

# Mengdi Wang

Assistant Professor (since July 2014)  
Senior Research Scholar (September 2013 - June 2014)  
Department of Operations Research and Financial Engineering  
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## Education

- PhD in Electrical Engineering and Computer Science, PhD Minor in Mathematics, MIT, 2013
  - Advisor: Dimitri P Bertsekas
- BS in Information Science and Control Theory, Tsinghua University, 2007

## Research Interests

- Fundamental complexity and algorithms for stochastic optimization in statistical machine learning
- Dimension reduction methods for Markov decision process and reinforcement learning
- Data-driven sequential decision-making process for healthcare and FinTech applications

## Honors and Awards

- NSF CAREER Award “*Stochastic Nested Composition Optimization: Theory and Algorithms*,” 2017-2022 (**1st attempt**)
- Princeton SEAS Innovation Award “*Machine Learning to Aid Clinical Decision-Making*,” 2017-2018 (**in collaboration with the hospital chain Hackensack Meridian Health**)
- FinTech Award “*Optimization and Machine Learning in Financial Technology*,” 2017-2019
- NSF DMS Award “*Closing the Duality Gap: Decomposition of High-Dimensional Nonconvex Optimization*,” 2016-2018
- *Young Researcher Prize in Continuous Optimization*, by the Mathematical Optimization Society, 2016 (**awarded once every three years**)

## Preprints

1. Y. Sun, J. Mulvey, M. Wang, J. Ye. **Learning Mean Reversion Trading Strategy With Transaction Costs Using Deep Neural Networks.** Preprint.
2. L. Yang, S. Kakade, M. Wang. **Achieving Optimal Regret in Finite-Horizon Reinforcement Learning.** Preprint.
3. W. Cho, M. Wang. **Deep Primal-Dual Reinforcement Learning.** Preprint.
4. A. Zhang, M. Wang. **State Compression for Markov Processes via Low-Rank Approximation.** Preprint.
5. Y. Chen and M. Wang. **On The Computational Complexity of Two-Player Dynamic Games.** Preprint.
6. S. Yang, M. Wang, E. Fang. **Multi-Level Stochastic Gradient Methods for Nested Composition Optimization.** In review with *SIAM Journal on Optimization*.

7. M. Wang. **Primal-Dual PI Learning: Sample Complexity and Sublinear Runtime for Ergodic Decision Process.** In review with Mathematics of Operations Research.
8. M. Wang. **Randomized Linear Programming Solves the Discounted Markov Decision Problem In Nearly-Linear Running Time.** In review with Mathematics of Operations Research.
9. Y. Chen and M. Wang. **Lower Bound On the Computational Complexity of Discounted Markov Decision Problems.** In review with Mathematics of Operations Research.
10. Y. Chen, M. Wang. **Stochastic Primal-Dual Methods and Sample Complexity of Reinforcement Learning.** In revision with Journal of Machine Learning Research, 2017
11. X. Fang, H. Liu, M. Wang. **Blessing of Massive Scale: Spatial Graphical Model Inference with a Total Cardinality Constraint.** In review with Mathematical Programming.
12. M. Wang, Y. Chen. **Random Multi-Constraint Projection: Stochastic Gradient Methods for Convex Optimization with Many Constraints.** In revision with Mathematics of Operations Research.

### Journal Publications

13. Y. Chen and M. Wang. **Strong NP-Hardness for A Class of Sparse Optimization Problems.** *Journal of Machine Learning Research*, forthcoming, 2018.
14. M. Wang. **Vanishing Price of Anarchy in Large Nonconvex Collaborative Optimization.** *SIAM Journal on Optimization*, 27(3) 1977-2009, 2017.
15. M. Wang\*, J. Liu\*, X. Fang. **Accelerating Stochastic Composition Optimization.** A short version at NIPS, 2016. *Journal of Machine Learning Research*, 18(105): 1–23, 2017.
16. J. Li, M. Wang (corresponding author), H. Liu, T. Zhang. **Near-Optimal Stochastic Approximation for Online Principal Component Estimation.** *Mathematical Programming*, forthcoming, 2017.
17. M. Wang (1st and corresponding author), X. Fang, and H. Liu. **Stochastic Compositional Gradient Descent: Algorithms for Minimization of Nonlinear Operators of Expected-Value Functions.** *Mathematical Programming*, 161(1), 419-449, 2016.  
 - **Best Paper Prize for Young Researchers in Continuous Optimization, ICCOPT 2016 (1 in 3 years)**
18. M. Wang and D.P. Bertsekas. **Stochastic First-Order Methods with Random Constraint Projection,** *SIAM Journal on Optimization*, 26(1): 681–717, 2016.
19. X. Wang, M. Wang, Y. Gu. **A Distributed Tracking Algorithm for Reconstruction of Graph Signals,** *IEEE Journal of Selected Topics in Signal Processing*, 9(4): 728-740, 2015.
20. M. Wang and D.P. Bertsekas. **Incremental Constraint Projection Methods for Variational Inequalities,** *Mathematical Programming*, 1-43, 2014.
21. M. Wang and D.P. Bertsekas. **On the Convergence of Simulation-Based Iterative Methods for Singular Linear Systems,** *Inform Journal on Stochastic Systems*, 3(1) 39-96, 2013.
22. M. Wang and D.P. Bertsekas. **Stabilization of Stochastic Iterative Methods for Singular and Nearly Singular Linear Systems,** *Mathematics of Operations Research*, 39(1) 1-30, 2013.
23. N. Polydorides, M. Wang, D.P. Bertsekas. **A Quasi Monte Carlo Method for Large-Scale Inverse Problems,** *Monte Carlo and Quasi-Monte Carlo Methods*, Springer Proc. in Mathematics and Statistics, 623-637, 2010.

## Peer-Reviewed Conference Publications

24. J. Ge, Z. Wang, M. Wang, H. Liu. **Minimax-Optimal Privacy-Preserving Sparse PCA in Distributed Systems.** *Artificial Intelligence and Statistics (AISTATS)*, 2018.
25. A. Sidford, M. Wang, X. Wu, Y. Ye (alphabetical-order). **Variance Reduced Value Iteration and Faster Algorithms for Solving Markov Decision Processes.** *ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2018.
26. L. Yang, V. Braverman, T. Zhao, M. Wang. **Online Factorization and Partition of Complex Networks from Random Walks.** *Conference on Neural Information Processing Systems (NIPS), NIPS Workshop on Optimization for Machine Learning*, 2017.
27. J. Li, M. Wang, H. Liu, T. Zhang. **Diffusion Approximations for Online Principal Component Estimation and Global Convergence.** *Neural Information Processing Systems (NIPS)*, 2017
  - **NIPS Oral Presentation; top 1.23% of all papers**
28. Y. Chen, D. Ge, M. Wang (corresponding author), Z. Wang, Y. Ye, H. Yin. **Strong NP-Hardness for Sparse Optimization with Concave Penalty Functions.** *International Conference on Machine Learning (ICML)*, 2017.
29. X. Lian, M. Wang, J. Liu. **Finite-Sum Compositional Optimization via Variance Reduced Gradient Descent.** *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2017.
30. X. Li\*, J. Ge\*, T. Zhang, M. Wang, H. Liu, and T. Zhao. **The "PICASSO" package for high dimensional nonconvex sparse learning in R.**
  - **2016 ASA Best Student Paper Award on Statistical Computing.**
31. M. Wang\*, J. Liu\* (co-first author), X. Fang. **Accelerating Stochastic Composition Optimization.** *Conference on Neural Information Processing Systems (NIPS)*, 2016.
32. M. Wang and Y. Chen. **A Stochastic Primal-Dual for Online Solution of Markov Decision Process.** *IEEE Conference of Decision and Control (CDC)*, 2016.
33. M. Wang and J. Liu. **A Stochastic Compositional Subgradient Method Using Markov Samples.** *Winter Simulation Conference (WSC)*, 2016.
34. M. Wang, Y. Xu, Y. Gu. **Multi-Task Nonconvex Optimization with Joint Constraints: A Distributed Algorithm Using Monte Carlo Estimates,** *International Conference on Digital Signal Processing (DSP)*, 2014.
35. Y. Gu and M. Wang. **Learning Distributed Jointly Sparse Systems by Collaborative LMS,** *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2014.

## Invited Lectures

- Academia: University of Chicago Booth Business School, Simons Institute of Theoretical Science at Berkeley, Cornell University, Duke University, UC Berkeley, MIT, Stanford University, Georgia Institute of Technology, Columbia University, Rutgers University, University of Wisconsin, University of South California, Tsinghua University, Peking University, Chinese Academy of Science, Princeton Neuroscience Institute, Purdue University, University of Illinois Urbana-Champaign
- Industry: Google, Ant Financial, DIDI, Microsoft Research, Baidu

## Teaching

- Princeton **ORF570: Special Topics in Statistical Optimization and Reinforcement Learning**, Spring 2018
  - A new PhD-level seminar course to be co-offered with Prof. Yuxin Chen
- Princeton **ORF522: Linear and Nonlinear Optimization, Princeton**, Fall 2014, 2015, 2016
  - A PhD-level course on the theoretical and algorithmic foundations for optimization
  - Included in the [Princeton Engineering Commendation List for Outstanding Teaching](#)
- Princeton **ORF360: Decision Modeling in Business Analytics**, Princeton, Spring 2015, 2016, 2017
  - A new junior-level course based on business themes and case studies
  - [Highest-ranked undergraduate course in operations research](#)
- Applied Math Summer School: **Dynamic Programming and Reinforcement Learning**, Peking University, 2016
- Global Scholar Summer Course: **Optimization in Big Data**, Tsinghua University, July 2014

## Advising

- Postdoc Students (3):
  - Lin Yang, Saeed Ghadimi, Xudong Li
- PhD Students (7):
  - Yichen Chen, Woon Sang Cho, Jason Ge, Yaqi Duan, Zachary T. Hervieux-Moore, Hao Lu, Yifan Sun
- Undergraduate Senior Thesis Advisees (17):
  - Simran Mathews, Jennifer Yin, Julia Ni (Princeton 2018)
  - Ben Wolfsen, Grace Chang, Rellie Luo, Joy Zhou, Likith Govindaiah, Bradley Snider (2017)
  - Eliot Tan, John Jablonski, Frances Lu, Angela Wang, Barbara Zhan (Princeton 2016)
  - Kevin Simms, Satyajeet Pal, Michael Casper (Princeton 2015)

## Services and Activities

- Associate Editor of *Operations Research*, since Jan 2018
- Conference Co-Organizer, Princeton PCTS-CSML Workshop "*Bridging Mathematical Optimization, Information Theory, and Data Science*", May 2018
- Panel Member, *NSF*, 2016, 2017
- Organizing Committee Member, *INFORMS Optimization Society Conference*, Mar 2015
- Reviewer of *Management Science*, *Operations Research*, *Mathematical Programming*, *Mathematics of Operations Research*, *SIAM Journal on Optimization*, *Management Science*, *Journal of Machine Learning Research*, *Journal of the American Statistical Association*, *Mathematics of Computation*, *INFORMS Journal on Computing*, *Journal of Global Optimization*, *Computational Optimization and Applications*, *Annals of Operations Research*, *IEEE Transactions on Signal Processing*, *IEEE Transactions on Automatic Control*.
- Reviewer of *Neural Information Processing Systems (NIPS)*, *International Conference on Machine Learning (ICML)*, *Artificial Intelligence and Statistics (AISTATS)*, *International Conference on Learning Representations (ICLR)*, *IEEE Conference of Decision and Control (CDC)*, *Winter Simulation Conference (WSC)*