Curriculum VITAE Farid Alizadeh

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RESEARCH INTERESTS

Theory, algorithms and applications of semidefinite programming, second order cone programming, and sum-of-square optimization problems. Particular interest in application areas of shape-constrained statistical learning theory, geometric and shape optimization problems, and continuously time varying network flow problems.

CURRENT POSITION

- Visiting Scholar, Department of Management Science and Engineering Economics, Stanford University, Palo Alto , CA (Winter and Spring 2015)
- Professor, Department of Management Science and Information System, Rutgers Business School, Rutgers University

PAST POSITIONS

- Fall semester 2014 Adjunct visiting professor at Columbia University, IEOR department (on sabbatical leave from Rutgers)
- January 2000-December 2000 Visiting Associate Professor, IEOR Department, Columbia University, New York NY
- July 1994-June 1998 Assistant Professor, RUTCOR, Rutgers University, Piscataway, NJ
- May 1992-June 1994 Postdoctoral Associate, ICSI, The University of California, Berkeley CA
- January 1992-March 1992 Adjunct Professor, Computer Science Department, Stanford University, Stanford CA

EDUCATION

- Ph.D. Computer Science University of Minnesota (October 1991). Dissertation title: Combinatorial Optimization with Interior Point Methods and Semi-definite Matrices. Adviser: J.B. Rosen.
- M.S. Computer Science University of Nebraska–Lincoln (1987). Masters thesis title: *"Affine Transformations of k-Recognizable sets".* Adviser: David Klarner.
- B.S. Economics–Mathematics Emphasis University of Wisconsin, Madison (1984).

CURRENT RESEARCH ACTIVITIES

- 1. With Graduate students Deniz Seyyed Eskandani, Marta Cavaleiro and Mehdi Ranjbar, working on design of simplex like algorithms for semidefinite and second order cone programming problems
- 2. With Graduate students Deniz Seyyed Eskandani, Marta Cavaleiro and Mehdi Ranjbar, working on applications of semidefinite programming in time dependent network flow problems

PAST RESEARCH ACTIVITIES

- 1. **2008-2012** With former graduate student David Papp developed SD representation of sum of squares cones in algebras and applied it to geometric optimization problems.
- 2. 2007-2011 With former graduate student David Papp developed techniques for multivariate shape constrained regression, density estimation and arrival rate of nonhomogeneous Poisson process.
- 3. **2007-2010** With former graduate students Nilay Noyan, Gabor Rudolf and David Papp developed the theory of bilinearity rank of cones, and computed that for cones of nonnegative polynomials and related cones.
- 4. **2005-2007** With colleague Jonathan Eckstein and graduate students Nilay Noyan and Gabor Rudolf investigated use of semidefinite and second order cone programming techniques to the estimation of unknown, smooth arrival rate of nonhomogeneous Poisson process
- 5. 2000-2004 With former student Yu Xia used the machinery of Euclidean Jordan algebras and extended the so-called Q method for semidefinite programming to general symmetric cones and in particular to second order cone programs
- 6. **1998-2001** With former student Stefan Schmieta used the machinery of Euclidean Jordan algebras and extended many classes of primal-dual interior point algorithms from semidefinite programming to general symmetric cones and in particular second order cone programming

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- 7. **1993-1997** With Michael Overton of NYU and Jean-Pierre Haeberly of Fordham and former graduate students Stefan Schmieta (Rutgers) and Madhu Nayakkankuppam (New York University) developed a software package for semidefinite and second order programs which was made available as an open source package called SDPPACK
- 8. **1993-1998** With Michael Overton and Jean-Pierre Haeberly developed a class of primal-dual interior point algorithms for semidefinite programming which are widely known as the AHO method and has inspired numerous other research and publications
- 9. **1993-1997** With Michael Overton and Jean-Pierre Haeberly developed concepts of degeneracy and strict complementarity for semidefinite programming
- 10. **1992-1994** held a two year NSF postdoctoral position at the International Computer Science Institute, University of California, Berkeley, California under the supervision of Richard M. Karp, and with collaboration with former graduate students Deborah Weisser, Lee Newberg and Geoffrey Zweig developed combinatorial optimization techniques for the problem of physical mapping of chromosomes in molecular biology
- 11. **1990-1991** With Andrew Goldberg of Stanford University developed and implemented parallel versions of Goldberg's maximum flow algorithm on an SIMD architecture, Connection Machine CM–2 in response to DIMACS Implementation Challenge
- 12. **1989-1991** As a founder of the field of semidefinite programming, developed the basic theory, interior point methods for the problem, studied its duality theory, connections to eigenvalue optimization, and various applications in combinatorial optimization, culminated in my PhD dissertation, this research is considered a pivotal work in development and popularization of semidefinite programming and related topics

TEACHING EXPERIENCE

Computer science:

- 1. Discrete Mathematics (Nebraska sophomores, Summer 1985),
- 2. Data structures (Nebraska juniors Summer 1986),
- 3. Numerical analysis (Nebraska senior, summer 1987),
- 4. Combinatorial theory (CS-math-OR Stanford senior-grad, Winter 1992),
- 5. Data structures (Rutgers sophomore, Spring 1995)
- 6. Introduction to Programming (Rutgers freshman, Spring 1995),
- 7. Probability Theory (Rutgers Sophomores, Fall 1995),
- Algorithms and data structures (Rutgers PhD, Spring 1997, Business IT PhD and Masters 2013),
- Randomized algorithms (Rutgers PhD seminar RUTCOR and CS, Spring 96 and Fall 97),

- Introduction to computers and Microsoft Office (Rutgers Business School sophomores, Fall 1998),
- Object oriented programming with UML and Patterns (Rutgers MBA at MSIS, Fall 1999, Spring 2000)
- Introduction to object oriented programming (Rutgers MSIS seniors, Fall 2001 and Fall 2004),
- 13. Computer Technology (Rutgers MBA, Fall 2002, Fall 2003)
- Software engineering and C++ programming to Masters of Quantitative Finance students (Fall/Spring 2011-2012) and IEOR Masters students at Columbia University (Fall 2014)

Operations Research and Statistics

- 1. Linear Programming (Rutgers Math juniors, Spring 1996),
- Integer Programming (Rutgers OR senior Spring 1998, Columbia University IEOR Spring 2001),
- Business Statistics (Rutgers Business juniors, Spring and Fall 99, Fall 2006), Fall/Spring 1999, 2000, 2005, 2006, 2008, 2009
- 4. Data Models (Rutgers MBA, Spring 2001, Spring 2004),
- Operations Management (Rutgers Business School juniors Fall 2004, Fall 2008, Spring 2012),
- Linear Programming (Rutgers Business PhD, Fall 1999, Fall 2000, Fall 2002, Spring 2013, Fall 2013),
- 7. Nonlinear Programming (Rutgers Business PhD, Spring 2003),
- 8. Supply chain logistics management (Rutgers MBA, Spring 2004)
- 9. Probability Theory (Rutgers Business PhD, Fall 2000),
- 10. Stochastic processes (Rutgers Business PhD, Spring 2005, 2006),
- Linear multivariate statistical models (Rutgers Business PhD, Spring and Fall 2005, Fall 2006),
- Seminar on semidefinite programming (Rutgers RUTCOR PhD and Columbia IEOR PhD, Spring 1995, Spring 1997, Spring 2000, Fall 2001, Fall 2003, Fall 2007, Fall 2010, Fall 2012)
- Masters and PhD level course on applications of operations research to finance (Fall 2008)
- Independent study supervision for Graduate students on positive polynomials (Fall 2007, Spring 2008)

AWARDS AND FELLOWSHIPS

- 1. Winner of 2014 INFORMS Optimization Society Farkas Prize
- 2. NSF Postdoctoral Research Associateship in Computational Science and Engineering Number CDA-9211106
 - Co-principal Investigator: Richard M. Karp (UC-Berkeley)
 - Date: April 1992-April 1994
 - Amount: \$45,000 (with matching funds from ICSI at UC-Berkeley)
- 3. DIMACS postdoctoral Fellowship, 1992
 - Name: DIMACS postdoctoral Fellowship
 - Period: Academic year 1992-1993
 - Amount: Unknown (since it was declined)
 - Institution: Center for Discrete Mathematics and Theoretical Computer Science (DIMACS), Rutgers-State University of New Jersey
 - Note: This fellowship was declined due to conflict with another fellowship

PAST AND CURRENT EXTERNAL GRANTS

1. NSF CAREER: CCR-9501941

Date: July 1995-April 1998
Title: Applications of Convex Programming in Combinatorial Optimization A Mathematical, Algorithmic, and Computational Study
Amount: \$135,000
Co-principal Investigator: none

2. ONR N00014-1-0704

Date: April 1996 April 1999
Title: Study of Semidefinite Programming and Related Problems: Theoretical, Algorithmic, and Practical Approaches
Amount: \$225,000
Co-principal Investigator: none

3. NSF CCR-9901991

Date: July 1999-April 2002
Title: Symmetric Cone Optimization: Algorithmic and structural study, Application development
Amount: \$250,000
Co-principal Investigator: none 4. ONR N00014-03-1-0042

Date: October 2002-October 2005
Title: Second Order Cone Programming: New algorithms, Applications to Integer Programming and Combinatorial Optimization
Amount: \$235,000
Co-principal Investigator: none

5. NSF CCR-0306558

Date: July 2003-July 2006 (extended to July 2007) Title: Optimization over Positive Polynomials and Moment Cones: an Algorithmic Study with Applications in Approximation Theory, Regression and Data Visualization Amount: \$258,592 added for July 2005 to April 2006 Co-principal Investigator: none

6. NSF CMMI-0935305

Date: July 2009-July 2012 (extended to July 2013) Title: Optimization over Positive Polynomials or Sum-Of-Squares Functions with Applications to Constrained Approximation and Shape Constrained Learning Amount: \$325,000 Co-principal Investigator: none

PROFESSIONAL ACTIVITIES

- 1. GRADUATE STUDENT SUPERVISION
 - Current students: Marta Cavaleiro of RUTCOR, Mehdi Ranjbar of RUTCOR,
 - David Papp Graduation: 2011, Current affiliation: Post doctoral fellow at Harvard University and Massachusetts General Hospital (To join Math Dept at North Carolina State University in Fall 2014)
 - *Gabor Rudolf* Graduation: 2009, Current affiliation: Assistant Professor, Koc University, Istanbul, Turkey.
 - Yu Xia (Graduation: September 2003), Current affiliation: Assistant Professor, Lakehead University, Thunderbay, Ontario, CA
 - Stefan Schmieta of RUTCOR, Graduation: August 1999, Current Affiliation: Chief Technology Officer, Axioma Inc.;
 - *Reuben Settergren* of RUTCOR, **Graduation:** 1997, **Current affiliation:** BEA Systems, Inc.
- 2. Outside Professional Service
 - Invited minisymposium organizer at International Symposium on Mathematical Programming, Pittsburgh, PA, 2015
 - Invited tutorial presentation in INFORMS annual meeting October 2006 Pittsburgh, PA

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- Cluster chair of Lenoid Khachiyan cluster at International Symposium on Mathematical Programming (ISMP2006) in Rio de Janeiro 2006, organized three sessions and chaired a semi-plenary session at ISMP2006
- Invited tutorial presentation at IMA conference, University of Minnesota, Minneapolis MN, 2003
- Jointly organized a two-part minisymposium in SIAM conference on Optimization, May 1999, on Primal-dual interior point methods for optimization problems on symmetric cones
- Jointly organized a minisymposium in SIAM annual meeting, May 1999, on applications of semidefinite programming in finance, statistics, engineering and discrete optimization
- Refereed or in the process of refereeing articles submitted to professional journals including SIAM J. on Optim., SIAM J. on Control and Optimization, Mathematical Programming, Mathematics of Operations Research, SIAM J. on Discrete Mathematics, Computational Biology, International Journal of Foundation of Computer Science, Discrete Applied Mathematics, and The American Mathematical Monthly.
- Served on six NSF panels (two involving *Career* proposal only) and refereed several NSF proposals
- Served as referee for government sponsored scientific grant proposals from Israel, Canada and Chile
- Served as reviewer for tenure and other promotion for IEOR department of Columbia University (twice) and Mathematics Department of King Fahd University (Saudi Arabia)
- 3. PROFESSIONAL SOCIETY MEMBERSHIP member Mathematical Programming Society, SIAM, INFORMS, American Mathematical Association, and IEEE Computer Society
- 4. Invited Lectures:
 - Carnegie–Mellon University (1992)
 - Stanford University (1991 and 1993)
 - University of Oregon (1994)
 - DIMACS at Rutgers University (1994)
 - RUTCOR, Rutgers University (1994)
 - New York University (1994)
 - Oberwolfach Workshop on Applied and Computational Convexity, Oberwolfach Germany (1995)
 - M.I.T. Cambridge (1995), Carlton University Ottawa Canada (1995)
 - Yale University (1996)
 - Cornell University (1996)
 - Parametric Optimization and Related Topics V Hayama Japan (1996)
 - Princeton University (1995, 1996)

- I.B.M T. J. Watson Labs (1997)
- Columbia University (1997)
- University of Florida–Gainesville, Florida (1998)
- PARAOPT V conference (Tokyo Japan 1997), AT&T Labs (1998)
- HOPT conference in Rotherdam Netherlands (1998)
- University of Triere, Triere Germany (1998)
- University of Notre Dame (2000)
- University of Waterloo, Waterloo Canada (2001)
- MSRI at UC-Berkeley (2002)
- Rice University Houston Texas (2002)
- IMA University of Minnesota (2003)
- Continuous Optimization Workshop Istanbul Turkey(2003)
- V Brazilian Workshop in Continuous Optimization Florianopolis Brazil (2004)
- McMaster University Hamilton Ontario Canada (2004)
- Cowles Foundation Conference on Optimization, Yale University, New Haven, CT (2006)
- Invited Tutorial for INFORMS annual meeting November 2006, Pittsburgh PA (2006)
- IEOR Dept. Lehigh University, Bethlehem, PA (2008)
- IEOR Dept. UC-Berkeley, Berkeley, CA (2011)
- AMS regional meeting, George Washington University, Washington DC, (2012)
- AMS regional meeting, University of Maryland–Baltimore County, Baltimore MD, (2014)
- University of Texas-Austin, IEOR Program, (2014)
- Lehigh University INFORMS Student Chapter Distinguished Lecturer (2014)
- Columbia University IEOR department, (2014)

SELECTED PUBLICATIONS AND TECHNICAL RE-PORTS

- D. PAPP, AND F. ALIZADEH, "Semidefinite characterization of sum of squares cones in algebras" SIAM J. Optimization Vol. 23, no. 3, pages 1398-1423, 2013.
- D. PAPP, AND F. ALIZADEH, "Estimating arrival rate of nonhomogeneous Poisson processes with semidefinite programming", Annals of Operations Research, Vol. 208, no. 1, pages 291-308, 2013.
- 3. D. PAPP, AND F. ALIZADEH, "Shape constrained estimations using nonnegative splines", *Journal of Computational and graphical Statistics*, Vol. 23 no. 1, 2014 pages 211-231. (On line publication Feb 2012)

- D. PAPP, AND F. ALIZADEH, Multivariate arrival rate estimation using semidefinite programming, In Proceedings of Winter Simulation Conference (WSC) 2011, Phoenix, AZ, pp. 2772 - 2782.
- 5. F. ALIZADEH, Formally real Jordan algebras in Handbook of semidefinite, conic and polynomial optimization: theory and algorithms International Series in Operational Research and Management Science. Volume 166, 2012. Springer.
- G. RUDOLF, N. NOYAN, D. PAPP, AND F. ALIZADEH "Bilinear Optimality Constraints for the Cone of Positive Polynomials and Related Cones", *Math. Programming* 2011 129(5-31).
- F. ALIZADEH, Semidefinite and Second Order Cone Programming and Their Application to Shape Constrained Regression and Density Estimation, INFORMS Tutorials in Operations Research, 2006. pp 37–65.
- F. ALIZADEH, J. ECKSTEIN, N. NOYAN, AND G. RUDOLF, Arrival Rate Approximation by Nonnegative Cubic Splines *Operations Research*, Vol. 56 no. 1, (2008), pages 140-156.
- 9. Y. XIA AND F. ALIZADEH "The Q Method for Symmetric Cone Optimization", Journal of Optimization Theory and Applications, 149(1), pp. 102-137, 2011.
- Y. XIA AND F. ALIZADEH "The Q Method for Second-Order Cone Programming", Computers and Oper. Research, 35 (2008) 1510-1538.
- F. ALIZADEH AND D. GOLDFARB "Second Order Cone Programming", Math. Programming 95 (2003) 3-51.
- S. SCHMIETA AND F. ALIZADEH, "Extension of Primal-dual Algorithms to Symmetric Cones", Math. Programming 96 (2003)409-438.
- S. SCHMIETA AND F. ALIZADEH, "Associative and Jordan Algebras, and Polynomial Time Interior-Point Algorithms for Symmetric Cones", *Math. of Oper. Res.* 26(3):543-564, 2001.
- 14. F. ALIZADEH & YU XIA "The Q method for Second Order Cone Programming, Extended Abstract", In Proceedings of WSES Conference, Cairns, Australia, December 2001.
- F. ALIZADEH AND S. SCHMIETA, "Symmetric Cones, Potential Reduction Methods and Word-by-Word Extensions", in *Handbook of Semidefinite Programming*, Editors R. Saigal, L. Vandenberghe, and H. Wolkowicz, Kluwer Publications, 2000.
- F. ALIZADEH, J.P. HAEBERLY AND M.L. OVERTON, "Complementarity and Degeneracy in Semidefinite Programming", *Math. Programming* 77 (1997) 111-128
- F. ALIZADEH, J.P. HAEBERLY AND M.L. OVERTON, "Primal–Dual interior Point Methods for Semidefinite Programming", SIAM J. Optim. V.8 No. 3, pp. 746-768, August 1998

- 18. I. ADLER AND F. ALIZADEH, "Primal–Dual Interior Point Algorithm for Quadratically Constrained Quadratically Constrained and semidefinite Optimization Problems", RUTCOR rrr report number 46-95, presented at the ISMP 94, Ann Arbor MI, and Park City AMS meeting on complexity of computing with real numbers, 1995
- F. ALIZADEH, J.-P. HAEBERLY AND M.L. OVERTON, A New Primal-Dual Interior-Point Method for Semidefinite Programming, in: Proceedings of Fifth SIAM Conf. on Applied Linear Algebra, Snowbird, Utah, June 1994 (J.G. Lewis, ed.), pp. 113-117 (SIAM, Philadelphia).
- F. ALIZADEH, R. M. KARP, D. K. WEISSER AND G. ZWEIG, "Physical Mapping of Chromosomes Using Unique Probes", *Computational Biology* 2:2, 159-184.
- F. ALIZADEH, R. M. KARP, L. A NEWBERG AND D. K. WEISSER, "Physical Mapping of Chromosomes: A Combinatorial Problem in Molecular Biology", *Algorithmica*, (1995)13:52-76.
- F. ALIZADEH, "Interior Point Methods in Semidefinite Programming with Applications to Combinatorial Optimization", 1995, SIAM J. on Optimization (1995)5:13-51
- F. ALIZADEH, "Combinatorial Optimization with Semi-definite Matrices" in Proc. of the second Conf. on Integer Programming and Combinatorial Optimization (IPCO), Carnegie Mellon University, May 1992.
- 24. F. ALIZADEH AND A. GOLDBERG, "Experiments with the Push/Relabel method for The Maximum Flow Problem on a Connection Machine", in *Proc. of DIMACS Work*shop, Network Flows and Matching: first DIMACS Implementation Challenge, 1993.
- 25. F. ALIZADEH, "Optimization Over the Positive Semi-Definite Cone: Interior Point Methods and Combinatorial Applications" in *Advances in Optimization and Parallel Computing*, Honorary volume on the occasion of J.B. Rosen's 70th Birthday.
- F. ALIZADEH, "A Sublinear-Time Randomized Parallel Algorithm for the Maximum Clique Problem in Perfect Graphs", in Proc. of the second ACM-SIAM Symposium on Discrete Algorithms (SODA), January 1991.