Sheng Xu

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Academic Appointment

Princeton University — 2022 - present
Postdoctoral Researcher — Princeton, NJ, USA
Advisor: Amit Singer

Education

Yale University — 2016 - 2022
Ph.D. in Statistics and Data Science — New Haven, CT, USA

- Advisors: Zhou Fan and Sahand Negahban
- Thesis: "Efficient Estimation of Signals via Non-Convex Approaches"
- Francis J. Anscombe Award: "Given on an occasional basis for outstanding academic performance in the Department of Statistics and Data Science."

Peking University
B.S. in Mathematics — 2010 - 2014
Advisor: Zhi Geng — Beijing, China
B.S. (dual) in Economics — 2011 - 2014
Advisor: Miaojie Yu — Beijing, China

Research Experiences

Research Interests

- Theory / Methodology: statistical inference; machine learing; mathematics of data science; optimization (with emphasis on non-convex landscapes).
- Applications: signal and image processing (notably 3-D reconstruction in cryogenic electron microscopy (Cryo-EM)); structural biology; geophysics; network analysis; time series analysis; econometrics.

Journal Publications

1. Gong, Z., Evans, D.A.D., Fu, R.R., **Xu, S.** (2025). Reassessing the Geocentric-Axial-Dipole (GAD) Model for Proterozoic Time with Paleomagnetic Directions from Dike Swarms. *Earth and Planetary Science Letters (EPSL)*, 667: 119508.

2. Fan, Z., Lederman, R., Sun, Y., Wang, T., & **Xu, S.** (2024). Maximum Likelihood for High-Noise Group Orbit Estimation and Single-Particle Cryo-EM. *Annals of Statistics*: 52(1), 52-77.

3. Gao, W. Y., Li, M., & **Xu, S.** (2023). Logical Differencing in Dyadic Network Formation Models with Nontransferable Utilities. *Journal of Econometrics*, 235(1): 302-324.

4. **Xu, S.**, & Fan, Z. (2021). Iterative Alpha Expansion for Estimating Gradient-Sparse Signals from Linear Measurements. *Journal of the Royal Statistical Society: Series B (JRSS-B)*, 83(2): 271-292.

5. Han, F., **Xu, S.**, & Zhou, W. (2018). On Gaussian Comparison Inequality and Its Application to Spectral Analysis of Large Random Matrices. *Bernoulli*, 24(3): 1787-1833.

Conference Publications

1. Chen, L., & **Xu, S.** (2021). Deep Neural Tangent Kernel and Laplace Kernel Have the Same RKHS. In *Proceedings of the 9th International Conference on Learning Representations (ICLR)*.

2. **Xu, S.**, Fan, Z., & Negahban, S. (2020). Tree-Projected Gradient Descent for Estimating Gradient-Sparse Parameters on Graphs. In *Proceedings of the 33rd Annual Conference on Learning Theory (COLT)*.

3. Qiu, H., **Xu, S.**, Han, F., Liu, H., & Caffo, B. (2015). Robust Estimation of Transition Matrices in High Dimensional Heavy-Tailed Vector Autoregressive Processes. In *Proceedings of the 32nd International Conference on Machine Learning (ICML)*.

Preprints / Submitted Manuscripts

1. **Xu, S.**, Zhang, A. Y., & Singer, A. (2025). Misspecified Maximum Likelihood Estimation for Non-Uniform Group Orbit Recovery. Submitted to *Journal of the American Statistical Association (JASA)*.

2. Kileel, J., Mickelin, O., Singer, A., & **Xu, S.** (2025). Method of Double Moments for 3-D Reconstruction in Cryo-EM: Using Multiple Datasets with Different Viewing Angle Distributions. Submitted to *Inverse Problems*.

3. **Xu, S.**, Balanov, A., Singer, A., Bendory, T. (2025). Bayesian Perspective for Orientation Determination in Cryo-EM with Application to Structural Heterogeneity Analysis. Under revision at *Acta Crystallographica Section D: Structural Biology*.

4. Zhang, L., Mickelin, O., **Xu, S.**, & Singer, A. (2025). Diagonally-Weighted Generalized Method of Moments Estimation for Gaussian Mixture Modeling. Under revision at *SIAM Journal on Mathematics of Data Science (SIMODS)*.

5. Gao, W. Y., **Xu, S.**, & Xu, K. (2025). Two-Stage Maximum Score Estimator. Submitted to *Bernoulli*.

Manuscripts in Preparation

1. **Xu, S.**, Sharon, N., Storey, J., Singer, A. (2025). Distribution-Free Symmetry Detection in Multi-Reference Alignment.

2. **Xu, S.**, Fan, Z., & Negahban, S. (2025). On Convergence of Frequency Marching Algorithm for Multi-Reference Alignment.

3. **Xu, S.**, & Cattaneo, M. (2025). Adaptive Minimax Estimation of Quadratic Functionals under Dyadic Data.

4. Zhang, A., Mickelin, O., **Xu, S.**, & Singer, A. (2025) Autocorrelation Analysis for Reconstruction in Cryo-EM with Structural Priors.

Patents

1. **Xu, S.**, Zhang, Y., Singer, A. *"Unbiased 3-D Reconstruction in Cryo-Electron Microscopy via Anisotropic Viewing-Angle Prior"*. U.S. Provisional Patent Application No. 63/887,219. Filed September 2025.

2. Kileel, J., Mickelin, H.E.O., Singer, A., **Xu, S.** *"Method of Moments for 3-D Reconstruction in Cryo-Electron Microscopy from Multiple Datasets with Different Viewing Angle Distributions"*. U.S. Provisional Patent Application No. 63/816,313. Filed June 2025.

Software

1. MoDM: Python package implementing the Method of Moments for 3-D reconstruction in cryo-EM from two datasets with different viewing angle distributions (on github).

2. ITALE: R package for piecewise-constant signal estimation on general graphs (on github).

Teaching Experiences

Instructor, Princeton University, APC 199/MAT 199, Math Alive, Spring 2025.

Co-organizer, Princeton University, Junior Seminar in Mathematics, Top 10 Algorithms of the 20th Century, Fall 2024.

Instructor, Princeton University, APC 199/MAT 199, Math Alive, Spring 2024.

TA, Yale University, S&DS 351/551, Stochastic Processes, Spring 2022 (taught by Andrew, Barron).

TA, Yale University, S&DS 363/563, Multivariate Statistics, Spring 2020 (taught by Jonathan, Reuning-Scherer).

TA, Yale University, S&DS 410/610, Statistical Inference, Fall 2019 (taught by Zhou, Fan).

TA, Yale University, S&DS 351/551, Stochastic Processes, Spring 2019 (taught by Sahand, Negahban and Yihong, Wu).

TA, Yale University, S&DS 410/610, Statistical Inference, Fall 2018 (taught by Zhou, Fan).

TA, Yale University, S&DS 351/551, Stochastic Processes, Spring 2018 (taught by Sahand, Negahban).

Professional Services

Talks

University of Missouri, Data Seminar, Columbia, MO, 2025

AMS Spring Eastern Sectional Meeting, Hartford, CT, 2025

SIAM Conference on Mathematics of Data Science, Atalanta, GA, 2024

New Jersey Institute of Technology, Statistics Seminar, Newark, NJ, 2024.

Joint Statistical Meetings (JSM), Portland, OR, 2024.

National University of Singapore, IMS Young Mathematical Scientists Forum—Statistics and Data Science, Singapore, 2023.

Princeton University, PACM IDeAS Seminar, Princeton, NJ, 2021.

Conference on Learning Theory (COLT), Virtually (due to COVID), 2020.

International Conference on Machine Learning (ICML), Lille, France, 2015.

Reviewing

Journals: Annals of Statistics (AoS), Annals of Applied Statistics (AoAS), Bernoulli, Journal of Econometrics (JoE), IEEE Transactions on Information Theory, SIAM Journal on Mathematics of Data Science (SIMODS).

Conferences:

Conference on Neural Information Processing Systems (NeurIPS), 2021, 2022, 2023, 2025.

AAAI Conference on Artificial Intelligence (AAAI), 2025.

International Conference on Learning Representations (ICLR), 2021.

International Conference on Machine Learning (ICML), 2020.