Xiaoqi (Shirley) Liu

I work across theory and implementation: deriving fundamental limits for statistical inference problems, building principled algorithms, and rapidly validating them through large-scale experiments.

Contact information

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Research

Postdoc, University of Oxford Oct 2024–present
Host: Prof. Patrick Rebeschini
Research focus:

- State-of-the-art black-box uncertainty quantification for sequential data
- Study training dynamics of attention and neural networks, particularly under challenging conditions including non-stationarity, adversarial contamination, and distribution shifts

PhD, Trinity Hall college, University of Cambridge Oct 2019–June 2024
Supervisor: Prof. Ramji Venkataramanan

Thesis: Message passing algorithms for high-dimensional statistical estimation, featuring structured signals:

- Changepoint detection in heterogeneous data (e.g. genomics, financial data)
- Sketching sparse, low-rank matrices (e.g. adjacency matrices of large social networks)
- Reliable, efficient communications (encoding and decoding information) for large user networks

Selected preprints and publications:

X. Liu, D. Baudry, J. Zimmert, P. Rebeschini, A. Akhavan, "Non-stationary Bandit Convex Optimization: A Comprehensive Study", to appear in *Proceedings of the 39th Annual Conference on Neural Information Processing Systems*, 2025.

J. Allison, P. Anderson, E. Aranas, Y. Assaf, M. Caballero, J. Chattaway, A Chatzieleftheriou, J. Clegg, B. Cooper, T. Deegan, A. Donnelly, R. Drevinskas, C. Gkantsidis, A. G. Diaz, I. Haller, F. Hong, T. Ilieva, R. Joyce, V. Kapitany, W. Kunkel, D. Lara, T. Lawson, S. Legtchenko, F. Liu, **X. Liu**, B. Magalhaes, S. Nowozin, H. Overweg, A. Rowstron, M. Sakakura, N. Schreiner, A. Smith, O. Snowdon, I. Stefanovici, D. Sweeney, G. Verkes, P. Wainman, C. Whittaker, P. W. Berenguer, H. Williams, T. Winkler, S. Winzeck, R. Black, B. Canakci, D. Cletheroe, Z. Feng, "Laser writing in glass for dense, fast and efficient archival data storage", to appear in *Nature*, 2025.

X. Liu, P. Pascual Cobo and R. Venkataramanan, "Many-user multiple access with random user activity: achievability bounds and efficient schemes", to appear in *IEEE Transactions on Information Theory*, 2025, doi: 10.1109/TIT.2025.3622969. (poster, talk)

G. Arpino, **X. Liu**, J. Gontarek and R. Venkataramanan, "Inferring Change Points in High-Dimensional Regression via Approximate Message Passing", to appear in *Journal of Machine Learning Research*, 2025. (poster, code)

X. Liu, K. Hsieh and R. Venkataramanan, "Coded many-user multiple access via Approximate Messsage Passing", to appear in *Information Theory, Probability and Statistical Learning: A Festschrift in Honor of Andrew Barron*, 2025. (talk)

G. Arpino, **X. Liu** and R. Venkataramanan, "Inferring change points in high-dimensional linear regression via Approximate Message Passing", *Proceedings of the 41st International Conference on Machine Learning, PMLR 235:1841-1864,* 2024. (arXiv, poster, code)

X. Liu and R. Venkataramanan, "Sketching Sparse Low-Rank Matrices With Near-Optimal Sample- and Time-Complexity Using Message Passing," in *IEEE Transactions on Information Theory*, vol. 69, no. 9, pp. 6071-6097, Sept. 2023.

Education

BA and MEng, Newnham College, University of Cambridge Oct 2015–Jun 2019
Major: Information and Computer Engineering (Honours with Distinction)
Simultaneously qualified in Electrical and Information Sciences; Instrumentation and Control
Ranked 3%, 7%, 4% and 3% (top first class) respectively each year in my cohort of 300+ people

Overseas Family School, Singapore Aug 2013–Jun 2015
International Baccalaureate Diploma Programme (Bilingual) 45/45 (0.3% globally): High Level

Mathematics, Physics, Economics, English; Standard Level Business & Management, Chinese Language & Literature all with 7/7.

Scholarships and Awards

Schlumberger Cambridge Trust International Scholar: full PhD studentship (£49,000/year)
2020 British Education Award: One of 5 winners selected across UK in recognition of outstanding academic achievements. Congratulated by No.10 Downing Street (Nov 2019)
Best Presentation Prize: Awarded at Engineering Department MEng thesis final presentations (Jun 2019)
Best Technical Report of the Year (Jun 2018)
Scholar of Newnham College (2016–2019); **recipient of major undergraduate research award** (2018)

Academic Service and Outreach

Reviewer: NeurIPS (top reviewer 2024), ICLR, TMLR, ISIT
Speaker and lecturer, 2025 Oxford Algorithmic Statistics CDT module and workshop (Nov 2025): Delivered lecture on uncertainty quantification via e-values and e-processes and presented NeurIPS publication on non-stationary bandits
Research supervision (2022-present): MSc projects on in-context learning in transformers under adversarial attacks; MEng projects on high-dimensional statistical estimation for heterogeneous data
Organiser and speaker, Cambridge information engineering divisional conference (Mar 2022): Coordinated 100-attendee conference and delivered research talk on fast matrix sketching
Teaching: Supervisor for Information Theory & Coding and Data Transmission (Oct 2019–June 2024); **Cambridge AI+ Programme** (Feb 2022, 2023): Described by students as insightful and thoughtful supervisor who can "explain complex topics in an easy-going manner"

Work Experience

Microsoft Research (Cambridge, UK), researcher intern Apr 2023–June 2023
- Designed novel error correction scheme for Project Silica (glass-based data storage), increasing transmission rate by 5-10%
- Enhanced image classification decoder in PyTorch
- Contributed to a Nature publication
- Clarified key information-theoretic performance metric and proposed unifying workflow for the team
- Final presentation attracted large audience, and praised for exceptional clarity and organisation

MediaTek Inc (Cambourne, UK), software development summer intern Jun 2017–Sep 2017
- Developed data mining and test automation tools in C#, LINQ, SQL & XML
- Created GUI applications for GPS signal analysis and cellular network visualization

Skills

- Extensive experience with Python (incl. JAX), MATLAB, Git, Slurm. Familiar with C#, C++, VBA, HTML, CSS, LINQ, SQL, XML, R & PyTorch
- Bilingual in Chinese and English