Louis Sharrock

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SUMMARY

Senior Research Associate in Statistical Machine Learning at Lancaster University. Previously HIMR Data Science Research Fellow at the University of Bristol. PhD in Statistics from Imperial College London, and MA in Mathematics from the University of Cambridge.

Research interests include machine learning, optimisation, and computational statistics, with a particular focus on likelihood-free inference and stochastic gradient MCMC. Current research focuses on the development of new algorithms for high dimensional Bayesian inference, score-based methods for likelihood-free inference, and online parameter estimation for mean-field equations.

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."

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 Bayesian Viticulture." (91%)
Supervisor: Dr Ben Calderhead.

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

PUBLICATIONS

2023 **L. Sharrock**, D. Dodd, C. Nemeth (2023). "CoinEM: Tuning-Free Particle-Based Variational Inference For Latent Variable Models." *In Review.* https://arxiv.org/abs/2305.14916.

2023 **L. Sharrock**, L. Mackey, C. Nemeth (2023). "Learning Rate Free Bayesian Inference in Constrained Domains." *In Review.* https://arxiv.org/abs/2305.14943.

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 2023), Hawaii.* https://arxiv.org/abs/2301.11294.

2023 **L. Sharrock**, N. Kantas., P. Parpas, and G.A. Pavliotis (2021). "Online Parameter Estimation for the Stochastic McKean-Vlasov Equation." *Stochastic Process and their Applications* (In Press). https://arxiv.org/abs/2106.13751.

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. https://doi.org/10.3150/22-BEJ1493.

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 (ICML) Workshop on Continuous-Time Methods for Machine Learning.*

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. https://doi.org/10.1137/20M1375073.

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. https://doi.org/10.3390/e23101281.

In Submission

2023 J. Simon, **L. Sharrock*,** S. Liu, M. Beaumont (2023). "Neural Score Estimation: Likelihood Free Inference with Conditional Score Based Diffusions." *In submission to the 5th Symposium on Advances in Approximate Bayesian Inference (AABI).*

2023 **L. Sharrock**, J. Simons, S. Liu, M. Beaumont (2022). "Sequential Neural Score Estimation: Likelihood-Free Inference with Conditional Score Based Diffusions." *arXiv preprint:* https://arxiv.org/abs/2210.04872.

In Preparation

2023 **L. Sharrock**, N. Kantas., P. Parpas, and G.A. Pavliotis (2023) . "Online Learning in McKean-Vlasov SDEs and Interacting Particle Systems using Single Trajectory Data.'' In preparation.

* denotes joint first authorship.

PRESENTATIONS

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

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

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

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

Mar 2022 **Invited Talk,** "Parameter Estimation for the McKean Stochastic Differential Equation", *Computational Statistics and Machine Learning Seminars*, *Lancaster University* (Lancaster, UK).

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

Aug 2021 **Contributed Talk,** "Parameter Estimation for Stochastic McKean-Vlasov Equations", *Joint Statistical Meetings* 2021 (Virtual)**.**

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

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

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

Nov 2019 **Contributed Talk,** "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,* CliMathParis 2019 (Institut Henri Poincaré, Paris, France).

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

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

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

PRIZES AND AWARDS

Student Prizes . . . . . .

2023 **Yael Dowker Prize (runner-up).** *Department of Mathematics, Imperial College London.* A prize awarded for the best Maths PhD Thesis.

2020 **Doris Chen Merit Award (shortlisted).** *Department of Mathematics, Imperial College London.* A 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.* A prize awarded to the best overall student on the course.

2013 - 2016 **BP STEM Scholarship.** *University of Cambridge.* A national scholarship of £5000/annum, awarded to ten STEM students each year.

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

Research Funding

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.

2014 - present **Mathematics Tutor, Online (MyTutor)**
- Deliver one-to-one tutorials to secondary school, undergraduate, and postgraduate students. Over 850 hours of lessons, 175 five-star reviews.
- Awarded 'premium tutor' status to reflect 'impressive expertise and experience'

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 included Data and Uncertainty (postgraduate), Computational Statistics (postgraduate), Probability and Statistics (undergraduate)

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

2014 **English Language Teacher, Jinju Health College, South Korea**
- Planned and led English lessons (30 hours p.w.) for a class of Korean students.
- Achieved highest test average (82%) among all 'advanced' classes.

- Provided personal academic and pastoral support outside of teaching hours.

OTHER RELEVANT EXPERIENCE

Research

Nov 2021 **Visiting Researcher, Department of Statistics, Boston University**
- Research visit funded by The Doris Chen Mobility Fund.

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

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

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

Peer Review

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 (advanced), R (advanced), MATLAB (proficient), C (proficient).

Programming Packages. PyTorch (advanced), Jax (advanced), TensorFlow (proficient).

Document Markup Languages. LaTeX (advanced), HTML (basic).

Version Control Software. Git.