20, 1962, 300-302.
4. "Numerical solution of the first biharmonic problem by linear programming", International J. of Engineering Science 1, 1963, 231-240.
5. "An elementary proof of an equivalence theorem and duality consequence", J. of the Operations Research Society of Japan 4, 1962, 1970-1975.
6. "Equivalence in nonlinear programming", Naval Research Logistics Quarterly 10, 1963, 299-306.
7. (with J. B. Rosen) "Inequalities for stochastic nonlinear programming problems", Operations Research 12, 1964, 143-154.
8. "Nonlinear programming problems with stochastic objective functions", Management Science 10, 1964, 353-359.
9. "Stability criteria for nonlinear ordinary differential equations", J. SIAM Control 1, 1963, 311-318.
10. (with H. Stone) "Two-person nonzero-sum games and quadratic programming", J. Math. Anal. and Appl. 9, 1964, 348-355.
11. "Equilibrium points of bimatrix games", J. SIAM 12, 1964, 778-780.
12. "Linear and nonlinear separation of patterns by linear programming", Operations Research 13, 1965, 444-452.
13. (with J. Ponstein) "Minmax and duality in nonlinear programming", J. Math. Anal. and Appl. 11, 1965, 504-518.
14. "Pseudo-convex functions", J. SIAM Control 3, 1965, 281-290.
15. "Sufficient conditions for the optimal control of nonlinear systems", J. SIAM Control 4, 1966, 139-152.
16. (with S. Fromovitz) "The Fritz John necessary optimality conditions in the presence of equality constraints", J. Math. Anal. and Appl. 17, 1967, 34-47.
17. "Multi-surface method of pattern separation", IEEE Trans. on Information Theory, IT-14, 1968, 801-807.
18. (with S. Fromovitz) "A maximum principle in mathematical programming", in "Mathematical Theory of Control", A. V. Balakrishnan and L. W. Neustadt (eds.), Academic Press, New York, 1967, 85-95.
19. "Optimality and duality in nonlinear programming", in "Proc. of the Princeton Symposium on Mathematical Programming", H. W. Kuhn (ed.), Princeton University Press, 1970, 429-444.
20. "Nonlinear fractional programming", J. of the Operations Research Society of Japan 12, 1969, 1-10.
21. (with A. Klinger) "Logarithmic convexity and geometric programming", J. Math. Anal. and Appl. 24, 1968, 388-408.
22. "Characterizations of real matrices of monotone kind", SIAM Review 10, 1968, 439-441.
23. "Convexity, pseudo-convexity and quasi-convexity of composite functions", Cahiers du Centre d'Etudes de Recherche Operationnelle 12, 1970, 114-122.
24. "Perron-Frobenius properties of  $Ax = \lambda Bx$ ", J. Math. Anal. and Appl. 35, 1971, 86-102.

25. "A convergent splitting of matrices", *Numer. Math.* 15, 1970, 351-353.
26. (with L. L. Schumaker) "Splines via optimal control", in "Approximations with Special Emphasis on Splines", I. J. Schoenberg (ed.), Academic Press, New York, 1969, 119-156.
27. (with L. L. Schumaker) "Discrete splines via mathematical programming", *SIAM J. Control* 9, 1971, 174-183.
28. "Convergent generalized monotone splitting of matrices", *Math. Comp.* 25, 1971, 649-653.
29. "Monotone splitting of matrices", *Linear Algebra and Its Appl.* 8, 1974, 43-55.
30. "Techniques of optimization", *J. of Engineering for Industry, Trans., ASME* 94, Series B., 1972, 365-372.
31. (with L. L. Schumaker) "Best summation formulae and discrete splines", *SIAM J. Numer. Anal.* 10, 1973, 448-459.
32. "Dual, feasible direction algorithms", in "Techniques of Optimization", A. V. Balakrishnan (ed.), Academic Press, New York, 1972, 67-68.
33. "Second and higher order duality in nonlinear programming", *J. Math. Anal. and Appl.* 51, 1975, 607-620.
34. "Unconstrained Lagrangians in nonlinear programming", *SIAM J. Control* 13, 1975, 772-791.
35. "Nonlinear programming theory and computation", in "Handbook of Operations Research", J. J. Modor and S. E. Elmaghraby (eds.), Van Nostrand Reinhold Co., New York, 1978, 245-265.
36. (with U. M. Garcia-Palomares) "Superlinearly convergent quasi-Newton algorithms for nonlinearly constrained optimization problems", *Mathematical Programming* 11, 1976, 1-13.
37. "Unconstrained optimization methods", in "Proceedings Twelfth Annual Allerton Conference on Circuit and System Theory", Oct. 2-4, 1974, University of Illinois, Urbana-Champaign, 153-160.
38. "Equivalence of the complementarity problem to a system of nonlinear equations", *SIAM J. App. Math.* 31, 1976, 89-92.
39. "Linear complementarity problems solvable by a single linear program", *Mathematical Programming* 10, 1976, 263-270.
40. "Unconstrained methods in nonlinear programming", in "Nonlinear Programming", SIAM-AMS Proceedings, Volume IX, American Math. Soc., Providence, Rhode Island, 1976, 169-184.
41. "Solution of linear complementarity problems by linear programming", in "Numerical Analysis Dundee 1975", G. A. Watson (ed.), Lecture Notes in Mathematics 506, Springer-Verlag, Berlin, 1976, 166-175.
42. "Characterization of linear complementarity problems as linear programs", *Mathematical Programming Study* 7, 1978, 74-87.
43. "Solution of symmetric linear complementarity problems by iterative methods", *Journal of Optimization Theory and Applications* 22, 1977, 465-485.
44. (with W. R. S. Sutherland) "Solution of the linear inverse vector optimization problem by a single linear program", *Mathematical Programming* 15, 1978, 232-235.
45. "Simplified characterizations of linear complementarity problems solvable as linear programs", *Mathematics of Operations Research* 4, 1979, 268-273.
46. "Uniqueness of solution in linear programming", *Linear Algebra and Its Applications* 25, 1979, 151-162.
47. (with R. R. Meyer) "Nonlinear perturbation of linear programs", *SIAM Journal on Control and Optimization* 17, 1979, 745-752.
48. "Iterative solution of linear programs", *SIAM Journal on Numerical Analysis* 18, 1981, 606-614.

49. (with S.-P. Han) "Exact penalty functions in nonlinear programming", *Mathematical Programming* 17, 1979, 251-269.
50. "Generalized linear complementarity problems as linear programs", *Proceedings of the Third International Symposium on Operations Research*, Mannheim, September 1-8, 1978, *Operations Research Verfahren*, Volume 31, 1979, Verlag Anton Hain, Königstein/Taunus, 1979, 393-402.
51. "Locally unique solutions of quadratic programs, linear and nonlinear complementarity problems", *Mathematical Programming* 19, 1980, 200-212.
52. "Characterizations of bounded solutions of linear complementarity problems", *Mathematical Programming Study* 19, 1982, 153-166.
53. "Optimal simplex tableau characterization of unique and bounded solutions of linear programs", *Journal of Optimization Theory and Applications* 35, 1981, 123-128.
54. "Least-norm linear programming solution as an unconstrained minimization problem", *Journal of Mathematical Analysis and Applications* 92, 1983, 240-251.
55. "A stable theorem of the alternative: An extension of the Gordan theorem", *Linear Algebra and Its Applications* 41, 1981, 209-223.
56. "A condition number for linear inequalities and linear programs", in "Methods of Operations Research", *Proceedings of 6. Symposium über Operations Research*, Augsburg, 7-9 September 1981, G. Bamberg & O. Opitz (eds.), Verlagsgruppe Athenaum/ Hain/Scriptor/Hanstein, Königstein 1981, 3-15.
57. (with S.-P. Han) "A dual differentiable exact penalty function", *Mathematical Programming* 25, 1983, 293-306.
58. "Sparsity-preserving SOR algorithms for separable quadratic and linear programming", *Computers and Operations Research* 11, 1984, 105-112.
59. (with O. Fujiwara & S.-P. Han) "Local duality of nonlinear programs", *SIAM Journal on Control and Optimization* 22, 1984, 162-169.
60. (with S.-P. Han) "Conjugate cone characterization of positive definite and semidefinite matrices", *Linear Algebra and Its Applications* 56, 1984, 89-103.
61. (with S.-P. Han) "Characterization of positive definite and semidefinite matrices via quadratic programming duality", *SIAM Journal on Algebraic and Discrete Methods* 5, 1984, 26-32.
62. (with S.-P. Han) "Conjugate decomposition of the Euclidean space", *Proceedings National Academy of Sciences U.S.A.* 30, 1983, 5156-5157.
63. "A condition number for differentiable convex inequalities", *Mathematics of Operations Research* 10, 1985, 175-179.
64. "Normal solutions of linear programs", *Mathematical Programming Study* 22, 1984, 206-216.
65. "Sufficiency of exact penalty minimization", *SIAM Journal on Control and Optimization* 23, 1985, 30-37.
66. "Simple computable bounds for solutions of linear complementarity problems and linear programs", *Mathematical Programming Study* 25, 1985, 1-12.
67. (with L. McLinden) "Simple bounds for solutions of monotone complementarity problems and convex programs", *Mathematical Programming* 32, 1985, 32-40.
68. "Some applications of penalty functions in mathematical programming", *Lecture Notes in Mathematics* No. 1190, "Optimization and Related Fields", R. Conti, E. De Giorgi and F. Giannessi, editors, Springer-Verlag, Berlin, 1986, 307-329.
69. (with T.-H. Shiau) "A variable-complexity norm maximization problem", *SIAM Journal on Algebraic and Discrete Methods* 7, 1986, 455-461.

70. "Computable numerical bounds for Lagrange multipliers of stationary points of nonconvex differentiable nonlinear programs", *Operations Research Letters* 4, 1985, 47-48.
71. (with T.-H. Shiau) "Lipschitz continuity of solutions of linear inequalities, programs and complementarity problems", *SIAM Journal on Control and Optimization* 25, 1987, 583-595.
72. (with T.-H. Shiau) "Error bounds for monotone linear complementarity problems", *Mathematical Programming* 36, 1986, 81-89.
73. (with R. De Leone): "Error bounds for strongly convex programs and (super)linearly convergent iterative schemes for the least 2-norm solution of linear programs", *Applied Mathematics and Optimization*, 17, 1988, 1-14.
74. (with R. De Leone): "Parallel successive overrelaxation methods for symmetric linear complementarity problems and linear programs", *Journal of Optimization Theory and Applications* 54, 1987, 437-446.
75. (with R. De Leone): "Parallel gradient projection successive overrelaxation for symmetric linear complementarity problems and linear programs", *Annals of Operations Research* 14, 1988, 41-59.
76. "A simple characterization of solution sets of convex programs", *Operations Research Letters* 7, 1988, 21-26.
77. "Least norm solution of non-monotone linear complementarity problems", in "Functional analysis, optimization and mathematical economics", L. J. Leifman, editor, Oxford University Press, New York 1990, 217-221.
78. (with R. De Leone): "Serial and parallel solution of large scale linear programs by augmented Lagrangian successive overrelaxation" in A. Kurzhanski, K. Neumann & D. Pallaschke (eds): "Optimization, parallel processing and applications", *Lecture Notes in Economics and Mathematical Systems* Volume 304, Springer-Verlag, Berlin, 1988, 103-124.
79. (with R. De Leone): "Asynchronous parallel successive overrelaxation for the symmetric linear complementarity problem", *Mathematical Programming B* 42, 1988, 347-362.
80. "Error bounds for nondegenerate monotone linear complementarity problems", *Mathematical Programming B* 48, 1990, 437-445.
81. (with R. De Leone & T.-H. Shiau): "Multi-sweep asynchronous parallel successive overrelaxation for the nonsymmetric linear complementarity problem", *Annals of Operations Research* 22, 1990, 43-54.
82. (with M. C. Ferris): "Finite perturbation of convex programs", *Applied Mathematics and Optimization* 23, 1991, 263-273.
83. (with W. H. Wolberg): "Multisurface method of pattern separation for medical diagnosis applied to breast cytology", *Proceedings of the National Academy of Sciences U.S.A.* 87, 1990, 9193-9196.
84. (with W. H. Wolberg & W. N. Street): "Computer-aided diagnosis of breast aspirates via expert systems", *Analytical and Quantitative Cytology and Histology* 12, 1990, 314-320.
85. (with M. C. Ferris): "Minimum principle sufficiency", *Mathematical Programming B* 57, 1992, 1-14.
86. (with R. Setiono & W. H. Wolberg): "Pattern recognition via linear programming: Theory and application to medical diagnosis", in: "Large-scale numerical optimization", Thomas F. Coleman and Yuying Li, editors, SIAM, Philadelphia 1990, 22-30.
87. (with W. H. Wolberg): "Computer-designed expert systems for breast cytology diagnosis", *Analytical and Quantitative Cytology and Histology*, 15, 1993, 67-74.
88. "Convergence of iterates of an inexact matrix splitting algorithm for the symmetric monotone linear complementarity problem", *SIAM Journal on Optimization* 1, 1991, 114-122.

89. (with K. P. Bennett): "Neural network training via linear programming", in P. M. Pardalos (Editor), "Advances in Optimization and Parallel Computing", North Holland, Amsterdam 1992, 56-67.
90. (with W. H. Wolberg): "Cancer diagnosis via linear programming", SIAM News 23(5), September 1990, pp. 1 & 18.
91. "Mathematical programming musings", in "History of mathematical programming", J. K. Lenstra, A. H. G. Rinnooy Kan and A. Schrijver, editors, North Holland, Amsterdam 1991, 107-113.
92. (with M. C. Ferris): "Parallel constraint distribution", SIAM Journal on Optimization 1, 1991, 487-500.
93. "Global error bounds for monotone affine variational inequality problems", Linear Algebra and Its Applications 174, 1992, 153-164.
94. (with K. P. Bennett): "Robust linear programming discrimination of two linearly inseparable sets", Optimization Methods and Software 1, 1992, 23-34.
95. (with M. C. Ferris): "Error bounds and strong upper semicontinuity for monotone affine variational inequalities", Annals of Operations Research, 47, 1993, 293-305.
96. (with M. V. Solodov): "Nonlinear complementarity as unconstrained and constrained minimization", Mathematical Programming, Series B, 62, 1993, 277-297.
97. (with K. P. Bennett): "Bilinear separation of two sets in n-space", Computational Optimization and Applications 2, 1993, 207-227.
98. (with W. N. Street & W. H. Wolberg): "Breast cytology diagnosis with digital image analysis", Analytical and Quantitative Cytology and Histology 15(6), 1993, 396-404.
99. (with Z.-Q. Luo, J. Ren & M. V. Solodov): "New error bounds for the linear complementarity problem", Mathematics of Operations Research 19(4), November 1994, 880-892.
100. (with K. P. Bennett): "Multicategory discrimination via linear programming", Optimization Methods and Software 3, 1994, 27-39.
101. "Mathematical programming in neural networks", ORSA Journal on Computing 5, 1993, 349-360.
102. (with W. N. Street & W. H. Wolberg): "Nuclear feature extraction for breast tumor diagnosis", in Proceedings of Meeting on "Biomedical image processing and biomedical visualization", San Jose, California, February 1-4, 1993, SPIE-The International Society for Optical Engineering, Bellingham, Washington, SPIE Volume 1905, 1993, 861-870.
103. "Parallel gradient distribution in unconstrained optimization", SIAM Journal on Control and Optimization 33(6), 1995, 1916-1925.
104. (with M. V. Solodov): "Serial and parallel backpropagation convergence via nonmonotone perturbed minimization", Optimization Methods and Software 4(2), 1994, 103-116.
105. (with J. Ren): "New improved bounds for the linear complementarity problem", Mathematical Programming 66, September 1994, 241-255.
106. (with K. P. Bennett): "Serial and parallel multicategory discrimination", SIAM Journal on Optimization, 4(4), November 1994, 722-734.
107. "Error bounds for inconsistent linear inequalities and programs", Operations Research Letters 15, May 1994, 187-192.
108. (with M. C. Ferris): "Parallel variable distribution", SIAM Journal on Optimization, 4(4), November 1994, 815-832.
109. "Misclassification minimization", Journal of Global Optimization 5(4), December 1994, 309-323.
110. (with Jong-Shi Pang): "The extended linear complementarity problem", SIAM Journal on Matrix Analysis and Applications 16, January 1995, 359-368.

111. (with Chunhui Chen): "Smoothing methods for convex inequalities and linear complementarity problems", *Mathematical Programming* 71, 1995, 51-69.
112. (with M. V. Solodov): "Backpropagation convergence via deterministic nonmonotone perturbed minimization". *Mathematical Programming Technical Report 94-06*, June 1994. "Advances in Neural Information Processing Systems -6-", (NIPS\*93), J. D. Cowan, G. Tesauro and J. Alspector, editors, Morgan Kaufmann, San Francisco, CA, 1994, 383-390.
113. (with J. Ren): "New error bounds for the nonlinear complementarity problem", *Communications on Applied Nonlinear Analysis* 1, 1994, 49-56.
114. (with W. H. Wolberg and W. Nick Street): "Machine learning techniques to diagnose breast cancer from image-processed nuclear features of fine needle aspirates", *Cancer Letters* 77, 1994, 163-171.
115. "The linear complementarity problem as a separable bilinear program". *Mathematical Programming Technical Report 94-09*, July 1994. *Journal of Global Optimization* 6, 1995, 153-161.
116. (with W. Nick Street and W. H. Wolberg): "Breast cancer diagnosis and prognosis via linear programming". *Mathematical Programming Technical Report 94-10*, August 1994. *Operations Research*, 43(4), July-August 1995, 570-577.
117. (with Chunhui Chen): "A class of smoothing functions for nonlinear and mixed complementarity problems". *Mathematical Programming Technical Report 94-11*, August 1994. *Computational Optimization and Applications* 5, 1996, 97-138.
118. (with W. H. Wolberg and W. Nick Street): "Image analysis and machine learning applied to breast cancer diagnosis and prognosis", *Analytical and Quantitative Cytology and Histology* 17, 1995, 77-87.
119. (with W. H. Wolberg, W. Nick Street and D. N. Heisey): "Computer- derived nuclear features distinguish malignant from benign breast cytology", *Human Pathology* 26, 1995, 792-796.
120. (with W. H. Wolberg, W. Nick Street and D. N. Heisey): "Computerized breast cancer diagnosis and prognosis from fine needle aspirates", *Archives of Surgery* 130, 1995, 511-516.
121. (with W. H. Wolberg, W. Nick Street and D. N. Heisey): "Computer- derived nuclear grade and breast cancer prognosis", *Analytical and Quantitative Cytology and Histology* 1995, 17, 257-264.
122. "Optimization in Machine Learning". *Mathematical Programming Technical Report 95-01*, January 1995. *SIAG/OPT Views-and-News*, No.6, Spring 1995, 3-7.
123. (with Chunhui Chen): "Hybrid misclassification minimization". *Mathematical Programming Technical Report 95-05*, February 1995. *Advances in Computational Mathematics* 5(2) 1996, 127-136.
124. (with W. Nick Street and W. H. Wolberg): "An Inductive Learning Approach to Prognostic Prediction", in "Machine Learning: Proceedings of the Twelfth International Conference", A. Prieditis and S. Russell (editors), Morgan Kaufmann, San Francisco 1995, 522-530.
125. "Mathematical programming in machine learning". *Mathematical Programming Technical Report 95-06*, April 1995. "Nonlinear Optimization and Applications", G. Di Pillo and F. Giannessi, editors, *Proceedings of Nonlinear Optimization and Applications Workshop*, Erice, June 1995, Plenum Press, New York 1996, 283-295.
126. (with W. Nick Street): "Improved Generalization via Tolerant Training". *Mathematical Programming Technical Report 95-11*, July 1995. *Journal of Optimization Theory and Applications* 96(2), 1998, 259-279.
127. "The ill-posed linear complementarity problem". *Mathematical Programming Technical Report 95-15*, August 1995. "Complementarity and variational problems", M. C. Ferris and J.-S. Pang, editors, SIAM Publishers, Philadelphia, PA 1997, 226-233.

128. "Machine learning via polyhedral concave minimization", University of Wisconsin, Computer Sciences Department, Mathematical Programming Technical Report 95-20, November 1995, "Applied Mathematics and Parallel Computing – Festschrift for Klaus Ritter", H. Fischer, B. Riedmueller, S. Schaeffler, editors, Physica-Verlag, Germany 1996, 175-188.
129. (with M. C. Ferris): "Breast cancer diagnosis via linear programming", IEEE Computational Science and Engineering 2, 1995, 70-71.
130. (with P. S. Bradley and W. Nick Street): "Feature selection via mathematical programming". Mathematical Programming Technical Report 95-21, December 1995. INFORMS Journal on Computing 10, 1998, 209-217.
131. (with P. S. Bradley and W. Nick Street): "Clustering via concave minimization". Mathematical Programming Technical Report 96-03, May 1996. "Advances in Neural Information Processing Systems -9-", (NIPS\*96), M. C. Mozer and M. I. Jordan and T. Petsche, editors, MIT Press, Cambridge, MA, 1997, 368-374.
132. "Error bounds for nondifferentiable convex inequalities under a strong Slater constraint qualification". Mathematical Programming Technical Report 96-04, July 1996. Mathematical Programming A, 83, 1998, 187-194.
133. "Mathematical programming in data mining". Mathematical Programming Technical Report 96-05. Journal of Data Mining and Knowledge Discovery 1(2), 1997, 183-201.
134. (with J.-S. Pang): "Exact penalty functions for mathematical programs with linear complementarity constraints". Mathematical Programming Technical Report 96-06, August 1996. Optimization 42, 1997, 1-8.
135. (with M. V. Solodov): "A linearly convergent derivative-free descent method for strongly monotone complementarity problems", Computer Sciences Department, Mathematical Programming Technical Report 96-07, October 1996, Computational Optimization and Applications 14, 1999, 5-16.
136. "Solution of general linear complementarity problems via nondifferentiable concave minimization". Mathematical Programming Technical Report 96-10, November 1996. Acta Mathematica Vietnamica, 22(1), 1997, 199-205.
137. (with W. H. Wolberg & W. N. Street): "Computerized diagnosis of breast needle aspirates", The Breast Journal 3, 1997, 77-80.
138. (with M. W. Teague, W. H. Wolberg, W. N. Street, S. Lambremont & D. L. Page): "Indeterminate fine needle aspiration of the breast: Image analysis-assisted diagnosis", Cancer Cytopathology 81(2), 1997, 129-135.
139. (with P. S. Bradley & J. B. Rosen): "Parsimonious least norm approximation". Mathematical Programming Technical Report 97-03, March 1997. Computational Optimization and Applications, 11, 1998, 5-21.
140. "Minimum-support solutions of polyhedral concave programs", Mathematical Programming Technical Report 97-05, April 1997, Optimization 45, 1999, 149-162.
141. "Arbitrary-norm separating plane", Mathematical Programming Technical Report 97-07, May 1997, Operations Research Letters 24, 1999, 15-23.
142. (with W. H. Wolberg & W. N. Street): "Computer-derived nuclear features compared with axillary lymph node status for breast carcinoma prognosis", Cancer Cytopathology 81, 1997, 172-179.
143. "Polyhedral boundary projection", Mathematical Programming Technical Report 97-10, October 1997, SIAM Journal on Optimization 9, 1999, 1128-1134.
144. (with P. S. Bradley): "Parsimonious side propagation". Mathematical Programming Technical Report 97-11, October 1997. ICASSP98: IEEE International Conference on Acoustics, Speech and Signal Processing, Seattle May 12-15, 1998, Volume 3, 1873-1876.

145. “Regularized linear programs with equilibrium constraints”. Mathematical Programming Technical Report 97-13, November 1997. “Reformulation-Nonsmooth, Piecewise Smooth, Semismooth and Smoothing Methods”. M. Fukushima and Liqun Qi, editors, Kluwer Academic Publishers, 1998, 259-268.
146. (with P. S. Bradley and Usama M. Fayyad): “Mathematical programming for data mining: formulations and challenges”, Mathematical Programming Technical Report 98-01, January 1998. INFORMS Journal on Computing 11, 1999, 217-238.
147. (with P. S. Bradley): “Feature selection via concave minimization and support vector machines”. Mathematical Programming Technical Report 98-03, February 1998. “Machine Learning Proceedings of the Fifteenth International Conference (ICML ’98)”, Madison, WI, July 24-27, 1998, Morgan Kaufmann, San Francisco, CA 1998, 82-90.
148. (with P. S. Bradley): “Massive data discrimination via linear support vector machines”, Mathematical Programming Technical Report 98-05, May 1998. Optimization Methods and Software 13(1), 2000, 1-10.
149. (with P. S. Bradley): “k-Plane Clustering”, Mathematical Programming Technical Report 98-08, August 1998. Journal of Global Optimization 16, 2000, 23-32.
150. “Generalized Support Vector Machines”, Mathematical Programming Technical Report 98-14, October 1998. “Advances in Large Margin Classifiers”, A. J. Smola, P. Bartlett, B. Schölkopf and D. Schuurmans, editors, MIT Press, 2000, 135-146.
151. (with D. R. Musicant): “Successive Overrelaxation for Support Vector Machines”, Mathematical Programming Technical Report 98-18, November 1998, IEEE Transactions on Neural Networks 10, 1999, 1032-1037.
152. (with D. R. Musicant): “Data Discrimination via Nonlinear Generalized Support Vector Machines”, Mathematical Programming Technical Report 99-03, March 1999, in “Complementarity: Algorithms, Applications and Extensions”, M. C. Ferris, O. L. Mangasarian and J.-S. Pang, editors, Kluwer Academic Publishers, 2001, Dordrecht, 233-251.
153. (with W. H. Wolberg and W. N. Street): “Importance of Nuclear Morphology in Breast Cancer Prognosis”, Clinical Cancer Research 5, 1999, 3542-3548.
154. (with P. S. Bradley and D. R. Musicant): “Optimization Methods in Massive Datasets”, Data Mining Institute Technical Report 99-01, June 1999. “Handbook of Massive Datasets”, J. Abello, P. M. Pardalos, M. G. C. Resende, editors, Kluwer Academic Publishers 2002, 439-472.
155. (with D. R. Musicant): “Large Scale Kernel Regression via Linear Programming”, Data Mining Institute Technical Report 99-02, August, 1999. Machine Learning 46 (1/3):255-269, January 2002.
156. (with Y.-J. Lee): “SSVM: A Smooth Support Vector Machine for Classification”, Data Mining Institute Technical Report 99-03, September 1999. Computational Optimization and Applications 20, 2001, 5-22.
157. (with A. J. Smola and B. Schölkopf): “Sparse Kernel Feature Analysis”, Data Mining Institute Technical Report 99-04, October 1999. 24th Annual Conference of Gesellschaft für Klassifikation, University of Passau, Passau, Germany March 15-17, 2000.
158. (with G. Fung): “Semi-Supervised Support Vector Machines for Unlabeled Data Classification”, Data Mining Institute Technical Report 99-05, October 1999. Optimization Methods and Software 15, 2001, 29-44.
159. (with D. R. Musicant): “Robust Linear and Support Vector Regression”, Data Mining Institute Technical Report 99-09, November 1999. IEEE Transactions on Pattern Analysis and Machine Intelligence 22, 2000, 950-955.

160. (with Y.-J. Lee and W. H. Wolberg): “Breast Cancer Survival and Chemotherapy: A Support Vector Machine Analysis”, Data Mining Institute Technical Report 99-10, December 1999. DIMACS Series in Discrete Mathematics and Computer Science, Volume 55, American Mathematical Society, 2000, 1-10.
161. (with G. Fung): “Data Selection for Support Vector Machine Classifiers”, Data Mining Institute Technical Report 00-02, February 2000. Proceedings KDD-2000, August 20-23, 2000, Boston. Association for Computing Machinery, New York, 2000, 64-70. ISBN 1-58113-233-6.
162. (with D. R. Musicant): “Active Support Vector Machine Classification”, Data Mining Institute Technical Report 00-04, April 2000. Neural Information Processing Systems 2000 (NIPS 2000), Todd K. Lee, Thomas G. Dietterich and Volker Tresp, editors, MIT Press 2001, 577-583.
163. (with D. R. Musicant): “Lagrangian Support Vector Machines”, Data Mining Institute Technical Report 00-06, June 2000. Journal of Machine Learning Research 1, March 2001, 161-177. <http://jmlr.csail.mit.edu/>
164. (with Y.-J. Lee): “RSVM: Reduced Support Vector Machines”, Data Mining Institute Technical Report 00-07, August 2000. CD Proceedings of the First SIAM International Conference on Data Mining, Chicago, April 5-7, 2001, SIAM, Philadelphia, ISBN 0-89871-495-8.
165. (with G. Fung and A. J. Smola): “Minimal Kernel Classifiers”, Data Mining Institute Technical Report 00-08, November 2000. Journal of Machine Learning Research 3, 2002, 303-321. <http://www.ai.mit.edu/projects/jmlr/>
166. (with G. Fung): “Proximal Support Vector Machine Classifiers”, Data Mining Institute Technical Report 01-02, February 2001. Proceedings KDD-2001, San Francisco August 26-29, 2001. Association for Computing Machinery, New York, 2001, 77-86.
167. (with Y.-J. Lee and W. H. Wolberg): “Survival-Time Classification of Breast Cancer Patients”, Data Mining Institute Technical Report 01-03, March 2001. Data Mining Institute Technical Report 01-03, March 2001. Computational Optimization and Applications, 25(1-3), 2003, 151-166.
168. “Data Mining via Support Vector Machines”, Data Mining Institute Technical Report 01-05, May 2001. “System Modeling and Optimization XX”, E. W. Sachs and R. Tichatschke, editors, Kluwer Academic Publishers, Boston 2003, 91-112.
169. (with G. Fung): “Multicategory Support Vector Machine Classifiers”, Data Mining Institute Technical Report 01-06, July 2001. Machine Learning 59, 2005, 77-97.
170. (with G. Fung): “Incremental Support Vector Machine Classification”, Data Mining Institute Technical Report 01-08, September 2001. Proceedings of the Second SIAM International Conference on Data Mining, Arlington, Virginia, April 11-13, 2002, R. Grossman, H. Mannila and R. Motwani (editors), SIAM, Philadelphia 2002, 247-260.
171. (with G. Fung and Jude Shavlik): “Knowledge-Based Support Vector Machine Classifiers”, Data Mining Institute Technical Report 01-09, November 2001. “Neural Information Processing Systems 15”, S. Becker, S. Thrun and K. Obermayer, editors, MIT Press, Cambridge, MA, 2003, 521-528.
172. “Set Containment Characterization”, Data Mining Institute Technical Report 01-10, November 2001. Journal of Global Optimization 24(4) December 2002, 473-480.
173. “Finite Newton Method for Classification Problems”, Data Mining Institute Technical Report 01-11, December 2001. Optimization Methods and Software 17, 2002, 913-929.
174. (with G. Fung): “Finite Newton Method for Lagrangian Support Vector Machine Classification”, Data Mining Institute Technical Report 02-01, February 2002. Neurocomputing 55, September 2003, 39-55.
175. “A Newton Method for Linear Programming”, Data Mining Institute Technical Report 02-02, March 2002. Journal of Optimization Theory and Applications 121, 2004, 1-18.

176. (with G. Fung): “A Feature Selection Newton Method for Support Vector Machine Classification”, Data Mining Institute Technical Report 02-03, September 2002. Computational Optimization and Applications 28(2), 185-202, 2004.
177. “Support Vector Machine Classification via Parameterless Robust Linear Programming”, Data Mining Institute Technical Report 03-01, March 2003. Optimization Methods and Software 20(1), 2005, 115-125.
178. (with G. Fung and Jude Shavlik): “Knowledge-Based Nonlinear Kernel Classifiers”, Data Mining Institute Technical Report 03-02, March 2003. Conference On Learning Theory (COLT 03) and Workshop on Kernel Machines, Washington, D.C., August 24 - 27, 2003. Proceedings edited by Manfred Warmuth and Bernhard Schölkopf, Springer Verlag, Berlin, 2003, 102-113.
179. (with J. B. Rosen and M. E. Thompson): “Global Minimization via Piecewise-Linear Underestimation”, Data Mining Institute Technical Report 03-03, June 2003. Journal of Global Optimization 32, 2005, 1-9.
180. “Knowledge-Based Linear Programming”, Data Mining Institute Technical Report 03-04, July 2003. SIAM Journal on Optimization 15(2), 2005, 375-382.
181. (with J. W. Shavlik and E. W. Wild): “Knowledge-Based Kernel Approximation”, Data Mining Institute Technical Report 03-05, October 2003. Journal of Machine Learning Research 5, 1127-1141, 2004. <http://jmlr.csail.mit.edu/>
182. (with G. Fung): “Breast Tumor Susceptibility to Chemotherapy via Support Vector Machines”, Data Mining Institute Technical Report 03-06, November 2003. Computational Management Science 3, 2006,103-112.
183. (with E. W. Wild): “Feature Selection in  $k$ -Median Clustering”, Data Mining Institute Technical Report 04-01, January 2004. SIAM International Conference on Data Mining, Workshop on Clustering High Dimensional Data and its Applications, April 24, 2004, La Buena Vista, FL, Proceedings, pages 23-28.
184. (with J. B. Rosen and M. E. Thompson): “Convex Kernel Estimation of Functions with Multiple Local Minima”, Data Mining Institute Technical Report 04-02, May 2004. Computational Optimization and Applications 34(1), 2006, 34-45.
185. (with E. W. Wild): “Multisurface Proximal Support Vector Classification via Generalized Eigenvalues”, Data Mining Institute Technical Report 04-03, June 2004. IEEE Transactions on Pattern Analysis and Machine Intelligence 28(1), 2006, 69-74.
186. (with J. B. Rosen and M. E. Thompson): “Nonconvex Piecewise-Quadratic Underestimation for Global Minimization”, Data Mining Institute Technical Report 05-01, March 2005. Journal of Global Optimization 34(4), 2006, 475-488.
187. (with E. W. Wild): “Multiple Instance Classification via Successive Linear Programming”, Data Mining Institute Technical Report 05-02, May 2005. Journal of Optimization Theory and Applications 137(1), 2008, 555-568.
188. “Exact 1-Norm Support Vector Machines via Unconstrained Convex Differentiable Minimization”, Data Mining Institute Technical Report 05-03, August 2005. Journal of Machine Learning Research 7, 2006, 1517-1530.
189. “Absolute Value Programming”, Data Mining Institute Technical Report 05-04, September 2005. Computational Optimization and Applications 36(1), 2007, 43-53.
190. (with E. W. Wild): “Nonlinear Knowledge in Kernel Approximation”, Data Mining Institute Technical Report 05-05, October 2005. IEEE Transactions on Neural Networks 18, 2007, 300-306.
191. (with R. R. Meyer): “Absolute Value Equations”, Data Mining Institute Technical Report 05-06, December 2006. Linear Algebra and Its Applications 419 (2006) 359-367.

192. (with M. E. Thompson): “Massive Data Classification via Unconstrained Support Vector Machines”, Data Mining Institute Technical Report 06-01, March 2006. *Journal of Optimization Theory and Applications* 131(3), December 2006, 315-325.
193. “Absolute Value Equation Solution via Concave Minimization”, Data Mining Institute Technical Report 06-02, March 2006. *Optimization Letters* 1(1), 2007, 3-8.
194. (with E. W. Wild): “Feature Selection for Nonlinear Kernel Support Vector Machines”, Data Mining Institute Technical Report 06-03, July 2006. *IEEE Seventh International Conference on Data Mining (ICDM’07)* October 28, 2007, Omaha, NE, Workshop Proceedings 231-236.
195. (with E. W. Wild): “Nonlinear Knowledge-Based Classification”, Data Mining Institute Technical Report 06-04, August 2006. *IEEE Transactions on Neural Networks* 19, October 2008, 1826-1832.
196. (with E. W. Wild and G. M. Fung): “Proximal Knowledge-Based Classification”, Data Mining Institute Technical Report 06-05, November 2006. *Statistical Analysis and Data Mining* 1(4) 2009, 215-222.
197. (with E. W. Wild): “Nonlinear Knowledge in Kernel Machines”, Data Mining Institute Technical Report 06-06, November 2006. *CRM Proceedings & Lecture Notes, Volume 45*, American Mathematical Society and Centre de Recherches Mathématiques at the Université de Montréal, 2008, 181-198.
198. (with M. E. Thompson): “Chunking for Massive Nonlinear Kernel Classification”, Data Mining Institute Technical Report 06-07, December 2006. *Optimization Methods and Software* 23, 2008, 365-274.
199. (with E. W. Wild): “Exactness Conditions for a Convex Differentiable Exterior Penalty for Linear Programming”, Data Mining Institute Technical Report 07-01, July 2007. *Optimization*, to appear.
200. (with E. W. Wild and G. M. Fung): “Privacy-Preserving Classification of Vertically Partitioned Data via Random Kernels”, Data Mining Institute Technical Report 07-02, September 2007. *ACM Transactions on Knowledge Discovery from Data (TKDD)* Volume 2, Issue 3, October 2008.
201. (with E. W. Wild): “Privacy-Preserving Classification of Horizontally Partitioned Data via Random Kernels”, Data Mining Institute Technical Report 07-03, November 2007. *Proceedings of the 2008 International Conference on Data Mining DMIN08, Las Vegas July 2008, Volume II*, 473-479, R. Stahlbock, S.V. Crone and S. Lessman, Editors.
202. “A Generalized Newton Method for Absolute Value Equations”, Data Mining Institute Technical Report 08-01, May 2008. *Optimization Letters* 3(1), January 2009, 101-108. Online version: <http://www.springerlink.com/content/c076875254r7tn38/>
203. (with E. W. Wild): “Privacy-Preserving Random Kernel Classification of Checkerboard Partitioned Data”, Data Mining Institute Technical Report 08-02, September 2008. *Annals of Information Systems*, to appear.
204. “Knapsack Feasibility as an Absolute Value Equation Solvable by Successive Linear Programming”, Data Mining Institute Technical Report 08-03, September 2008. *Optimization Letters* 3(2) March 2009, 161-170. Online version: <http://www.springerlink.com/content/7011287432285747/>
205. (with M. C. Ferris): “Uniqueness of Integer Solution of Linear Equations”, Data Mining Institute Technical Report 09-01, July 2009.
206. (with B. Recht): “Probability of Unique Integer Solution to a System of Linear Equations”, Data Mining Institute Technical Report 09-02, September 2009.