

# Amir Ali Ahmadi

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## Affiliations at Princeton University

|   |                            |
|---|----------------------------|
| Full Professor<br>Dept. of Operations Research and Financial Engineering (ORFE) | July 2019 – Present        |
| Acting Director<br>Certificate Program in Engineering and Management Science    | July 2019 – Present        |
| Assistant Professor, ORFE   | September 2014 – July 2019 |
| Affiliated Faculty, Dept. of Computer Science                                   | June 2015 – Present        |
| Affiliated Faculty, Dept. of Mechanical and Aerospace Engineering               | May 2017 – Present         |
| Affiliated Faculty, Program in Applied and Computational Mathematics            | October 2017 – Present     |
| Participating Faculty, Center for Statistics and Machine Learning               | September 2016 – Present   |
| Academic-Athletic Fellow, Men's Tennis Team                                     | October 2015 – Present     |

## Previous Affiliation

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| <b>2012-2014 Herman Goldstine Fellow</b><br>Department of Business Analytics and Mathematical Sciences<br>IBM Watson Research Center<br>(The Goldstine Fellowship is awarded annually to at most two candidates in all areas of mathematical and computer sciences.) | Sept. 2012 – Aug. 2014 |
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## Postdoctoral Experience

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| Computer Science and Artificial Intelligence Laboratory (CSAIL)<br>Robot Locomotion Group, Laboratory for Information and Decision Systems (LIDS), MIT | Sept. 2011 – Sept. 2012 |
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## Education

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| <b>Massachusetts Institute of Technology</b><br><b>Ph.D., Electrical Engineering and Computer Science</b> (Minor in Mathematics) <ul style="list-style-type: none"><li>Thesis: "Algebraic Relaxations and Hardness Results in Polynomial Optimization and Lyapunov Analysis"</li><li>Advisor: Pablo A. Parrilo – Affiliation: LIDS</li></ul>     | 2008 – 2011 |
| <b>Massachusetts Institute of Technology</b><br><b>S.M., Electrical Engineering and Computer Science</b> (GPA: 5.0/5.0) <ul style="list-style-type: none"><li>Thesis: "Non-monotonic Lyapunov Functions for Stability of Nonlinear and Switched Systems: Theory and Computation"</li><li>Advisor: Pablo A. Parrilo – Affiliation: LIDS</li></ul> | 2006 – 2008 |
| <b>University of Maryland</b><br><b>B.S., Electrical Engineering</b> <ul style="list-style-type: none"><li>Ranked (strictly) 1<sup>st</sup> in the Dept., University Honors, Electrical Eng. Honors</li></ul> <b>B.S., Mathematics</b> <ul style="list-style-type: none"><li>Ranked 1<sup>st</sup> in the Dept., University Honors</li></ul>     | 2002 – 2006 |

## Selected Awards and Distinctions

### For teaching

1. **Phi Beta Kappa Award for Excellence in Undergraduate Teaching** 2017  
Awarded annually to two faculty members across the Princeton campus
2. **Excellence in Teaching of Operations Research Award** 2017  
International award given by the Institute for Industrial and Systems Engineers  
For the development of ORF 363: "Computing and Optimization"
3. **Teaching Award of Princeton University's Engineering Council** 2019  
For ORF 363/COS 323, taught in Fall 2018
4. **Teaching Award of Princeton University's Engineering Council** 2015  
For ORF 363/COS 323, taught in Fall 2014
5. **Princeton Engineering Commendation List for Outstanding Teaching**  
Fall '14,'15','16,'17 and Spring '15,'16,'17,'18,'19

### For research

1. **The Presidential Early Career Award for Scientists and Engineers (PECASE)** 2019  
The highest honor bestowed by the U.S. government on early-career scientists and engineers
2. **Sloan Fellowship** (in Computer Science) 2017
3. **INFORMS Optimization Society Young Researchers' Prize** 2018  
For an outstanding paper in optimization whose authors are within 8 years of their PhD
4. **Multidisciplinary University Research Initiative (MURI) Award** 2018-2023  
Jointly received with 6 colleagues. Total award of \$7.5M
5. **DARPA Faculty Award** 2017-2019  
Career award of the Defense Advanced Research Projects Agency
6. **NSF CAREER Award** 2016-2021  
Awarded on first attempt and after one year at Princeton
7. **AFOSR YIP** 2014-2017  
Air Force Office of Scientific Research Young Investigator Program Award (AF career award)  
Awarded on first attempt and during the first semester at Princeton
8. **Google Faculty Research Award** 2016  
Aimed to recognize and support world-class, permanent faculty perusing cutting-edge research in areas of mutual interest to Google
9. **Best SICON Paper Prize** 2015  
For one of two most outstanding papers published in the SIAM Journal on Control and Optimization in the years 2013-2015
10. **Princeton SEAS Innovation Award** 2018  
For innovative research
11. **Princeton University's Howard B. Wentz, Jr. Junior Faculty Award** 2016  
For excellence in research and teaching
12. **NSF Junior Oberwolfach Fellowship** 2019  
Awarded in conjunction with the Mathematisches Forschungsinstitut Oberwolfach in Germany to support the participation of outstanding junior scientists from US universities in research activities at Oberwolfach
13. **INFORMS Computing Society Prize** 2012  
For the best series of papers at the interface of Operations Research and Computer Science
14. **IBM Watson Herman Goldstine Fellowship in Mathematical Sciences** 2012, 2013  
Awarded annually to at most two candidates in all areas of mathematical and computer sciences; only one fellowship awarded in 2012

15. **ICRA Best Paper Award** 2013  
For the best paper at the 30<sup>th</sup> IEEE International Conference on Robotics and Automation
16. **Selected for National Academy of Engineering's US Frontiers of Eng. Symposium** 2018  
Attendance opportunity offered to 100 early career engineers from all areas of engineering (declined due to scheduling conflict)
17. **NSF Junior Oberwolfach Fellowship** 2019
18. **NSF Junior Oberwolfach Fellowship** 2016
19. **NSF Junior Oberwolfach Fellowship** 2015
20. **NSF Junior Oberwolfach Fellowship** 2014
21. **AMS-Simons Travel Award** 2012-2014  
Awarded by the American Mathematical Society and the Simons Foundation to assist with research-related travel of early-career mathematicians for two years
22. **Best Student-Paper Award Finalist at CDC** 2008  
Awarded at the 47<sup>th</sup> IEEE Conference on Decision and Control (CDC)
23. **Washington Society of Engineers' Young Engineer Prize** 2006
24. **Best undergraduate technical paper, 1<sup>st</sup> Prize, District of Columbia Council of Eng.** 2006

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**Representative Papers** (first letter in the title is linked to the paper online)

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***Algebraic techniques in optimization***

- A. A. Ahmadi, A. Majumdar. **DSOS and SDSOS optimization: more tractable alternatives to sum of squares and semidefinite optimization.**  
*SIAM Journal on Applied Algebra and Geometry*, 2019.  
(Subject of article in [Quanta Magazine \(Simons Foundation\)](#)):  
“[A classical math problem gets pulled into the modern world](#)”)
- A. A. Ahmadi, G. Hall. **On the construction of converging hierarchies for polynomial optimization based on certificates of global positivity.**  
*Mathematics of Operations Research*, 2019.  
([INFORMS Optimization Society Young Researchers' Prize](#))
- A. A. Ahmadi, O. Gunluk. **Robust-to-dynamics optimization.**  
Under review in *SIAM Journal on Applied Algebra and Geometry*, 2018.
- A. A. Ahmadi, G. Hall. **DC Decomposition of nonconvex polynomials with algebraic techniques.**  
*Mathematical Programming*, 2017.  
([INFORMS Computing Society Best Student Paper Award](#))

***Computational complexity in numerical optimization***

- A. A. Ahmadi, J. Zhang. **On the complexity of testing attainment of the optimal value in nonlinear optimization.**  
*Mathematical Programming*, 2019.
- A. A. Ahmadi, A. Olshevsky, P. A. Parrilo, and J. N. Tsitsiklis. **NP-hardness of deciding convexity of quartic polynomials and related problems.**  
*Mathematical Programming*, 2013.  
([INFORMS Computing Society Prize](#), [MIT News](#))

## Optimization in dynamical systems

- A. A. Ahmadi, B. El Khadir. **A globally asymptotically stable polynomial vector field with rational coefficients and no local polynomial Lyapunov function.** *Systems & Control Letters*, 2018.
- A. A. Ahmadi, B. El Khadir. **On algebraic proofs of stability for homogeneous vector fields.** *IEEE Transactions on Automatic Control*, 2019.
- A. A. Ahmadi, R. Jungers, P. A. Parrilo, and M. Roozbehani. **Joint spectral radius and path-complete graph Lyapunov functions.** *SIAM Journal on Control and Optimization*, 2014. (Best SICON Paper Prize, 2013-2015)

**Publications** (full downloadable list available at <http://aaa.princeton.edu/publications>)

A \* symbol indicates work currently under review (total of 2).

### Work done with my students only

1. A. A. Ahmadi, G. Hall. **On the construction of converging hierarchies for polynomial optimization based on certificates of global positivity.** *Mathematics of Operations Research*, 2019. (INFORMS Optimization Society Young Researcher's Prize)
2. A. A. Ahmadi, B. El Khadir. **A globally asymptotically stable polynomial vector field with rational coefficients and no local polynomial Lyapunov function.** *Systems & Control Letters*, 2018.
3. A. A. Ahmadi, B. El Khadir. **Time-varying semidefinite programs.** Accepted with minor revision, *Mathematics of Operations Research*, 2019.
4. A. A. Ahmadi, B. El Khadir. **On algebraic proofs of stability for homogeneous vector fields.** *IEEE Transactions on Automatic Control*, 2019.
5. A. A. Ahmadi, J. Zhang. **Semidefinite programming for Nash equilibria in bimatrix games.** *INFORMS Journal on Computing*, accepted with minor revision, 2018.
6. A. A. Ahmadi, G. Hall. **On the complexity of detecting convexity over a box.** *Mathematical Programming*, 2019.
7. A. A. Ahmadi, J. Zhang. **On the complexity of testing attainment of the optimal value in nonlinear optimization.** *Mathematical Programming*, 2019.
8. A. A. Ahmadi, G. Hall. **DC Decomposition of nonconvex polynomials with algebraic techniques.** *Mathematical Programming*, 2017.
9. A. A. Ahmadi, G. Hall. **Sum of squares basis pursuit with linear and second order cone programming.** *Contemporary Mathematics*, 2017.

### Other

10. A. A. Ahmadi, E. de Klerk, G. Hall. **Polynomial norms.** *SIAM Journal on Optimization*, to appear, 2018.
11. A. Majumdar, G. Hall, A. A. Ahmadi. **A survey of recent scalability improvements for semidefinite programming with applications in machine learning, control, and robotics.** *To appear in Annual Reviews in Control, Robotics, and Autonomous Systems*, 2019.
12. \*A. A. Ahmadi, O. Gunluk. **Robust-to-dynamics optimization.** Under review in *SIAM Journal on Applied Algebra and Geometry*, submitted in May 2018.
13. \*A. A. Ahmadi, R. Jungers. **Sos-convex Lyapunov functions for stability of nonlinear difference inclusions.** Under review in *SIAM Journal on Control and Optimization*, submitted in March 2018.
14. A. A. Ahmadi, S. Dash, G. Hall. **Optimization over structured subsets of positive semidefinite matrices with column generation.** *Discrete Optimization*, 2017.
15. A. A. Ahmadi, P.A. Parrilo. **Sum of squares certificates for stability of planar, homogeneous, and switched systems.** *IEEE Trans. on Automatic Control*, 2017.

16. A. A. Ahmadi, P.A. Parrilo. **Some recent directions in algebraic methods for optimization and Lyapunov analysis.** *Geometric and Numerical Foundations of Movements*, Editors: J.P. Laumond, N. Mansard, J.B. Lasserre, *Springer Tracts in Advanced Robotics (Book Chapter)*, 2017.
17. A. A. Ahmadi, R. Jungers. **Lower bounds on complexity of Lyapunov functions for switched systems.** *Nonlinear Analysis: Hybrid Systems*, 2016.
18. A. A. Ahmadi, G. Hall, A. Papachristodoulou, J. Saunderson, and Y. Zheng. **Improving efficiency and scalability of sum of squares optimization: recent advances and limitations.** In *Proceedings of the IEEE Conference on Decision and Control*, 2017.
19. A. A. Ahmadi, A. Majumdar. **Some applications of polynomial optimization in operations research and real-time decision making.** *Optimization Letters*, 2016.
20. R. Jungers, A. A. Ahmadi, P. A. Parrilo, and M. Roazbehani. **A characterization of Lyapunov inequalities for stability of switched systems.** *IEEE Trans. on Automatic Control*, 2017.
21. A. A. Ahmadi, G. Hall, A. Makadia, and V. Sindhvani. **Sum of squares polynomials and geometry of 3D environments.** In *proceedings of Robotics: Science and Systems*, 2017.
22. A. A. Ahmadi, R. Jungers, P. A. Parrilo, and M. Roazbehani. **Joint spectral radius and path-complete graph Lyapunov functions.** *SIAM Journal on Control and Optimization*, 2014. (Best SICON Paper Prize, 2013-2015)
23. A. A. Ahmadi and P. A. Parrilo. **A complete characterization of the gap between convexity and sos-convexity.** *SIAM Journal on Optimization*, 2013. (INFORMS Computing Society Prize)
24. A. A. Ahmadi, A. Olshevsky, P. A. Parrilo, and J. N. Tsitsiklis. **NP-hardness of deciding convexity of quartic polynomials and related problems.** *Mathematical Programming*, 2013. (INFORMS Computing Society Prize)
25. A. A. Ahmadi and P. A. Parrilo. **A convex polynomial that is not sos-convex.** *Mathematical Programming*, 2012. (INFORMS Computing Society Prize)
26. (a) A. A. Ahmadi. **Polynomial optimization for analysis of dynamical systems.** *Oberwolfach Reports* (MFO1606b: Applied Koopmanism), *European Mathematical Society*, 2016.  
(b) A. A. Ahmadi. **LP and SOCP-based algebraic techniques for nonlinear and integer optimization.** *Oberwolfach Reports* (MFO1543: Mixed-integer nonlinear optimization: a hatchery for modern mathematics), *European Mathematical Society*, 2015.  
(c) A. A. Ahmadi. **Computation of the joint spectral radius with optimization techniques.** *Oberwolfach Reports* (MFO1415: Real algebraic geometry with a view towards systems control and free positivity), *European Mathematical Society*, 2014.
27. A. A. Ahmadi, O. Gunluk. **Robust-to-dynamics linear programming.** In *Proceedings of the IEEE Conference on Decision and Control*, 2015.
28. A. A. Ahmadi and A. Majumdar. **DSOS and SDSOS optimization: LP and SOCP alternatives to SOS optimization.** In *Proceedings of the 48<sup>th</sup> Annual Conference on Information Sciences and Systems*, 2014.
29. A. A. Ahmadi, R. Jungers. **On complexity of Lyapunov functions for switched linear systems.** In *Proceedings of the World Congress of the International Federation of Automatic Control*, 2014.
30. A. A. Ahmadi, P. A. Parrilo. **Towards scalable algorithms with formal guarantees for Lyapunov analysis of control systems via algebraic optimization.** In *Proceedings of the IEEE Conference on Decision and Control*, 2014.
31. A. A. Ahmadi, D. Malioutov, R. Luss. **Robust minimum volume ellipsoids and higher order polynomial level sets.** *NIPS Workshop on Optimization in Machine Learning*, 2014.
32. A. A. Ahmadi. **Computational and Algebraic Aspects of Convexity.** *Newsletter of the INFORMS Computing Society*, 2013.
33. A. A. Ahmadi. **On the difficulty of deciding asymptotic stability of cubic homogeneous vector fields.** In *Proceedings of the 2012 American Control Conference*, 2012. (Best presentation award in session on Stability of Nonlinear Systems)

34. A. A. Ahmadi, R. Jungers, P. A. Parrilo, and M. Roozbehani. **Analysis of the joint spectral radius via Lyapunov functions on path-complete graphs.** *Hybrid Systems: Computation and Control (Book Chapter)*, 2011.
35. A. A. Ahmadi, A. Majumdar, and R. Tedrake. **Complexity of ten decision problems in continuous time dynamical systems.** In *Proceedings of the American Control Conference*, 2013.
36. A. A. Ahmadi, R. Jungers. **Sos-convex Lyapunov functions with applications to nonlinear switched systems.** In *Proceedings of the IEEE Conference on Decision and Control*, 2013.
37. A. A. Ahmadi, P. A. Parrilo. **Joint spectral radius of rank-one matrices and the maximum cycle mean problem.** In *Proceedings of the IEEE Conference on Decision and Control*, 2012.
38. A. Majumdar, A. A. Ahmadi, R. Tedrake. **Control and verification of high-dimensional systems via DSOS and SDSOS optimization.** In *Proceedings of the IEEE Conference on Decision and Control*, 2014.
39. A. Majumdar, A. A. Ahmadi, R. Tedrake. **Control design along trajectories via sum of squares optimization.** In *Proceedings of the IEEE Conference on Robotics and Automation*, 2013. ([Best ICRA Paper Award](#))
40. A. A. Ahmadi, P. A. Parrilo. **Converse results on existence of sum of squares Lyapunov functions.** In *Proceedings of the IEEE Conference on Decision and Control*, 2011.
41. A. A. Ahmadi, M. Krstic, P. A. Parrilo. **A globally asymptotically stable polynomial vector field with no polynomial Lyapunov function.** In *Proceedings of the IEEE Conference on Decision and Control*, 2011.
42. A. A. Ahmadi and P. A. Parrilo. **On higher order derivatives of Lyapunov functions.** In *Proceedings of the American Control Conference*, 2011.
43. A. A. Ahmadi, P. A. Parrilo. **On the equivalence of algebraic conditions for convexity and quasiconvexity of polynomials.** In *Proceedings of the IEEE Conference on Decision and Control*, 2010.
44. A. A. Ahmadi, P. A. Parrilo. **A positive definite polynomial Hessian that does not factor.** In *Proceedings of the IEEE Conference on Decision and Control*, 2009.
45. A. A. Ahmadi and P. A. Parrilo. **Non-monotonic Lyapunov functions for stability of discrete time nonlinear and switched systems.** In *Proceedings of the 47<sup>th</sup> IEEE Conference on Decision and Control*, 2008. ([Best student paper award finalist](#))

### **Working papers**

46. A. A. Ahmadi and B. El Khadir. **Learning dynamical systems with side information.**
47. A. A. Ahmadi and J. Zhang. **On local minima of cubic polynomials.**

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### **Selected Invited Talks** (out of >110)

#### **Plenary talks and talks in single-track invited meetings**

1. SIAM Conference on Optimization (Plenary Speaker), Hong Kong 5/20
2. National Applied Mathematics Conference of Colombia (Plenary Speaker), Medellin, 6/20
3. Workshop on Design and Analysis of Robust Systems (Keynote Speech), Porto 4/18
4. The 26<sup>th</sup> Canadian Undergraduate Mathematics Conference (Keynote Speech), Ontario 7/19
5. The Belgian inter-university conference on Dynamical Systems, Control and Optimization (Plenary Speaker), Liege 5/15
6. Oberwolfach meeting on Mixed Integer Nonlinear Optimization, 6/19
7. Oberwolfach meeting on Applied Koopmanism, 2/16
8. Oberwolfach meeting on Mixed Integer Nonlinear Optimization, 10/15
9. Oberwolfach meeting on Real Algebraic Geometry with a View Towards Systems Control, 4/14

10. DIMACS Workshop on Robot Learning, Lehigh University, 10/19
11. DIMACS Workshop on Mixed Integer Nonlinear Programming, Montreal, 10/19
12. Geometry of Real Polynomials, Convexity and Optimization, Banff, 5/19
13. Symposium on Machine Learning and Dynamical Systems, Imperial College, 2/19
14. Workshop on Core Computational Methods, ICERM, 9/18
15. TRIPODS/DIMACS workshop on Optimization in Machine Learning, 8/18
16. US/Mexico Workshop on Optimization and its Applications, 1/18
17. Workshop on Bridging Continuous and Discrete Optimization, Simons Institute, Berkeley, 11/17
18. Workshop on Nonconvex Statistical Learning, USC, 5/17
19. Workshop on Hybrid Systems, UT Austin, 6/17
20. Workshop on Mixed Integer Programming, Univ. of Miami, 5/16
21. Uncertain Dynamical Systems, the Royal Netherlands Academy of Arts and Sciences, 8/14
22. Geometry and Algebra of Linear Matrix Inequalities, CIRM, Marseille, 11/13
23. Mixed Integer Nonlinear Programming, Institut Henri Poincare, Paris, 9/13
24. Polynomial Optimization, Isaac Newton Inst. For Math. Sciences, Cambridge, UK, 7/13

#### **Departmental colloquia and seminars**

25. Columbia University, Industrial Eng. and Operations Research Colloquium, Spring '19
26. Bell Labs, Mathematics and Algorithms Research Group, Spring '19
27. California Institute of Technology, Computing and Math. Sciences Colloquium, Fall '18
28. Massachusetts Institute of Technology, Lab. for Information and Decision Systems, Fall '18
29. Kolchin Seminar on Differential Algebra, CUNY and NYU Courant, Spring '19
30. New Jersey Inst. of Technology, Applied Mathematics Colloquium, Spring '19
31. Rutgers University, Center for Operations Research, Spring '19
32. New York University, Courant Institute, 3/18
33. Temple University, Dept. of Mathematics, Numerical Analysis and Scientific Computing seminar, 4/18
34. Yale University, Electrical Eng. and Computer Science, 11/17
35. Stanford University, Management Science and Engineering, 11/17
36. Princeton University, Program in Applied and Computational Mathematics, 9/17
37. Oxford University, Dept. of Mathematics, Numerical Analysis Group 5/17
38. Institute for Advanced Studies, Princeton University 2/17
39. University of Pennsylvania, Dept. of Electrical and Systems Engineering 10/17
40. Laboratoire d'analyse et d'architecture des systems, Toulouse 6/16
41. Ecole Polytechnique, Dept. of Computer Science, Paris 07/16
42. University of Texas at Austin, Dept. of Aerospace Engineering and Engineering Mechanics, 10/16
43. University of Chicago, Booth School of Business, 3/16
44. University of Chicago, Booth School of Business, 12/15
45. Google Research, 11/15
46. Princeton University, Department of Computer Science, 10/15
47. University of Chicago, Dept. of Statistics, 5/15

48. Queen's University, Dept. Mathematics and Statistics, 3/15
49. Northwestern Univ., Electrical Engineering & Kellogg School of Management, 5/15
50. Georgia Tech, Dept. of Industrial and Systems Engineering (ISyE), 10/14
51. Univ. of Texas at Austin, Program in Operations Research and Industrial Engineering, 5/15
52. Tilburg University, Dept. of Econometrics and Operations Research, Netherlands, 8/14
53. University of Stuttgart, Institute for Systems Theory and Automatic Control, 4/14
54. Rutgers University, Center for Operations Research, 4/13
55. IBM Research, Dept. of Business Analytics and Math. Sciences, 11/12
56. Princeton University, Dept. of Operations Research and Financial Eng., 2/13
57. NYU, Dept. of Computer Science, 3/13
58. University of Wisconsin, Institute for Discovery, 2/12
59. Boston University, Dept. of Electrical Engineering, 3/12
60. University of Maryland, Dept. of Electrical Engineering, 3/12
61. IBM Research, Dept. of Business Analytics and Math. Sciences, 10/12
62. Universite Catholique de Louvain, Dept. of Systems Eng., 11/12
63. University of California San Diego, Dept. of Mechanical and Aerospace Eng., 3/11
64. University of California Davis, Dept. of Mathematics, 3/11
65. Massachusetts Institute of Technology, Robot Locomotion Group, 5/11

#### **Invited tutorial lectures**

66. Summer School on Applied Algebraic Geometry, Institute for Advanced Studies and Basic Sciences, Zanjan, Iran, 9/19
67. Robust optimization based control and planning, International Conference on Robotics and Automation, Stockholm, 5/16
68. INFORMS Optimization Society meeting, Princeton University, 3/16
69. Recent advances in scalability of sum of squares optimization, IEEE Conference on Decision and Control, 10/17
70. Workshop on large-scale semidefinite programs in control, machine learning, and robotics, IEEE Conference on Decision and Control, 10/16
71. Big data and sparsity in system identification and control, IEEE Conference on Decision and Control, Los Angeles, 12/14
72. Recent advances in semialgebraic geometry: applications in system identification, estimation and filtering, IEEE Conference on Decision and Control, Florence, 12/13

#### **Invited talks in other meetings and conferences**

73. SIAM Conference on Applied Algebraic Geometry, 7/19
74. SIAM Conference on Applications of Dynamical Systems, 5/19
75. Algebraic and Geometric Methods in Discrete Optimization, MAA-AMS Joint Mathematics Meeting, 1/19
76. International Conference on Polynomial and Tensor Optimization, 12/18
77. European Workshop on Advances in Continuous Optimization, 7/18
78. SIAM Conference on Applied Algebraic Geometry, 8/17
79. Foundations of Computational Mathematics, 7/17
80. SIAM Conference on Applied Algebraic Geometry, 8/15
81. Meeting of the American Mathematical Society, 1/15
82. Meeting of the American Mathematical Society, 8/12



83. Meeting of the Mathematical Association of America, '12
84. INFORMS Computing Society, 1/17
85. INFORMS International Conference, Hawaii, 6/16
86. SIAM Conference on Optimization, '11, '14, '17
87. SIAM Conference on Applied Algebraic Geometry, 11
88. International Conference on Continuous Optimization, '13, '16
89. International Symposium on Mathematical Programming, '12, '15, '18
90. INFORMS Annual meeting, '09, '13, '14, '15, '16, '17, '18
91. Modeling and Optimization: Theory and Applications, '14, '16, '17, '18
92. AFOSR Workshop on Dynamics and Control, '16, '17, '18
93. SIAM Annual Meeting, '17
94. American Control Conference, '12, '18

### Funding sources (\$2.8M total)

- **AFOSR, Multidisciplinary University Research Initiative (MURI)** (2019-2024, \$1.1M personal portion)  
For project titled “Verifiable, Control-Oriented Learning on the Fly”  
In collaboration with Princeton MAE, Math, UT Austin, and Northeastern University
- **NSF CAREER Award** (2016-2021, \$500K)  
For project titled “Polynomial Optimization and Dynamical Systems”  
Award received on first attempt
- **DARPA Faculty Award** (2017-2019, \$500K)  
For project titled “Exploiting Geometry in the Design of Scalable Algebraic Relaxations for Nonconvex Polynomial Optimization”
- **AFOSR Young Investigator Award** (2014-2017, \$360K)  
For project titled “Scalable Algorithms with Formal Guarantees for Lyapunov Analysis of Control Systems via Algebraic Optimization”  
Award received on first attempt
- **SEAS Innovation Award** (2018-2019, \$110K)  
For project titled “Nonconvex Polynomial Optimization for Machine Learning in Finance”
- **Google Faculty Research Award** (2017-2018, \$82K)  
For project titled “Scalable Sum of Squares Optimization for Machine Learning”
- **Sloan Fellowship in Computer Science** (2017-2019, \$65K)
- **Gaspard Monge Program for Optimization and Operational Research Award** (2016-2017, €13K)  
For project titled “Fast Relaxations of the Optimal Power Flow Problem”  
In collaboration with Ecole Polytechnique, Paris
- **AMS-Simons Travel Grant** (2012-2014, \$4K)
- **NSF Oberwolfach Fellowship** (four-time recipient: 2014, 2015, 2016, €1.4K)
- **The Howard B. Wentz, Jr. Faculty Award by Princeton SEAS** (\$45K)

### Graduate students advised at Princeton University

- Georgina Hall, ORFE, graduated May 2018 (website: <http://scholar.princeton.edu/ghall>)
  - Assistant Professor at INSEAD, Decision Sciences (starting September 2018)
  - Thesis title: *Optimization over nonnegative and convex polynomials with and without semidefinite programming*; available at <https://arxiv.org/pdf/1806.06996.pdf>

- Recipient of the INFORMS Computing Society Best Student Paper Award
- Jeffrey Zhang, ORFE (website: <https://sites.google.com/view/jeffreyzhang> )
  - Optimization in game theory, computational complexity in optimization
- Bachir El Khadir, ORFE (website: <https://scholar.princeton.edu/bachir> )
  - Time-varying convex optimization, optimization in dynamical systems
  - Recipient of the Princeton Day of Optimization [Best Poster Award](#) (category: optimization and control)
- Cemil Dibek, ORFE (website: <https://scholar.princeton.edu/cemildibek> )
  - Co-advised with Prof. Maria Chudnovsky
  - Semidefinite optimization and graph coloring
  - Recipient of the Princeton Day of Optimization [Best Poster Award](#) (category: optimization theory)

## Teaching

- **ORF 363/ COS 323, “Computing and Optimization”** Fall ’14, ’15, ’16, ’17, ’18 Princeton
  - Course website: <http://aaa.princeton.edu/orf363>
  - Recipient of the Excellence in Teaching of Operations Research Award by the Institute for Industrial and Systems Engineers
  - Recipient of the 2017 Phi Beta Kappa Award for Excellence in Undergraduate Teaching by Princeton University
  - Recipient of the 2014 and 2018 Teaching Award of the Engineering Council of Princeton University
  - Princeton Engineering Commendation List for Outstanding Teaching (every semester)
- **ORF 523, “Convex and Conic Optimization”** Spring ’15, ’16, ’17, ’18 Princeton
  - Course website: <http://aaa.princeton.edu/orf523>
  - Princeton Engineering Commendation List for Outstanding Teaching (every semester)

## Professional Activities – Service to ORFE, Princeton University, and the research community

### Princeton University

- Initiator and organizer of the first **Princeton Day of Optimization** (September 28, 2018)
  - ~350 participants from over 50 academic and industrial institutions
  - Website: <https://orfe.princeton.edu/pdo/>
  - Theme of the inaugural edition: Creative symbioses at the interface between optimization, control, and machine learning
  - Related news article that appeared on the Princeton University homepage: <https://www.princeton.edu/news/2018/10/09/inaugural-princeton-day-optimization-convenes-researchers-forefront-data-science>
- Initiator and organizer of the **Princeton Optimization Seminar**
  - 61 seminars held Fall 2014-Spring 2019
  - Past talks: <https://orfe.princeton.edu/events/optimization-seminar/past>
- On the Curriculum Committee for the Undergraduate Program of the Center for Statistics and Machine Learning (headed by Prof. Peter Ramadge), Fall 2017- Present

- On the Curriculum Committee for the Graduate Program of the Center for Statistics and Machine Learning (headed by Prof. Peter Ramadge), Fall 2017- Present
- On the Committee for SEAS-wide Senior Faculty Search in Robotics and Cyber-physical Systems, Fall 2017 and Spring 2018
- On the Executive Committee of the Robotics and Intelligent Systems Certificate Program, Fall 2018-present
- Academic-Athletic Fellow of Princeton's Men's Tennis Team, 2015-present
- Freshman Advisor and Faculty Advisor for Whitman College, 2017-2018
- Freshman Advisor and Faculty Advisor for Whitman College, 2016-2017
- Freshman Advisor and Faculty Advisor for Whitman College, 2015-2016
- Participating Faculty Member of the Center for Statistics and Machine Learning, 2016-Present
- On the evaluation committee of the School of Engineering and Applied Sciences' Innovation Funds (category: Data Science) and the "small-c centers initiative".
- On the PhD Final Public Oral Examination Committee of
  - Katie Fitch, Mechanical Engineering (advised by Prof. Naomi Leonard), 10/16
  - Chu Wang, PACM (advised by Prof. Bernard Chazelle), 6/16
  - Yutong Chen, PACM (advised by Prof. Amit Singer), 3/18
  - Jose Simoes Bravo Ferreira, PACM (advised by Prof. Amit Singer), 10/18
- On the General Examination Committee of
  - Desmond Zhong, Mechanical Engineering (advised by Prof. Naomi Leonard), 1/17
  - Jose Simoes Bravo Ferreira, PACM (advised by Prof. Amit Singer), 8/15
  - Yuan Liu, PACM (advised by Prof. Amit Singer), 10/15

### ORFE

- Organizer of the ORFE Colloquium, Fall 2016 & Spring 2017
- Developed a new undergraduate course (ORF 363) and completely redesigned a core graduate course (ORF 523)
- Advisor of 18 undergraduate students for senior theses and 2 undergraduate students for junior theses
- On the search committee for a junior faculty hire in Data Science, Fall 2018 & Spring 2019
- Academic advisor of ~15 undergraduate students per year
- On the PhD Final Public Oral Examination Committee of
  - Changle Lin (advised by Prof. John Mulvey), 9/16
  - Firdevs Ulus (advised by Prf. Birgit Rudloff), 8/15
  - Maximilian Goer (advised by Prof. John Mulvey), 8/15
  - Georgina Hall, 5/18
  - Jing Ye (advised by Prof. John Mulvey), 9/18
- On the General/Qualification Examination Committee of
  - Jeffrey Zhang, 5/16
  - Thomas Pumir, 5/16
  - Jing Ye (advised by Prof. John Mulvey), 5/15
  - Kaizheng Wang (advised by Prof. Jianqing Fan), 5/17
  - Bachir El Khadir, 5/17

- Sinem Uysal, 8/17 (Qualification Examination), 5/18 (General Examination)
- Zach Hervieux, 8/17
- Cemil Dibek, 5/18
- Joane Joseph (advised by Prof. Robert Vanderbei) 5/18

### **Research community at large**

- Associate Editor of *Mathematics of Operations Research* (term begins 1/1/2019)
- On the Selection Committee of the 2018 Best Student Paper Prize of the INFORMS Optimization Society
- Co-organizer of a workshop on “Solving large-scale semidefinite programs in control, machine learning, and robotics” at the 2016 IEEE Conference on Decision and Control (11 coordinated lectures)
  - Website: <http://aaa.princeton.edu/largesdps>
- Tutorial lectures on algebraic methods in optimization
 

Speaker:

  - 2016 International Conference on Robotics and Automation
  - 2014 IEEE Conference on Decision and Control
  - 2013 IEEE Conference on Decision and Control

Co-organizer and speaker:

  - 2017 IEEE Conference on Decision and Control (on “Improving efficiency of SOS optimization: recent advances and limitations”)
  - 2016 INFORMS Optimization Society Conference (on “Sum of squares hierarchies for polynomial optimization”)
  - Website: <http://aaa.princeton.edu/tutorials>
- Speaker and panelist at a workshop titled “Getting your Research Funded” held by the Junior Faculty Interest Group at the 2018 INFORMS Annual Meeting
- Speaker and panelist at a workshop titled “Getting an NSF CAREER Award” held for junior faculty at the 2018 American Control Conference
- On the organizing committee of the:
  - INFORMS Optimization Society Conference, ’16
  - INFORMS International Conference, Cluster on Optimization, ’16
- On the technical committee of the:
  - IEEE Conference on Decision and Control, ’17
  - Control Systems Society: Computational Aspects of Control System Design, ’16
  - 5<sup>th</sup> IFAC Workshop on Estimation and Control in Networked Systems, ’15
  - DIMACS Workshop on the Geometry of Distances, ’16
  - IEEE Symp. on Signal and Information Processing in Finance and Economics, ’13
- Co-organizer (with Ramon van Handel) of the Julia Robinson Math Festival, Princeton University, Spring 2017
  - Program aimed at inspiring primary and middle-school students to pursue mathematics
- Mathematics mentor at the Julia Robinson Math Festival, Princeton University, ’15, ’16
- Organizer of >15 technical sessions at major optimization meetings including ISMP, SIOPT, ICCOPT, INFORMS, MOPTA
- Reviewer for Mathematical Programming, SIAM Journal on Optimization, Mathematics of Operations Research, Annals of Mathematics, Journal of the American Mathematical

Society, SIAM J. on Control and Optimization, IEEE Transactions on Automatic Control, Cambridge Univ. Press, and the National Science Foundation of the US & Czech Republic

### Undergraduate theses advised at Princeton University

#### Senior theses – Academic year 2018-2019

- Woramant Yomjinda, *“Money laundering route optimization”*.
  - Winner of the Cakmak Prize for innovative research and an exceptional senior thesis.
- Arav Arora, *“Supervised machine learning for optimization of salary cap distribution across player positions in the National Football League”*.
  - Winner of the Proctor and Gamble Prize for best thesis in operations research.
- Tor Nitayanont, *“Predicting public transportation ridership and locating optimal locations for new stations”*.

#### Senior theses – Academic year 2017-2018

- Tin Nguyen (now PhD student at MIT), *“Novel results on computational methods for polynomial optimization”*.
  - Winner of the Proctor and Gamble Prize for best thesis in operations research.
  - Winner of the Calvin Dodd MacCracken Senior Thesis Award (awarded by Princeton, SEAS to a thesis that is most distinctive for its inventiveness and technical accomplishment).
- Deniz Cekirge, *“Maximize safety, minimize cost: a long-term solution to the Syrian refugee crisis through optimization”*.
  - Winner of the Admiral W. Mack Angas Memorial Prize for significant contributions to society.
- Tianay Ziegler, *“How to succeed in basketball without really trying: a support vector machine approach to draft picks and trade deals”*.
- Haley Wan, *“Overcoming barriers to 100% renewable energy: network flow optimization of California’s energy transmission grid”*.

#### Senior theses – Academic year 2016-2017

- Mihaela Curmei (now PhD student at UC Berkeley), *“Monotonically constrained polynomial regression: an application of sum of squares techniques and semidefinite programming”*.
  - Winner of the Proctor and Gamble Prize for best thesis in operations research.
- Ellie McDonald, *“Minimizing, through a mixed integer nonlinear programming problem, the cost of reaching Hawaii’s one hundred percent renewable energy goal by 2045”*.
  - Winner of the Sigma Xi Book Award for excellence in research.
- Naman Jain, *“An application of computer vision methods for diamond classification: color, clarity, and cut”*.
  - Winner of the Admiral W. Mack Memorial Prize for significant contributions to society.
- Ryan Miller, *“The outdoor action trip assignment problem”*.
  - Winner of the Joseph Clifton Elgin Prize (awarded by Princeton, SEAS to a thesis that has done the most to advance the interests of the school and the community at large).

- Winner of the Kenneth H Condit '13 Prize (awarded for academic achievement and impact on the community).

#### *Senior theses – Academic year 2015-2016*

- Jacob Eisenberg, “Combating uncertainty with context: optimal lineup construction in daily fantasy baseball”.
  - Winner of the Procter and Gamble Prize for best thesis in operations research.
- Michael Wattendorf, “Systemic risk in the asymmetric case: theory and experiments with epidemiology using semidefinite programming”.
  - Winner of the Procter and Gamble Prize for best thesis in operations research.
- Salena Hess, “Predicting gentrification in Washington DC using housing prices and support vector machines”.
- Max Kaplan, “Subway optimization: New York Metro and London Underground”.

#### *Senior theses – Academic year 2014-2015*

- Ben Quazzo, “Levels of the game: a statistical and mathematical analysis of ATP Grand Slam competitions from 2005-2012”.
  - Thesis was featured via video on the [Princeton Tigers website](#).
- Janie Gu, “The minimum vacation cost problem: a novel generalization of the traveling salesman problem with vertex costs and flexible time windows”.
- Rishita Patlolla, “Redistribution of unused pharmaceuticals from hospitals to safety-net clinics in New Jersey”.

#### *Junior theses – Academic year 2014-2015*

- Jacob Eisenberg, “Determining the boundary of the MLB strike zone: a convex optimization approach”.
- Michael Wattendorf, “Predicting points in tennis”.

### Press

- **“A Classical Math Problem Gets Pulled Into the Modern World”** (May 2018)  
**Quanta Magazine** (Simons Foundation) <https://www.quantamagazine.org/a-classical-math-problem-gets-pulled-into-the-modern-world-20180523/>  
 The story was picked up by other news outlets, including Wired Magazine.
- **“After Almost 20 Years, Math Problem Falls”**  
**MIT News** (on the MIT homepage, July 2011)  
<http://web.mit.edu/newsoffice/2011/convexity-0715.html>
- **“Inaugural Princeton Day of Optimization Convenes Researchers at Forefront of Data Science and Machine Learning”**  
**Princeton University Office of Communications** (on the P.U. homepage, October 2018)  
<https://www.princeton.edu/news/2018/10/09/inaugural-princeton-day-optimization-convenes-researchers-forefront-data-science>

- **“Set to Optimize”**  
**LIDS Magazine** (Publication of the MIT Laboratory for Information and Decision Systems)  
[http://lidsmag.lids.mit.edu/2012/set\\_to\\_optimize.html](http://lidsmag.lids.mit.edu/2012/set_to_optimize.html)

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#### **Tennis honors**

- Chosen as an Academic-Athletic Fellow of Princeton University’s Men’s Tennis Team (2015)
- Played for the National Junior Tennis Team of Iran (18 and under)
- USTA Boys 18 Singles Winner, Prince George’s Tennis Open, June 2003
- USTA Boys 18 Singles Winner, Stonehenge Tennis Open, September 2002
- United States Tennis Association Division 5 player (2013)
- The 2013 IBM Watson Tennis Tournament (Winner)