Comput Optim Appl (2008) 41: 147–149
DOI 10.1007/s10589-008-9203-8

COAP 2007 Best Paper Award

William W. Hager

Published online: 12 September 2008

Each year, the Computational Optimization and Applications (COAP) editorial board selects a paper from the preceding year's COAP publications for the Best Paper Award. The recipient of the award for papers published in 2007 is Olvi Mangasarian of the University of Wisconsin, Madison and the University of California, San Diego, for his paper "Absolute Value Programming", published in Volume 36, pages 43–53.

This paper [7] as well as subsequent closely related papers [6, 8, 9] deal with the absolute value equation (AVE) $Ax + B|x| = b$, where A and B are arbitrary $m \times n$ real matrices and $|x|$ denotes the vector with absolute values of the n-dimensional real valued vector x. The significance of this class of NP-hard problems arises partly from the fact that when $B = I$, the identity matrix, AVE is equivalent to the general linear complementarity problem, $0 \le x \perp Mx + q \ge 0$.

Even though problems involving absolute values are NP-hard, they share some very interesting properties with those of linear systems. For example, optimization problems with absolute value constraints possess optimality and duality results similar to those of linear programming, even though the problems are inherently nonconvex. Another interesting property that AVE shares with linear inequalities are theorems of the alternative which are established in this paper. The paper also contains a finite successive linearization algorithm for solving absolute value equations that terminates at a necessary optimality condition. This algorithm has solved all random test problems given to it for which mostly $m \ge 2n$ or $n \ge 2m$, up to size (m, n) of $(2000, 100)$ and $(100, 2000)$. When $m = n$ and B is invertible, which is the case for the linear complementarity problem formulation, a simpler concave minimization

W.W. Hager (✉)
University of Florida, Gainesville, FL, USA
e-mail: hager@math.ufl.edu

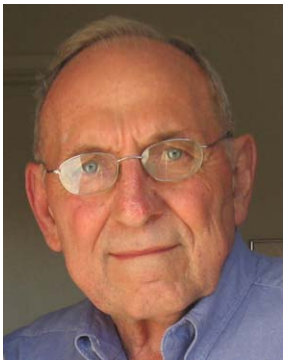
formulation is given that is also solvable by a finite succession of linear programs. Problems with $m = n$ and n between 50 and 1000 were solved by this approach.

Mangasarian's recent research revolves around the application of optimization to machine learning and data mining. One specific area that he has contributed to recently is privacy-preserving classification [11, 14] wherein a data classifier is generated based on a dataset each part of which is owned by an entity that is unwilling to make it public. Another area is knowledge-based classification [1, 10, 12, 13] wherein a classifier is generated from both conventional data as well as knowledge provided by an expert such as an experienced clinician. This approach requires tools for handling optimization problems with implication-based constraints [5]. Another important application concerns minimum support solution of optimization problems [3] which has broad application in both machine learning and data mining. Finally, in essentially all these applications support vector machines [4] play a key role which can be traced to an early paper of Mangasarian's [2].

References

1. Fung, G., Mangasarian, O.L., Shavlik, J.: Knowledge-based support vector machine classifiers. In: Becker, S., Thrun, S., Obermayer, K. (eds.) Advances in Neural Information Processing Systems 15, pp. 521–528. MIT Press, Cambridge (2003). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/01-09.ps
2. Mangasarian, O.L.: Linear and nonlinear separation of patterns by linear programming. Oper. Res. **13**, 444–452 (1965)
3. Mangasarian, O.L.: Minimum-support solutions of polyhedral concave programs. Optimization **45**, 149–162 (1999). ftp://ftp.cs.wisc.edu/math-prog/tech-reports/97-05.ps
4. Mangasarian, O.L.: Generalized support vector machines. In: Smola, A., Bartlett, P., Schölkopf, B., Schuurmans, D. (eds.) Advances in Large Margin Classifiers, pp. 135–146. MIT Press, Cambridge (2000). ftp://ftp.cs.wisc.edu/math-prog/tech-reports/98-14.ps
5. Mangasarian, O.L.: Knowledge-based linear programming. SIAM J. Optim. **15**, 375–382 (2005). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/03-04.ps
6. Mangasarian, O.L.: Absolute value equation solution via concave minimization. Optim. Lett. **1**(1), 3–8 (2007). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/06-02.pdf
7. Mangasarian, O.L.: Absolute value programming. Comput. Optim. Appl. **36**(1), 43–53 (2007). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/05-04.ps
8. Mangasarian, O.L.: A generalized Newton method for absolute value equations. Technical Report 08-01, Data Mining Institute, Computer Sciences Department, University of Wisconsin (May 2008). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/08-01.pdf. Optim. Lett. (to appear)
9. Mangasarian, O.L., Meyer, R.R.: Absolute value equations. Linear Algebra Appl. **419**, 359–367 (2006). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/05-06.pdf
10. Mangasarian, O.L., Wild, E.W.: Nonlinear knowledge-based classification. Technical Report 06-04, Data Mining Institute, Computer Sciences Department, University of Wisconsin, Madison, Wisconsin (August 2006). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/06-04.pdf, IEEE Trans. Knowl. Data Eng. (to appear)
11. Mangasarian, O.L., Wild, E.W.: Privacy-preserving classification of horizontally partitioned data via random kernels. Technical Report 07-03, Data Mining Institute, Computer Sciences Department, University of Wisconsin, Madison, Wisconsin (November 2007). Proceedings of the 2008 International Conference on Data Mining, DMIN08, Las Vegas July 2008, Volume II, pp. 473–479, R. Stahlbock, S.V. Crone and S. Lessman, Editors
12. Mangasarian, O.L., Wild, E.W.: Nonlinear knowledge in kernel machines. In: Pardalos, P.M., Hansen, P. (eds.) Data Mining and Mathematical Programming. Centre de Recherches Mathématiques Montréal Proceedings and & Lecture Notes, pp. 181–198. American Mathematical Society, Providence (2008). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/06-06.pdf

13. Mangasarian, O.L., Wild, E.W., Fung, G.M.: Proximal knowledge-based classification. Technical Report 06-05, Data Mining Institute, Computer Sciences Department, University of Wisconsin, Madison, Wisconsin (November 2006). ftp://ftp.cs.wisc.edu/pub/dmi/tech-reports/06-05.pdf. Stat. Anal. Data Mining (to appear)
14. Mangasarian, O.L., Wild, E.W., Fung, G.M.: Privacy-preserving classification of vertically partitioned data via random kernels. Technical Report 07-02, Data Mining Institute, Computer Sciences Department, University of Wisconsin, Madison, Wisconsin (September 2007). ACM Trans. Knowl. Discov. Data (TKDD) (to appear)



Olvi L. Mangasarian received his Ph.D. in Applied Mathematics from Harvard University, and worked for eight years as a Mathematician for Shell Oil Company in California before coming to the University of Wisconsin, where he is now the John von Neumann Professor Emeritus of Mathematics and Computer Sciences. He is also co-director of the Data Mining Institute of the Computer Sciences Department (www.cs.wisc.edu/dmi) and a Research Scientist in the Mathematics Department at the University of California at San Diego. His main research interests are in the areas of optimization, machine learning and data mining. He is author of the book "Nonlinear Programming", co-author of the book "Linear Programming with MATLAB", co-editor of four books, associate editor of two journals and author/co-author of over 200 papers. He was the recipient of the INFORMS 2000 Lanchester Prize for Mathematical Programming in Machine Learning and Data Mining. He is Principal Investigator on a 2005-09 National Science Foundation grant. His recent work is available at: www.cs.wisc.edu/~olvi.