Combinatorics & Optimization Waterloo

Prof. Henry Wolkowicz
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as of April 22, 2017

Personal Data

Citizenship: Canadian (as of 1956)

Born: Lodz, Poland, Feb. 25, 1948 (arrived in Canada December, 1949)

Married: Sept. 19, 1970.

Children: Son Daniel Howard, born Sept. 19, 1990.

Academic Information

Degrees:

1972	B.Sc. (Mathematics)	McGill University, Montreal
1975	M.Sc. (Applied Mathematics)	McGill University, Montreal
1978	Ph.D. (Mathematics)	McGill University, Montreal

Academic Positions:

1977	Lecturer, Department of Mathematics, McGill University
1978-1979	Assistant Professor, Department of Mathematics, Dalhousie University
1979-1985	Assistant Professor (promoted to assoc. in 1981), Department of Mathematics, University of Alberta
1985-1986	Associate Professor, Department of Mathematical Sciences, University of Delaware
1986-	Professor, tenured (promoted to full in 1989), Dept. of Comb. & Opt., Univ. of Waterloo

Research Activities

Areas of Interest: Optimization; Mathematical Programming (linear, nonlinear, semidefinite programming, semi-infinite); Scheduling Problems; Quadratic Assignment Problem; Numerical Analysis (numerical linear algebra); Convex Analysis; Matrix Theory (eigenvalue bounds, invariant cones); Generalized Inverses (operators and matrices).

Visiting Appointments:

1982	Visiting Associate professor,, Teaching and Research (invited) Institute for Physical Science and Technology, The University of Maryland
1984-1985	Visiting Associate Professor (invited) Department of Mathematics and Computer Science, Emory University
1992/93	Visiting professor and Research Fellow (invited) Department of Civil Engineering and Operations Research, Princeton University
1999	Summer Research Visitor (invited) Laboratoire Approximation & Optimisation, Universite Paul Sabatier (Toulouse III)
2001	Summer Lecturer (invited) CEFET-RJ, UFRJ, UFF, IMPA, Rio de Janeiro, Brazil
2002	Summer Lecturer (invited) Scuola Matematica Interuniversitaria, Cortona/Firenze, Italy
2007	Summer Lecturer (invited) MSRI, Berkeley/CA, USA

Honours

- **Fellow** Society for Industrial and Applied Mathematics (SIAM) 2015-

Teaching Activities:

Courses (and Short Courses) Given:

1. Graduate:

   (a) **Invited Optimization Courses/Workshops Given**:
   MSRI, Berkeley, CA, July 9-20, 2007
   Short Course on Semidefinite Programming, Eigth SIAM Conference on Optimization, Stockholm, May 15-18, 2005
   Short course presentation Waterloo, ON, May, 2004
   Scuola Matematica Interuniversitaria, Firenze, Italy, Aug. 18-31, 2002
   Fields Institute, Jan.-Apr. 2002
   Joint Short Course, UFRJ, CEFET, IMPA in Rio de Janeiro, Brazil, on SDP and QAP, Apr. 10-24, 2001
   Short Course on SDP, at Eighth SIAM Conference on Optimization, SIAG/OPT, OP05, May 15-18, Stockholm.

   (b) **Selection of University Courses Given**:
   University of Alberta - Convex Analysis and Optimization
   The University of Maryland - Nonlinear Programming
   Emory University - Numerical Analysis
   University of Delaware - Nonlinear Programming; Advanced Linear Programming; Introduction to Statistics
   University of Waterloo - Continuous Optimization; Convex Optimizaton; Infinite Linear Programming; Topics courses on Semidefinite Programming

2. Undergraduate:
   McGill University - Applied Matrix Algebra
   Dalhousie University - Calculus; Numerical Methods and Structured programming; Nonlinear Programming
   University of Alberta - Numerical Analysis ; Calculus; Mathematical Programming
   University of Delaware - Introduction to Statistics; Finite Mathematics

University of Waterloo - Nonlinear Programming; Methods of Operations Research (coordinator); Linear Programming; Linear Algebra

NSERC Scholarship Summer Students

Mike Lamoreaux, The University of Alberta, 1983.

Luo Quan Zheng, University of Waterloo, 1988.

Cathy Bakos, University of Waterloo, 1990.

Bernard Hsiung, University of Waterloo, 1990.

Miguel Anjos, University of Waterloo, 1991.

Dorian Birsan, University of Waterloo, 1991

Jason Hinek, University of Waterloo, 1999

Leo Tzou, University of Waterloo, 2000

Charles Fortin, University of Waterloo, 2001

Oleg Grodzevich, University of Waterloo, 2002

David Tweedle, University of Waterloo, 2004

David Tweedle, University of Waterloo, 2005

Jamie Sikora, University of Waterloo, 2005

Jiawei Qian, University of Waterloo, 2006

Hao Sun, University of Waterloo, 2012

Bo Yang Liu, University of Waterloo, 2013

Hao Sun, University of Waterloo, 2013

Hao Sun, University of Waterloo, 2014

Ian Davidson, University of Waterloo, 2015

Shimeng Huang, University of Waterloo, 2016

Graduate Students:

M.Math.:

- Ravindar Kumar, "Bounds for Eigenvalues", University of Alberta, 1984, [207].
- Christopher Schoettle, "The teaching assignment problem", Emory University, 1985, [206].
- Peter Stephan, "An explicit solution to the quadratic dynamic programming problem", Emory University, 1985, [205].
- Donna Tudhope, University of Waterloo (by essay) 1987.
- Joe Lund, "Optimal vehicle replacement policy", 1988, [204].
- Qing Zhao, "Measures for Least Change Secant Methods", University of Waterloo, 1992 [200].

- Steven Thomas, "Optimal Project Planning for a Pharmaceutical Company", University of Waterloo.
- Stefan Karisch, "Trust Regions and the Quadratic Assignment Problem", "University of Waterloo", 1992, [202].
- Serge Kruk, "Semidefinite Programming Applied to General Nonlinear Programming", "University of Waterloo", 1996, [197].
- Charles Fortin, "A Survey of the Trust Region Subproblem within a Semidefinite Framework" "University of Waterloo", 2000, [195].
- Mike Froh, Thesis, "University of Waterloo", 2003, [196]
- Kathrin Schaeke, Essay, "University of Waterloo", Mar. 2004, [201]
- Oleg Grodzevich, Thesis, "University of Waterloo", Dec. 2004, [191]
- Yichuan Ding, "University of Waterloo", Dec. 2005, [192]
- Xuezhi (Daniel) Cui, "University of Waterloo", Sept. 2010, [193]
- Heng (Jerry) Ye, "University of Waterloo", completed,
- Ningchuan Wang, "University of Waterloo", Sept. 2014.
- Tom Sumbler, "University of Waterloo", Aug. 2015.
- Xinghang Ye, "University of Waterloo", completed Sept. 2016.
- Alister Zhenyu Liao, "University of Waterloo", completed Sept. 2016.

Ph.D.:

- Scott Hadley, "Continuous Optimization Approaches for the Quadratic Assignment Problem", University of Waterloo, 1990, [203].
- Qing Zhao, "Semidefinite Programming and Applications", University of Waterloo, 1996, [198].
- Serge Kruk, "High Accuracy Algorithms for the Solutions of Semidefinite Linear Programs", "University of Waterloo", (Dec/01), [190].
- Miguel Anjos, "New Convex Relaxations for the Maximum Cut and VLSI Layout Problems", University of Waterloo, [199], 2001.
- Francesc Rossell, visiting graduate student from Dept. of Statistics & Operations Research. Pau Gargallo, 5, 08026, Barcelona, Catalonia, 2002.
- Renata Sotirov, visiting graduate student from Institut fuer Mathematik, Universitaet Klagenfurt, Austria, 2003.
- Pawoumodom L. Takouda, visiting graduate student from Laboratoire Approximation & Optimisation, Universite Paul Sabatier (Toulouse III), France, 2004.
- Hua Wei, Thesis, "Robust Solutions for Large Sparse Linear and Semidefinite Programming", 2005, [188].
- Marina Potaptchik, Thesis, "Portfolio Selection Under Nonsmooth Convex Transaction Costs", 2006, [189].
- Nathan Krislock, "University of Waterloo", Apr. 2010, [187]
- Minghua LIn, Thesis, "Angles, Majorization, Wielandt Inequality and Applications", 2013, [186].
- Yuen-Lam Cheung, Thesis, "Preprocessing and Reduction for Semidefinite Programming via Facial Reduction: Theory and Practice", 2013, [185].
- Dessalegn Hirpa, Sept. 2014, stopped early Dec. 2015.
- Stefan Sremac, Sept. 2015, in progress.

- Xiao-Bo Li, Sept. 2015, in progress.

Post. Doctorate Supervision:

- V. Jeyakumar, 1986
- Julie Falkner 1994
- Abdo Alfakih 1997-98
- Abdo Alfakih 1/2001-4/2001
- Veronica Piccialli, March-April, 2004.
- Pawoumodom L. Takouda, Sept. 2004 - July 2005.
- Veronica Piccialli, Sept. 2005 - March 2006.
- Simon Schurr, Nov. 2006 - Nov 2008.
- Pang Chin How (Jeffrey) Pang, Sept. 2009 - Sept. 2010.
- Vinh Xuan Doan, Nov. 2009 - Aug. 2011.
- Jason, Hinek, Sept. 2010 - Dec. 2010.
- Nathan Krislock, May. 2010 - Dec. 2010.
- Gillis, Nicolas, Sept. 2011 - 2012.
- Yuen-Lam Cheung, Oct. 2013 - Feb. 2014.
- Pong, Ting Kei, May 2011 - May 2013.
- Drusvyatskiy, Dmitriy, Sept. 2013 - Sept. 2014.
- Xu, Yangyang, Aug. 2014 - Aug. 2015.
- Oliveira, Danilo, Mar. - Dec. 2015.
- Wang, Fei, Feb. - Sept. 2017.

Sabbatical Visitors

- Gonzalez-Lima, Maria, Sept. 2001 - Sept. 2002.
- Salahi, Mazier, Mar. 2015-16.

Service

Library Committee – University of Alberta – 1980-1985.
Undergraduate Affairs Committee – University of Waterloo – 1987-1989.
Tenure and Promotions Committee – University of Waterloo – 1996-1997.
Student Appeals Committee – University of Waterloo – 1996-1997.
Associate Chairman, Graduate Student Affairs – University of Waterloo – 1989-1991.
Associate Chairman, Graduate Student Affairs – University of Waterloo – 1997-1998.
University Student Appeals Committee – University of Waterloo – 2005-6.
Dept. representative to the University committee for the Fields Instit. — 2006-7. (various other committees including examiner of theses and promotion)

Professional Activities

Societies:

Society for Industrial and Applied Mathematics,

Mathematical Programming Society,

International Linear Algebra Society,

INFORMS

Consulting and Technological Transfers:
Edmonton Transit, 1983.
Teleride-Sage, Toronto, 1988-1989.
CIBA-GEIGY, Toronto, 1991-1992.
Private Company - Sam Bottner 1997-98.
Canada Correctional Services 1998.
Kitchener Transit 1999.
Bell University Labs, 2002-6.
Waterfront International Ltd (Financial), 2007-2013.

Other:

Elected to the ILAS (International Linear Algebra Society) Board, January, 2015.

Elected Chair for the SIAM Activity Group on Optimization (SIAG/OPT) for a three-year term beginning retroactively on January 1, 2001 and ending December 31, 2004.

Elected to SIAM Council, 2006; re-elected 2008.

Co-chair organizer for MOTPA06 conference at Univ. of Waterloo, July, 2006.

Program Chair for ICCOPT II, to be held at McMaster University, August, 2007.

Chair Organizing Committee, SIAM Optimization Meeting, Stockholm, 2005.

Co-chair Organizing Committee, SIAM Optimization Meeting, Stockholm, 2005.

Associate Editor Mathematics of Operations Research.

Associate Editor Mathematical Programming, 2007-2014.

Associate Editor SIOPT (SIAM J. of Optimization).

Associate Editor of Operations Research, 1996-98.

Associate Editor, SIAM Book Series on Fundamentals of Algorithms

Associate Editor, Optimization and Engineering, OPTE, (Kluwer)

Associate Editor, J. of Computational Optimization and Applications , COAP,

Associate Editor, of the Canadian Applied Mathematics Quarterly, CAMQ,

Associate Editor, Algorithmic Operations Research, (FACETS Inc.)

Associate Editor, J. of Global Optimization, JOGO,

Associate Editor, J. of Combinatorial Optimization, JOCO,

Associate Editor, Canadian Applied Mathematics Quaterly

Associate Editor, American J. of Mathematical and Management Sciences

Associate Editor, Special Issue in Mathematical Programming on Fields Workshop in Memory of Jos Sturm

Associate Editor, Special Issue in Linear Algebra and its Applications, Regina ILAS Conference

Invited Associate editor, "Algorithmic Operations Research, FACETS

Editorial Advisory Board of The Encyclopedia of Optimization, Kluwer

Many invited plenary talks and also organizer of several conferences. More details are available on my WWW home page.

Member of the Division of Mathematics for Industry and Commerce, University of Waterloo

Joint organizer of several workshops on semidefinite programming and optimization, 1993 (DIMACS), 1996 (Fields), 2000 April and August (Fields), and Waterloo, 2004.

SIAG Prize Committee in Numerical Linear Algebra, 1991-92.

Invited editor for special issue on Convex Analysis in Mathematical Programming, 1993

Invited editor for special issue in honour of Ingram Olkin's birthday in Linear Algebra and its Applications, 1994.

Invited editor for secial issue on Semidefinite Programming, in Mathematical Programming, 1995

Editor of special issue on Semidefinite Programming in J. Global Optimization, 1997.

Editor of Handbook on Semidefinite Programming, Kluwer, 2000.

Invited editor for secial issue on Semidefinite Programming, in Mathematical Programming, 2005

Referee of approximately 12 papers per year

Math Reviews for 4 papers per year

Reviews for promotion and tenure and grant applications for approximately 4 per year.

Research and Publications:
A list of publications (including student theses) is included below. A record of my various research activities, talks, and publications is kept on my home page with URL
http://orion.math.uwaterloo.ca/~hwolkowi/. A list of publications (with abstracts and links to ps files) can be obtained with URL:
http://orion.math.uwaterloo.ca/~hwolkowi/henry/reports/ABSTRACTS.html. A complete list of publications can be obtained with:
http://orion.math.uwaterloo.ca:80/~hwolkowi/henry/reports/refpubl/node1.html. Plenary talks, invited courses and other presentations can be obtained with:
http://orion.math.uwaterloo.ca:80/~hwolkowi/henry/reports/talks.d/talks.html

References

[1] H.H. Bauschke, R.S. Burachik, P.L. Combettes, V. Elser, D.R. Luke, and H. Wolkowicz, editors. *Fixed-Point Algorithms for Inverse Problems in Science and Engineering*, volume 49 of *Springer Optimization and Its Applications*. Springer, 2011.

[2] R. Bhatia, R. Guralnick, S. Kirkland, and H. Wolkowicz, editors. *12th ILAS Conference Proceeding, Regina 2005*, volume 421,1. Elsevier, 2007. Held in Regina, SK, June 26–29, 2005.

[3] E. Andersen, E. de Klerk, L. Tunçel, H. Wolkowicz, and S. Zhang, editors. *Large Scale Nonlinear and Semidefinite Programming*, volume 109, 2-3, Ser. B. North-Holland Publishing Co., Amsterdam, 2007. Dedicated to the memory of Jos Sturm, Math. Programming, Ser. B.

[4] P. Pardalos and H. Wolkowicz, editors. *New approaches for hard discrete optimization*. Springer, Norwell, MA, 2002. Papers from the Fields Workshop on Novel Approaches to Hard Discrete Optimization held at the University of Waterloo, Waterloo, ON, April 26–28, 2001, J. Comb. Optim. **6** (2002), no. 3.

[5] P. Pardalos and H. Wolkowicz, editors. *Novel approaches to hard discrete optimization*, volume 37 of *Fields Institute Communications*, Providence, RI, 2003. American Mathematical Society. Papers from the workshop held at the University of Waterloo, Waterloo, ON, April 26–28, 2001.

[6] P. Pardalos and H. Wolkowicz, editors. *Topics in Semidefinite and Interior-Point Methods*, The Fields Institute for Research in Mathematical Sciences, Communications Series, Providence, RI, 1998. American Mathematical Society.

[7] P. Pardalos and H. Wolkowicz, editors. *Semidefinite Programming and Interior-Point Approaches for Combinatorial Optimization Problems*. Kluwer Academic Publishers, Hingham, MA, 1998. Papers from the workshop held at the University of Toronto, Toronto, ON, May 15–17, 1996, J. Comb. Optim. **2** (1998), no. 1.

[8] M.L. Overton and H. Wolkowicz, editors. *Semidefinite Programming*. North-Holland Publishing Co., Amsterdam, 1997. Dedicated to the memory of Svatopluk Poljak, Math. Programming **77** (1997), no. 2, Ser. B.

[9] F. Pukelsheim, G. P. H. Styan, H. Wolkowicz, and I. Zaballa, editors. *Special Issue Honoring Ingram Olkin*. Elsevier Science Inc., 1994. Linear Algebra and Its Applications **199** (1994).

[10] P. Pardalos and H. Wolkowicz, editors. *Quadratic assignment and related problems*. American Mathematical Society, Providence, RI, 1994. Papers from the workshop held at Rutgers University, New Brunswick, New Jersey, May 20–21, 1993.

[11] H. Wolkowicz, R. Saigal, and L. Vandenberghe, editors. *Handbook of semidefinite programming*. International Series in Operations Research & Management Science, 27. Kluwer Academic Publishers, Boston, MA, 2000. Theory, algorithms, and applications.

[12] N. Krislock and H. Wolkowicz. Euclidean distance matrices and applications. In *Handbook on Semidefinite, Cone and Polynomial Optimization*, number 2009-06 in International Series in Operations Research & Management Science, pages 879–914. Springer-Verlag, 2011.

[13] H. Wolkowicz. Generating eigenvalue bounds using optimization. In *Nonlinear analysis and variational problems*, volume 35 of *Springer Optim. Appl.*, pages 465–490. Springer, New York, 2010.

[14] H. Wolkowicz. Semidefinite programming. In Leslie Hogben, editor, *CRC Handbook of Linear Algebra (HLA)*, pages 51–1–51–13. CRC Press, Bacon Raton, Fl, 2007. 2008 Choice Magazine Outstanding Academic Title.

[15] H. Wolkowicz. Semidefinite programming approaches to the quadratic assignment problem. In *Nonlinear assignment problems*, volume 7 of *Comb. Optim.*, pages 143–174. Kluwer Acad. Publ., Dordrecht, 2000.

[16] A. Alfakih and H. Wolkowicz. Matrix completion problems. In *Handbook of semidefinite programming*, volume 27 of *Internat. Ser. Oper. Res. Management Sci.*, pages 533–545. Kluwer Acad. Publ., Boston, MA, 2000.

[17] Y.E. Nesterov, H. Wolkowicz, and Y. Ye. Semidefinite programming relaxations of nonconvex quadratic optimization. In *Handbook of semidefinite programming*, volume 27 of *Internat. Ser. Oper. Res. Management Sci.*, pages 361–419. Kluwer Acad. Publ., Boston, MA, 2000.

[18] S. Kruk and H. Wolkowicz. Sequential, quadratic constrained, quadratic programming for general nonlinear programming. In *Handbook of semidefinite programming*, volume 27 of *Internat. Ser. Oper. Res. Management Sci.*, pages 563–575. Kluwer Acad. Publ., Boston, MA, 2000.

[19] H. Wolkowicz. Semidefinite and Lagrangian relaxations for hard combinatorial problems. In M.J.D. Powell, editor, *Proceedings of 19th IFIP TC7 Conference on System Modelling and Optimization, July, 1999, Cambridge*, pages 269–309. Kluwer Academic Publishers, Boston, MA, 2000.

[20] H. Wolkowicz. Semidefinite programming. In P.M. Pardalos and M.G.C. Resende, editors, *Handbook of Applied Optimization*, pages 40–50. Oxford University Press, New York, 2002.

[21] H. Wolkowicz. Duality for semidefinite programming. In *Encyclopedia of Optimization*. Kluwer Academic Publishers, Boston, MA, 2001.

[22] D. Drusvyatskiy and H. Wolkowicz. The many faces of degeneracy in conic optimization. Technical report, University of Waterloo, Waterloo, Ontario, 2016. survey in progress.

[23] H. Wolkowicz. Tutorial: Facial reduction in cone optimization with applications to matrix completions, at: Dimacs workshop on distance geometry: Theory and applications, 2016. Based on survey paper: The many faces of degeneracy in conic optimization, (with D. Drusvyatskiy).

[24] S. Huang and H. Wolkowicz. Low-rank matrix completion using nuclear norm with facial reduction. *J. Global Optim.*, 2017. 20 pages.

[25] M. Salahi, A. Taati, and H. Wolkowicz. Local nonglobal minima for solving large scale extended trust region subproblems. *Comput. Optim. Appl.*, 2015. submitted Dec. 23, 2015, 25 pages, accepted to COAP Aug. 20, 2016, 25 pages, online Sept. 2016, doi:10.1007/s10589-016-9867-4.

[26] D.E. Oliveira, H. Wolkowicz, and Y. Xu. ADMM for the SDP relaxation of the QAP. Technical report, University of Waterloo, Waterloo, Ontario, 2015. arXiv:1512.05448, under revision Oct. 2016, 12 pages.

[27] X-B Li, F. Burkowski, and H. Wolkowicz. Protein structure normal mode analysis on the positive semidefinite matrix manifold. Technical report, University of Waterloo, Waterloo, Ontario, 2015. submitted Nov. 1, 2015, 10 pages.

[28] Y.-L. Cheung and H. Wolkowicz. Sensitivity analysis of semidefinite programs without strong duality. Technical report, University of Waterloo, Waterloo, Ontario, 2014. submitted June 2014, 37 pages.

[29] G. Reid, F. Wang, H. Wolkowicz, and W. Wu. Facial reduction and SDP methods for systems of polynomial equations. Technical report, University of Western Ontario, London, Ontario, 2014. submitted Dec. 2014, 38 pages.

[30] D. Drusvyatskiy, C.-K. Li, Y.-L. Cheung Voronin, D.C. Pelejo, and H. Wolkowicz. Projection methods for quantum channel construction. *Quantum Inf. Process.*, 14(8):3075–3096, 2015.

[31] Y.-L. Cheung, D. Drusvyatskiy, C.-K. Li, D.C. Pelejo, and H. Wolkowicz. Projection methods in quantum information science. *Quantum Information Processing*, 14(8):3075–3095, 2015. submitted July. 2014, 15 pages, under revision Oct. 2014.

[32] D. Drusvyatskiy, G. Li, and H. Wolkowicz. Alternating projections for ill-posed semidenite feasibility problems. *Math. Program.*, 2016. submitted Sept. 2014, 12 pages, accepted June 27, 2016, doi:10.1007/s10107-016-1048-9, appeared Mar. 2017.

[33] D. Drusvyatskiy, S.A. Vavasis, and H. Wolkowicz. Extreme point inequalities and geometry of the rank sparsity ball. *Math. Program.*, 152(1-2, Ser. A):521–544, 2015.

[34] D. Drusvyatskiy, G. Pataki, and H. Wolkowicz. Coordinate shadows of semidefinite and Euclidean distance matrices. *SIAM J. Optim.*, 25(2):1160–1178, 2015.

[35] T.K. Pong, H. Sun, N. Wang, and H. Wolkowicz. Eigenvalue, quadratic programming, and semidefinite programming relaxations for a cut minimization problem. *Comput. Optim. Appl.*, 63(2):333–364, 2016.

[36] D. Drusvyatskiy, N. Krislock, Y-L. Cheung Voronin, and H. Wolkowicz. Noisy sensor network localization: robust facial reduction and the Pareto frontier. Technical report, University of Waterloo, Waterloo, Ontario, 2014. arXiv:1410.6852, 20 pages, under revision.

[37] T.K. Pong and H. Wolkowicz. The generalized trust region subproblem. *Comput. Optim. Appl.*, 58(2):273–322, 2014.

[38] M-H. Lin and H. Wolkowicz. A general hua-type matrix equality and its applications. Technical report, University of Waterloo, 2013. 7 pages, submitted Jan. 2013.

[39] M-H. Lin and H. Wolkowicz. Hiroshima's theorem and matrix norm inequalities. *Acta Sci. Math. (Szeged)*, 81(1-2):45–53, 2015.

[40] B. Alipanahi, N. Krislock, A. Ghodsi, and H. Wolkowicz. Large-scale manifold learning by semidefinite facial reduction. Technical report, University of Waterloo, Waterloo, Ontario, 2012. 19pages.

[41] B. Alipanahi, N. Krislock, A. Ghodsi, H. Wolkowicz, L. Donaldson, and M. Li. Protein structure by semidefinite facial reduction. In Benny Chor, editor, *Research in Computational Molecular Biology*, volume 7262 of *Lecture Notes in Computer Science*, pages 1–11. Springer Berlin / Heidelberg, 2012.

[42] B. Alipanahi, N. Krislock, A. Ghodsi, H. Wolkowicz, L. Donaldson, and M. Li. Determining protein structures from NOESY distance constraints by semidefinite programming. *J. Comput. Biol.*, 20(4):296–310, 2013.

[43] B. Alipanahi, N. Krislock, A. Ghodsi, H. Wolkowicz, L. Donaldson, and M. Li. Protein structure by semidefinite facial reduction. In *URL: recomb2012.crg.cat*, Waterloo, Ontario, 2012. poster session at RECOMB2012.

[44] M-H. Lin and H. Wolkowicz. An eigenvalue majorization inequality for positive semidefinite block matrices. *Linear Multilinear Algebra*, 60(11-12):1365–1368, 2012.

[45] Y-L. Cheung, S. Schurr, and H. Wolkowicz. Preprocessing and regularization for degenerate semidefinite programs. In D.H. Bailey, H.H. Bauschke, P. Borwein, F. Garvan, M. Thera, J. Vanderwerff, and H. Wolkowicz, editors, *Computational and Analytical Mathematics, In Honor of Jonathan Borwein's 60th Birthday*, volume 50 of *Springer Proceedings in Mathematics & Statistics*, pages 225–276. Springer, 2013.

[46] Yuen-Lam Cheung, Simon Schurr, and Henry Wolkowicz. Preprocessing and regularization for degenerate semidefinite programs. In *Computational and analytical mathematics*, volume 50 of *Springer Proc. Math. Stat.*, pages 251–303. Springer, New York, 2013.

[47] Heinz H. Bauschke, Michel Théra, and Henry Wolkowicz. Preface [Special issue: Computational and analytical mathematics]. *Math. Program.*, 139(1-2, Ser. B):1–3, 2013.

[48] D.H. Bailey, H.H. Bauschke, P. Borwein, F. Garvan, M. Thera, J. Vanderwerff, and H. Wolkowicz, editors. *Preprocessing and Regularization for Degenerate Semidefinite Programs*, volume 50 of *Springer Proceedings in Mathematics & Statistics*. Springer, 2013.

[49] Henry Wolkowicz Heinz H. Bauschke, Michel Thra, editor. *Computational and Analytical Mathematics*. Springer, 2013. Special issue in honour of Jon Borwein"s 60th birthday, Math. Programming **139** (2013), no. 1-2.

[50] B. Alipanahi, N. Krislock, A. Ghodsi, H. Wolkowicz, L. Donaldson, and M. Li. SPROS: An SDP-based protein structure determination from NMR data. In *URL: compbio.cs.sfu.ca/recomb2011*, Waterloo, Ontario, 2011. poster session at RECOMB2011.

[51] B. Alipanahi, N. Krislock, A. Ghodsi, H. Wolkowicz, L. Donaldson, and M. Li. Determining protein structures from NOESY distance constraints by semidefinite programming. *J. Comput. Biol.*, 20(4):296–310, 2013.

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[53] F. Burkowski, Y-L. Cheung, and H. Wolkowicz. Efficient use of semidefinite programming for selection of rotamers in protein conformations. *INFORMS J. Comput.*, 26(4):748–766, 2014.

[54] X.V. Doan, S. Kruk, and H. Wolkowicz. A robust algorithm for semidefinite programming. *Optim. Methods Softw.*, 27(4-5):667–693, 2012.

[55] Y. Ding, D. Ge, and H. Wolkowicz. On equivalence of semidefinite relaxations for quadratic matrix programming. *Math. Oper. Res.*, 36(1):88–104, 2011.

[56] N. Krislock and H. Wolkowicz. Explicit sensor network localization using semidefinite representations and facial reductions. *SIAM Journal on Optimization*, 20(5):2679–2708, 2010.

[57] A. Alfakih, M.F. Anjos, V. Piccialli, and H. Wolkowicz. Euclidean distance matrices, semidefinite programming, and sensor network localization. *Portug. Math.*, 68(1):53–102, 2011.

[58] L. Tunçel and H. Wolkowicz. Strong duality and minimal representations for cone optimization. *Comput. Optim. Appl.*, 53(2):619–648, 2012.

[59] Y. Ding, N. Krislock, J. Qian, and H. Wolkowicz. Sensor network localization, Euclidean distance matrix completions, and graph realization. *Optim. Eng.*, 11(1):45–66, 2010.

[60] Y. Ding, N. Krislock, J. Qian, and H. Wolkowicz. Sensor network localization, Euclidean distance matrix completions, and graph realization. In *MELT'08: Proceedings of the First ACM International Workshop on Mobile Entity Localization and Tracking in GPS-less Environments*, pages 129–134, 2008.

[61] M.F. Anjos, M. Desroches, A. Haque, O. Grodzevich, H. Wei, and H. Wolkowicz. Multi-stage investment decision under contingent demand for networking planning. In *Proceedings of the 2006 IEEE GLOBECOM Conference in San Francisco*, pages 1–5, 2007.

[62] M. Potaptchik, L. Tunçel, and H. Wolkowicz. Large scale portfolio optimization with piecewise linear transaction costs. *Optimization Methods and Software*, 23(6):929–952, 2008.

[63] Y. Ding and H. Wolkowicz. A low-dimensional semidefinite relaxation for the quadratic assignment problem. *Math. Oper. Res.*, 34(4):1008–1022, 2009.

[64] A. Alfakih and H. Wolkowicz. Necessary and sufficient trace inequalities for Euclidean distance matrices. *Linear and Multilinear Algebra*, 55(5):499–506, 2007.

[65] O. Grodzevich and H. Wolkowicz. Regularization using a parameterized trust region subproblem. *Math. Programming*, 116(1-2):193–220, 2009.

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