Xiaoqi (Shirley) Liu

I have broad interests in **statistical learning**, **information theory**, and **optimization**. I derive theoretical limits on the minimum sample complexity needed for solving specific statistical inference problems, and develop mathematically principled algorithms to approach these limits.

Contact information

Department of Statistics, 24-29 St Giles', Oxford OX1 3LB, UK
Phone: +44 07494 054968   Email: shirley.liu@stats.ox.ac.uk   Website: https://shirleyliuxq.github.io

Research and Education

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

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

Thesis: Message passing algorithms for high-dimensional statistical problems, featuring structured signals:
- compression (sketching) of sparse, low-rank matrices (e.g. adjacency matrices of large social networks)
- changepoint detection (mixed linear regression) in heterogeneous data (e.g. genomics, financial data)
- reliable communications (encoding and decoding information) for large user networks

Publications:

X. Liu, P. Cobo and R. Venkataramanan, "Many-user multiple access with random user activity", *2024 IEEE International Symposium on Information Theory*, Athens, Greece, 2024. (poster, talk)

X. Liu, K. Hsieh and R. Venkataramanan, "Coded many-user multiple access via Approximate Message Passing", *IEEE International Symposium on Information Theory*, Athens, Greece, 2024 (arXiv, 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.

X. Liu and R. Venkataramanan, "Sketching sparse low-rank matrices with near-optimal sample- and time-complexity," *IEEE International Symposium on Information Theory,* Espoo, Finland, 2022, pp. 3138-3143.

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 Number 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: Conference on Neural Information Processing Systems (NeurIPS), the International Conference on Learning Representations (ICLR), IEEE International Symposium on Information Theory (ISIT), International Symposium on Topics in Coding

Organiser and speaker, 2022 Cambridge Information Engineering Divisional Conference (Mar 2022): Oversaw logistics for 100-attendee conference, coordinated with speakers and concurrently prepared my talk

Supervisor for Information Theory & Coding and Data Transmission (Oct 2019–June 2024): Arrange biweekly Q&A sessions with third-year undergraduates in groups of three. Described by students as insightful and thoughtful supervisor who can "explain complex topics in an easy-going manner"

Co-supervisor of MEng projects (Oct 2022–June 2024): help students formulate research questions in statistical learning, conduct experiments and present results in verbal and written formats

Teaching assistant, Electronic & Information Engineering Track at Cambridge AI+ Programme (Feb 2022, 2023)

Selected supervisor for maths tutorials for Newnham STEM new-joiners (Oct 2017 & Oct 2019)

Invited guest and project leader at 2019 Micro Distance International Youth Forum (Jul 2019): Designed and led three-day project on visual information processing, guiding students aged 14–18 to explore compact coding and sparse coding principles through MATLAB experiments.

Work Experience

Microsoft Research (Cambridge, UK), researcher intern   Apr 2023–June 2023
- Designed novel error correction scheme for project Silica (cloud data storage on glass), which increased transmission rate by 5-10%
- Clarified key information-theoretic performance metric for the team
- Proposed unifying workflow to systematically evaluate new data storage technologies
- Helped enhance image classification decoder in PyTorch
- Final presentation attracted ~50 audience, and praised for exceptional clarity and organisation

MediaTek Inc (Cambourne, UK), software development summer intern   Jun 2017–Sep 2017
- Data mining and test automation software development in C#, LINQ, SQL & XML
- Created GUI application to identify locations with mobile phone GPS signal loss based on log data and accurately restore coordinates; and to display grouping of base stations in a cellular network into tracking areas
- Prototyped a smart kitchen device using sensors and an Arduino board

WSP | Parsons Brinckerhoff (Cambridge, UK), structural design engineer   Jun 2016–Aug 2016
- Designed 20+ pieces of steelwork and verified designs from first principles
- Taught myself reinforced concrete design specifications and created VBA program to systematically validate reinforced concrete slab designs

Extra-curricular Activities and Volunteering

Cambridge University Synthetic Biology Society (Oct 2017–Jun 2018): Member of computational modelling team. Simulated genetic construct in Python which allows bacterial colony to perform high-pass filtering (edge detection) in response to light patterns

Impact Through Innovation Cambridge (Oct 2017–Jun 2018): Prototyped circuit design of medical monitoring device dedicated to an HIV medication adherence study in Tanzania

Flautist, Cambridge University Chinese Orchestra Society (Oct 2016–Jun 2017): Flute Grade 9 (highest grade for non-professional flautists in China)

Skills and Hobbies

- Proficient in Python (incl. JAX), MATLAB, Git, Slurm. Familiar with C#, C++, VBA, HTML, CSS, LINQ, SQL, XML, R & PyTorch
- Competent with LTspice for electrical circuits design; Tekla, Tedds and RAM for technical steelwork or concrete design; Creo for mechanical design and drawing
- Bilingual in Chinese and English. Sports lover: half-marathon runner and regular gym goer

Referees

Prof. Ramji Venkataramanan (rv285@cam.ac.uk, Department of Engineering, Cambridge)
Prof. Ioannis Kontoyiannis (ik355@cam.ac.uk, Department of Pure Mathematics & Mathematical Statistics, Cambridge)
Dr. Ioan Stefanovici (Ioan.Stefanovici@microsoft.com, Microsoft Research Cambridge)
Dr. Richard Black (rjblack@microsoft.com, Microsoft Research Cambridge)