

# Cong Ma

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## EMPLOYMENT

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### Assistant professor

July 2021 - present

- Department of Statistics and the College, University of Chicago

### Postdoctoral scholar

June 2020 - June 2021

- Department of Statistics and Department of Electrical Engineering and Computer Sciences, University of California, Berkeley
- Advisor: Professor *Martin J. Wainwright*

## EDUCATION

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### Ph.D. in Operations Research and Financial Engineering

May 2020

- Princeton University, advised by Professor *Yuxin Chen* and Professor *Jianqing Fan*

### B.E. in Electrical Engineering

July 2015

- Tsinghua University

### Exchange student

Aug. 2013 - Dec. 2013

- School of Electrical and Computer Engineering, Georgia Institute of Technology

## RESEARCH INTERESTS

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Mathematics of data science, reinforcement learning, high-dimensional statistics, large-scale optimization, inference and uncertainty quantification, and their applications to neuroscience and signal processing.

## PREPRINTS

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- [P1] **C. Ma**, R. Pathak, M. J. Wainwright, "Optimally Tackling Covariate Shift in RKHS-based Nonparametric Regression", 2022.
- [P2] Y. Yang, **C. Ma**, " $O(T^{-1})$  Convergence of Optimistic-Follow-the-Regularized-Leader in Two-Player Zero-Sum Markov Games," 2022.
- [P3] Y. Yang, **C. Ma**, "Optimal Tuning-Free Convex Relaxation for Noisy Matrix Completion," 2022.

## JOURNAL ARTICLES

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- [J1] T. Tong, **C. Ma**, A. Prater-Bennette, E. Tripp, Y. Chi, "Scaling and Scalability: Provable Nonconvex Low-Rank Tensor Estimation from Incomplete Measurements," accepted to *Journal of Machine Learning Research*, 2022.
- [J2] P. Rashidinejad, B. Zhu, **C. Ma**, J. Jiao, S. Russel, "Bridging Offline Reinforcement Learning and Imitation Learning: A Tale of Pessimism," accepted to *IEEE Transactions on Information Theory*, 2022.
- [J3] **C. Ma**, B. Zhu, J. Jiao, M. J. Wainwright, "Minimax Off-Policy Evaluation for Multi-Armed Bandits," *IEEE Transactions on Information Theory*, vol. 68, no. 8, pp. 5314 - 5339, Mar. 2022.
- [J4] Y. Chen, Y. Chi, J. Fan, **C. Ma (alphabetical order)**, "Spectral Methods for Data Science: A Statistical Perspective," *Foundations and Trends in Machine Learning*, 2021.
- [J5] Y. Chen, J. Fan, **C. Ma**, Y. Yan (**alphabetical order**), "Bridging Convex and Nonconvex Optimization in Robust PCA: Noise, Outliers, and Missing Data," *Annals of Statistics*, vol. 49, no. 5, pp. 2948-2971, 2021.

- [J6] Y. Chen, **C. Ma**, H. V. Poor, Y. Chen, “Learning Mixtures of Low-Rank Models,” *IEEE Transactions on Information Theory*, vol. 67, no. 7, pp. 4613-4636, July 2021.
- [J7] T. Tong, **C. Ma**, Y. Chi, “Low-Rank Matrix Recovery with Scaled Subgradient Methods: Fast and Robust Convergence Without the Condition Number,” *IEEE Transactions on Signal Processing*, vol. 69, no. 3, pp. 2396-2409, 2021.
- [J8] J. Fan, **C. Ma**, Y. Zhong (**alphabetical order**), “A Selective Overview of Deep Learning,” *Statistical Science*, vol. 36, no. 2, pp. 264-290, May 2021 (**invited overview article**).
- [J9] T. Tong, **C. Ma**, Y. Chi, “Accelerating Ill-Conditioned Low-Rank Matrix Estimation via Scaled Gradient Descent,” *Journal of Machine Learning Research*, vol. 22, no. 150, pp. 1-63, May 2021.
- [J10] Y. Li, **C. Ma**, Y. Chen, Y. Chi, “Nonconvex Matrix Factorization from Rank-One Measurements,” *IEEE Transactions on Information Theory*, vol. 67, no. 3, pp. 1928-1950, March 2021.
- [J11] **C. Ma**, Y. Li, Y. Chi, “Beyond Procrustes: Balancing-Free Gradient Descent for Asymmetric Low-Rank Matrix Sensing,” *IEEE Transactions on Signal Processing*, vol. 69, pp. 867-877, Jan. 2021.
- [J12] **C. Ma**, J. Lu, H. Liu, “Inter-Subject Analysis: A Partial Gaussian Graphical Model Approach,” *Journal of the American Statistical Association*, vol. 116, no. 534, pp. 746-755, 2021.
- [J13] Y. Chen, Y. Chi, J. Fan, **C. Ma**, Y. Yan (**alphabetical order**), “Noisy Matrix Completion: Understanding Statistical Guarantees for Convex Relaxation via Nonconvex Optimization,” *SIAM Journal on Optimization*, vol. 30, no. 4, pp. 3098–3121, Oct. 2020.
- [J14] **C. Ma**, K. Wang, Y. Chi, Y. Chen, “Implicit Regularization in Nonconvex Statistical Estimation: Gradient Descent Converges Linearly for Phase Retrieval, Matrix Completion, and Blind Deconvolution,” *Foundations of Computational Mathematics*, vol. 20, no. 3, pp. 451-632, June 2020.
- [J15] Y. Chen, Y. Chi, J. Fan, **C. Ma** (**alphabetical order**), “Gradient Descent with Random Initialization: Fast Global Convergence for Nonconvex Phase Retrieval,” *Mathematical Programming*, vol. 176, no. 1-2, pp. 5-37, July 2019.
- [J16] Y. Chen, J. Fan, **C. Ma**, Y. Yan (**alphabetical order**), “Inference and Uncertainty Quantification for Noisy Matrix Completion,” *Proceedings of the National Academy of Sciences (PNAS)* vol. 116, no. 46, pp. 22931-22937, Nov. 2019 (direct submission).
- [J17] Y. Chen, J. Fan, **C. Ma**, K. Wang (**alphabetical order**), “Spectral Method and Regularized MLE Are Both Optimal for Top- $K$  Ranking,” *Annals of Statistics*, vol. 47, no. 4, pp. 2204-2235, Aug. 2019.
- [J18] J. Zhang, J. Tang, **C. Ma**, H. Tong, Y. Jing, J. Li, W. Luyten, M-F. Moens, “Fast and Flexible Top- $k$  Similarity Search on Large Networks,” *ACM Transactions on Information Systems*, vol. 36, no. 2, pp. 13:1-13:30, Sept. 2017.

## CONFERENCE PAPERS

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- [C1] R. Pathak, C. Ma, M. J. Wainwright, “A New Similarity Measure for Covariate Shift with Applications to Nonparametric Regression,” *International Conference on Machine Learning (ICML)*, 2022 (long presentation).
- [C2] G. Li, **C. Ma**, N. Srebro (**alphabetical order**), “Pessimism for Offline Linear Contextual Bandits using  $\ell_p$  Confidence Sets,” *Conference on Neural Information Processing Systems (Neurips)*, 2022.
- [C3] P. Rashidinejad, B. Zhu, **C. Ma**, J. Jiao, S. Russel, “Bridging Offline Reinforcement Learning and Imitation Learning: A Tale of Pessimism,” *Conference on Neural Information Processing Systems (Neurips)*, 2021.
- [C4] **C. Ma**, Y. Li, Y. Chi, “Beyond Procrustes: Balancing-Free Gradient Descent for Asymmetric Low-Rank Matrix Sensing,” *Asilomar Conference on Signals, Systems and Computers*, Nov. 2019.
- [C5] Y. Li, **C. Ma**, Y. Chen, Y. Chi, “Nonconvex Matrix Factorization from Rank-One Measurements,” *International Conference on Artificial Intelligence and Statistics (AISTATS)*, Apr. 2019.
- [C6] **C. Ma**, K. Wang, Y. Chi, Y. Chen, “Implicit Regularization in Nonconvex Statistical Estimation: Gradient Descent Converges Linearly for Phase Retrieval and Matrix Completion,” *International Conference on Machine Learning (ICML)*, July 2018.
- [C7] J. Zhang, J. Tang, **C. Ma**, H. Tong, Y. Jing, J. Li, “Panther: Fast Top- $k$  Similarity Search on Large Networks,” *ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD)*, Aug. 2015.

## TUTORIALS

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- [Tut1] “Nonconvex Optimization for High-Dimensional Signal Estimation: Spectral and Iterative Methods,” European Signal Processing Conference (EUSIPCO) 2020, together with Y. Chen and Y. Chi.

## INVITED TALKS

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- [T1] “Bridging Offline Reinforcement Learning and Imitation Learning: A Tale of Pessimism,” *SIAM Conference on Mathematics of Data Science*, Sept. 2022.
- [T2] “Minimax Off-Policy Evaluation for Multi-Armed Bandits,” *Statistics and Data Science Seminar, UIC*, Dec. 2021.
- [T3] “Bridging Offline Reinforcement Learning and Imitation Learning: A Tale of Pessimism,” *Joint CS and TTIC Machine Learning Seminar*, Oct. 2021.
- [T4] “Bridging Offline Reinforcement Learning and Imitation Learning: A Tale of Pessimism,” *Inform's Annual Meeting*, Oct. 2021.
- [T5] “Minimax Off-Policy Evaluation for Multi-Armed Bandits,” *FODSI Seminar, UC Berkeley*, Apr. 2021.
- [T6] “Bridging Convex and Nonconvex Optimization in Noisy Matrix Completion: Stability and Uncertainty Quantification,” *BLISS Seminar, UC Berkeley*, Nov. 2020.
- [T7] “Bridging Convex and Nonconvex Optimization in Noisy Matrix Completion: Stability and Uncertainty Quantification,” *Young Data Science Researcher Seminar, ETH*, June 2020.
- [T8] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *ISyE Seminar, School of Industrial & Systems Engineering, Georgia Tech*, Feb. 2020.
- [T9] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *Department Seminar, Department of IEOR, Columbia University*, Feb. 2020.
- [T10] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *Department Seminar, Department of Statistics, University of Pennsylvania*, Feb. 2020.
- [T11] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *Department of Statistics, UC Irvine*, Feb. 2020.
- [T12] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *Department Seminar, Department Seminar, Department of Statistics, UC Davis*, Feb. 2020.
- [T13] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *Department of Statistics, Rutgers University*, Jan. 2020.
- [T14] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty Quantification,” *Statistics Colloquium, Department of Statistics, University of Chicago*, Jan. 2020.
- [T15] “Statistics Meets Nonconvex Optimization: Computational Efficiency and Uncertainty quantification,” *Department Seminar, Department of Data Sciences and Operations, USC*, Jan. 2020.
- [T16] “Nonconvex Optimization Meets Statistics: Towards Rigorous Computational and Inferential Guarantees,” *School of Industrial Engineering, Purdue University*, Dec. 2019.
- [T17] “Bridging convex and nonconvex optimization in noisy matrix completion: Stability and uncertainty quantification,” *Statistics Seminar, Department of Mathematics, University of Maryland, College Park*, Dec. 2019.
- [T18] “Understanding statistical properties by bridging convex and nonconvex optimization,” *AMS Fall Eastern Sectional Meeting, Binghamton University*, Oct. 2019.
- [T19] “Noisy matrix completion: understanding statistical guarantees for convex relaxation via nonconvex optimization,” *Annual Young Researchers Workshop, ORIE, Cornell University*, Oct. 2019.
- [T20] “Noisy matrix completion: understanding statistical guarantees for convex relaxation via nonconvex optimization,” *Mathematics, Information and Computation (MIC) Seminar, Center for Data Science and Courant Institute, NYU*, Apr. 2019.
- [T21] “Nonconvex Matrix Completion Without Regularization,” *Asilomar Conference on Signals, Systems, and Computers, Pacific Grove*, Oct. 2018.
- [T22] “Spectral Method and Regularized MLE are Both Optimal for Top- $K$  Ranking,” *Energy and Information Systems Seminar, CMU*, July 2018.
- [T23] “Gradient Descent with Random Initialization: Fast Global Convergence for Nonconvex Phase Retrieval,” *ICML Workshop on Modern Trends in Nonconvex Optimization for Machine Learning, Stockholm*, July 2018.

- [T24] “Implicit Regularization in Nonconvex Statistical Estimation: Gradient Descent Converges Linearly for Phase Retrieval, Matrix Completion”, *International Conference on Machine Learning (ICML)*, Stockholm, July 2018.
- [T25] “Implicit Regularization in Nonconvex Statistical Estimation,” *International Symposium on Mathematical Programming*, Bordeaux, July 2018.
- [T26] “Implicit Regularization in Nonconvex Statistical Estimation,” *Department of Electrical Engineering, Tsinghua University*, Jan. 2018.
- [T27] “Spectral Method and Regularized MLE are Both Optimal for Top-K Ranking,” *International Conference on Data Science*, Shanghai, Dec. 2017.
- [T28] “Inter-Subject Analysis: Inferring Sparse Interactions with Dense Intra-Graphs,” *ICSA Applied Statistics Symposium*, Chicago, June 2017.

## PROFESSIONAL SERVICE

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1. Co-organizer of *Statistics Colloquium*, Department of Statistics, University of Chicago    Sept. 2018 – present
2. Co-organizer of *Wilks statistics seminar*, ORFE, Princeton University    July 2018 – May 2019
3. Co-organizer of 6<sup>th</sup> *Princeton Day of Statistics*, ORFE, Princeton University
4. Member of Technical Program Committee for *52nd Annual Conference on Information Sciences and Systems (CISS 2018)*
5. Reviewer for the following journals: *Annals of Statistics*, *Statistical Science*, *Bernoulli Journal*, *Operations Research*, *Proceedings of the IEEE*, *Journal of Machine Learning Research*, *IEEE Transactions on Signal Processing*, *IEEE Transactions on Information Theory*, *Journal of Business & Economic Statistics*, *Transactions on Knowledge and Data Engineering*, *SIAM Journal on Mathematics of Data Science*
6. Reviewer for the following conferences: *ACM Symposium on Theory of Computing*, *Conference on Neural Information Processing Systems (NeurIPS)*, *International Conference on Artificial Intelligence and Statistics*, *IEEE International Symposium on Information Theory*, *Annual Conference on Information Sciences and Systems*, *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*

## TEACHING

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1. Topics in Mathematical Data Science: Spectral Methods and Nonconvex Optimization, Fall 2021

## AWARDS AND HONORS

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| 1. Hannan Graduate Student Travel Award, Institute of Mathematical Statistics   | 2020 |
| 2. School of Engineering and Applied Science Award for Excellence, Princeton University<br><i>This award is given to SEAS advanced graduate students who have performed at the highest level as scholars and researchers.</i> | 2019 |
| 3. AI Labs Fellowship, Hudson River Trading   | 2019 |
| 4. Best Poster Award, Princeton Day of Optimization   | 2018 |
| 5. ICSA Student Paper Award, International Chinese Statistical Association  | 2017 |
| 6. First Year Engineering Fellowship, Princeton University  | 2015 |
| 7. Outstanding Academic Performance Scholarship, Tsinghua University  | 2014 |
| 8. National Scholarship, Tsinghua University (Highest honor, 2 out of 118 in department)  | 2013 |
| 9. CNPC Scholarship, Tsinghua University (Highest honor, only recipient in department)  | 2012 |