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Louis Sharrock

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SUMMARY

I am a senior research associate in statistical machine learning at Lancaster University. Prior to this, I was a HIMR Data Science Research Fellow at the University of Bristol. I obtained my PhD in Statistics from Imperial College London, supervised by Dr Nikolas Kantas and Professor Dan Crisan, and a BA in Mathematics from the University of Cambridge.

My research interests lie at the intersection of machine learning, optimisation, and computational statistics. My current research focuses on the development of parameter-free methods for scalable Bayesian inference, the use of score-based diffusion models for simulation based inference, and the design of efficient methods for online parameter estimation in interacting particle systems.

RESEARCH EMPLOYMENT

2022 - Present **Senior Research Associate in Statistical Machine Learning**
Department of Mathematics and Statistics, Lancaster University

2022 - Present **Research Consultant**
Heilbronn Institute for Mathematical Research

2022 - Present **Honorary Senior Research Associate**
School of Mathematics, University of Bristol

2022 **Heilbronn Data Science Research Fellow**
Department of Mathematics, University of Bristol

EDUCATION

2018 - 2022 **PhD in Statistics**
Department of Mathematics, Imperial College London
*Thesis: "*On the Theory and Applications of Stochastic Gradient Descent in Continuous Time."
Supervisor: Dr Nikolas Kantas, Professor Dan Crisan.

2017 - 2018 **MRes in Mathematics (Distinction - 93%)**
Department of Mathematics, Imperial College London
Thesis: "Large Scale Inference with Applications to Environmental Monitoring." (91%)
Supervisor: Dr Nikolas Kantas.

2016 - 2017 **MSc in Statistics (Distinction - 80%)**
Department of Mathematics, Imperial College London
Thesis: "An Application of Bayesian Networks to Yield Prediction in Portuguese Viticulture." (91%)
Supervisor: Dr Ben Calderhead.

2013 - 2016 **BA (Hons) in Mathematics (2.1)**
Emmanuel College, University of Cambridge
CATAM Computational Project: 98% (2nd year), 95% (3rd year).

PUBLICATIONS

2023 **L. Sharrock**, L. Mackey, C. Nemeth (2023). Learning Rate Free Bayesian Inference in Constrained Domains. *To appear in Proceedings of the 37th Conference on Neural Information Processing Systems (NeurIPS).* **arXiv**.

2023 **L. Sharrock**, C. Nemeth (2023). Coin Sampling: Gradient-Based Bayesian Inference without Learning Rates. *Proceedings of the 40th International Conference on Machine Learning (ICML),* Hawaii. **Link**.

2023 **L. Sharrock**, N. Kantas., P. Parpas, and G.A. Pavliotis (2023). Online Parameter Estimation for the Stochastic McKean-Vlasov Equation. *Stochastic Process and their Applications,* 162, 481-546. **DOI**.

2023 **L. Sharrock** and N. Kantas (2023). Two Timescale Stochastic Gradient Descent in Continuous Time with Applications to Joint Online Parameter Estimation and Optimal Sensor Placement. *Bernoulli,* 29(2), 1137-1165. **DOI**.

2023 J. Simons*, **L. Sharrock*,** S. Liu, M. Beaumont (2023). Neural Score Estimation: Likelihood Free Inference with Conditional Score Based Diffusions. *Proceedings of the 5th Symposium on Advances in Approximate Bayesian Inference (AABI),* Hawaii. **Link.**

2022 **L. Sharrock** (2022). Two-Timescale Stochastic Approximation for Bilevel Optimisation Problems in Continuous-Time Models. *Proceedings of the 39th International Conference for Machine Learning: Workshop on Continuous Time Methods for Machine Learning (ICML),* Online. **Link**.

2022 **L. Sharrock** and N. Kantas (2022). Joint Online Parameter Estimation and Optimal Sensor Placement for the Partially Observed Stochastic Advection-Diffusion Equation. *SIAM / ASA Journal on Uncertainty Quantification,* 10(1), 55-95. **DOI**.

2022 **L. Sharrock** (2022). On the Theory and Applications of Stochastic Gradient Descent in Continuous Time. *PhD Thesis, Imperial College London.* **Link**

2021 C. Leadbeater*, **L. Sharrock***, B. Coyle, and M. Benedetti (2021). F-Divergences and Cost Function Locality in Generative Modelling with Quantum Circuits. *Entropy***,** 23(10), 1281-1304. **DOI**.

In Submission

2023 **L. Sharrock**, D. Dodd, C. Nemeth (2023). CoinEM: Tuning-Free Particle-Based Variational Inference For Latent Variable Models. *In submission to AISTATS 2024.* **arXiv**.

In Preparation

2023 **L. Sharrock**, N. Kantas., P. Parpas, and G.A. Pavliotis (2023) . "Online Learning in Interacting Particle Systems using Single Trajectory Data." *In preparation for submission to Stats and Computing.*

2023 **L. Sharrock***, J. Simons*, S. Liu, M. Beaumont (2022). "Sequential Neural Score Estimation: Likelihood-Free Inference with Conditional Score Based Diffusions." *In preparation for submission to TMLR.* **arXiv**.

PRESENTATIONS

Invited Talks. . . . . .

Jul 2024 Coin Sampling: Parameter-Rate Optimisation on the Space of Probability Measures, *25th International Symposium on Mathematical Programming* (Montreal, Canada).

Mar 2024 Online Learning in McKean-Vlasov SDEs and Interacting Particle Systems using Single Trajectory Data, *SIAM Conference on Uncertainty Quantification* (Trieste, Italy).

Oct 2023 Sequential Neural Score Estimation: Likelihood-Free Inference with Conditional Score Based Diffusion Models, *Alan Turing Institute: Seminars on Simulation Based Science* (Online).

Jun 2023 Mirrors and Coins: Learning-Rate Free Methods for Bayesian Inference in Constrained Domains, *OxCSML Seminar, Oxford University* (Oxford, UK).

Jun 2023 Online Learning in McKean-Vlasov SDEs and Interacting Particle Systems using Single Trajectory Data, *Stochastic Analysis and Algorithms Seminar, Wuhan University* (Online).

Mar 2023 Coin Sampling: Gradient-Based Bayesian Inference without Learning Rates, *BayesComp 2023* (Levi, Finland).

Feb 2023 Particle Based Methods for Online ParameterEstimation in McKean-Vlasov Stochastic Differential Equations, *SIAM Conference on Computational Science and Engineering* (Amsterdam, The Netherlands).

Mar 2022 Parameter Estimation for the McKean Stochastic Differential Equation, C*omputational Statistics and Machine Learning Seminars*, *Lancaster University* (Lancaster, UK).

Mar 2022 Parameter Estimation for Weakly Interacting Particle Systems and Stochastic McKean-Vlasov Processes, *Statistics Seminars, University of Bristol* (Bristol, UK).

Contributed Talks and Poster Presentations . . . . . .

Jun 2023 Coin Sampling: Gradient-Based Bayesian Inference without Learning Rates, *Workshop on Distance Based Methods in Machine Learning, University College London* (London, UK).

Aug 2021 Parameter Estimation for Stochastic McKean-Vlasov Equations, *Joint Statistical Meetings* 2021 (Online).

Jul 2021 Parameter Estimation for Weakly Interacting Particle Systems and Stochastic McKean-Vlasov Processes, *Bernoulli-IMS 10th World Congress in Probability and Statistics* (Online).

Jun 2020 Two Timescale Stochastic Gradient Descent in Continuous Time with Applications to Joint Online Parameter Estimation and Optimal Sensor Placement*, Mathematics of Data Science Conference* (Online)

Nov 2019 Large Scale Inference with Applications to Environmental Monitoring, *MATHMET 2019 International Conference* (Lisbon, Portugal).

Nov 2019 Joint Online Parameter Estimation and Optimal Sensor Placement with Applications to a Stochastic Advection Diffusion Equation, *Conference on Big Data, Data Assimilation and Uncertainty Quantification, Institut Henri Poincaré* (Paris, France).

Nov 2019 Large Scale Inference and Optimal Design with Applications to Environmental Monitoring, *The Postgraduate Institute Conference, National Physical Laboratory* (Teddington, UK).

Jul 2019 Online Parameter Estimation in Continuous Time with Applications to a Stochastic Advection Diffusion Equation, *Workshop on Stochastic Parameterisations and Their Use in Data Assimilation, Imperial College London* (London, UK).

May 2019 Large Scale Inference with Applications to Environmental Monitoring, *Postgraduate Forum, Imperial College London* (London, UK).

Nov 2018 An Application of Bayesian Networks to Yield Prediction in Portuguese Viticulture, *6th Annual BayesiaLab Conference* (Chicago, USA).

PRIZES, AWARDS, AND FUNDING

Prizes and Awards

2023 **Yael Dowker Prize (proxime accessit).** *Department of Mathematics, Imperial College London.* Prize awarded for the best Maths PhD Thesis.

2020 **Doris Chen Merit Award.** *Department of Mathematics, Imperial College London.* Prize awarded to recognise exceptional early promise, progress and achievement in PhD studies.

2019 **Best Poster Prize, Statistics Section, Postgraduate Forum.** *Department of Mathematics, Imperial College London.*

2018 **MRes Student of The Year.** *Centre for Doctoral Training, Mathematics of Planet Earth, Imperial College London. P*rize awarded to the best overall student on the course.

2013 - 2016 **BP STEM Scholarship.** *University of Cambridge. N*ational scholarship awarded to ten STEM students each year.

2013 **Rowley Mainhood Award.** *Emmanuel College, University of Cambridge.* Award recognising outstanding achievement in pre-admission examinations.

Research Funding

2023 **G-Research Early Career Research Grant.** *G-Research, London.* A grant for early career researchers, awarded to enable high quality, innovative research in a quantitative discipline.

2021 **Doris Chen Mobility Fund.** *Department of Mathematics, Imperial College London.* A fund providing travel and subsistence for a PhD student with exceptional potential to take their research to another university abroad.

2018 **CliMathParis Travel Grant.** *Institut Henri Poincaré.* A grant to fund attendance at the CliMathParis 2019 conference on big data, data assimilation, and uncertainty quantification.

2017 **Warner Prize.** *Statistics Section, Department of Mathematics, Imperial College London.* A prize awarded to support a talented MSc statistics student further develop their research project.

TEACHING EXPERIENCE

Teaching

2023 **Instructor, School of Mathematics, University of Bristol**
- Designed and lectured a new unit on statistical machine learning for third year undergraduates.
- Responsibilities included writing and delivering lectures, supervising computer labs, writing and marking coursework and exams.

2018 - 2021 **Graduate Teaching Assistant, Imperial College London**
- Supported teaching of undergraduate and postgraduate courses in probability, statistics, and machine learning, including group tutorials and lecturing.
- Courses include *Data and Uncertainty* (Masters), *Computational Statistics* (Masters), *Probability and Statistics* (1st Year Undergraduate).

Other

2014 - 2023 **Mathematics Tutor, MyTutor.**
- Provided one-to-one tutorials to secondary school, undergraduate, and postgraduate students.
- Completed over 850 hours of lessons, with 175 five-star reviews.
- Awarded 'premium tutor' status to reflect 'impressive expertise and experience'

2014 - 2015 **Mathematics Teaching Assistant, STIMULUS.**
- Volunteered as a mathematics teaching assistant at a secondary school in Cambridge during undergraduate studies as part of the STIMULUS program.

2014 **English Language Teacher, Oxbridge Intercultural Programmes**
- Worked as an English language teacher as part of a 4 week residential program at Jinju Health College, South Korea.
- Wrote and delivered English lessons (30 hours per week) to a class of Korean students, achieving highest class average (82%) among all advanced classes on the program.

OTHER RELEVANT EXPERIENCE

Research

May - Aug 2021 **Quantum Machine Learning Scientist, Cambridge Quantum Computing**
- Research on new methods for mitigating exponentially vanishing gradients ('barren plateaus') in Quantum Neural Networks.
- Supervised by Marcello Benedetti and Mattia Fiorentini.

Miscellaneous

2019 - 2021 **Academic Editor, AsiaEdit**
- Edited academic papers, articles, and grant proposals relating to Machine Learning and Statistics.

2018 - 2021 **Statistics Postgraduate Student Representative, Imperial College London.**
- Represented views of students in academic & pastoral matters; organised social activities for staff and students.

2015 **Investment Banking Summer Analyst, Lazard**
- Prepared pitch-book materials for client meetings, including financial analysis, market research, valuation models, and due diligence.

ACADEMIC SERVICE

Conference & Workshop Organisation

Dec 2023 **Workshop Co-Organiser.** *RSS Workshop on Gradient Flows for Sampling, Learning and Inference.*

Mar 2022 **Workshop Co-Organiser.** *Heilbronn Institute of Mathematical Research: Internal Workshop on Neural Networks.*

May 2021 **Conference Co-Organiser.** *4th Annual MPE CDT Symposium on Wellbeing, Inclusivity, Diversity and Equality in STEM* (Virtual).

Peer Review

2023 - present **Reviewer.** *Conference on Artificial Intelligence and Statistics (AISTATS).*

2022 - present **Reviewer.** *Journal of the Royal Statistical Society (Series B: Methodology)*

2022 - present **Reviewer.** *Annales de l'Institut Henri Poincaré.*

2021 - present **Reviewer.** *Bernoulli.*

OTHER RELEVANT SKILLS

Computing

Programming Languages. Python, R, MATLAB.

Programming Packages. PyTorch, Jax, TensorFlow.

Document Markup Languages. LaTeX, HTML.

Version Control Software. Git.