Dr. Abdul-Lateef Haji-Ali

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Research Interests Uncertainty Quantification, Numerical Analysis, Machine Learning, Stochastic Differential Equation, Numerical methods for SDEs and SPDEs, Multilevel Monte Carlo, Particle systems, Crowd modelling, Mean-field theory, Sparse Grids, Combination techniques, Multi-index techniques, Inverse problems.

Education

King Abdullah University of Science and Technology (KAUST), Saudi Arabia

PhD, Applied Mathematics, December 2012 to May 2016

Thesis Title: *Efficient Multilevel and Multi-index Sampling Methods in Stochastic Differential Equations*

MSc, Applied Mathematics, September 2010 to December 2012

Thesis Title: *Pedestrian Flow in the Mean-field Limit*

Arab International University, Damascus, Syria

BSc, Informatics Engineering, September 2005 to August 2010

Employment History

Maxwell Institute for Mathematical Sciences and School of Mathematical and Computer Sciences, Heriot–Watt University, Edinburgh, United Kingdom
- Associate Professor, 01 August 2022, ongoing.
- Assistant Professor, 03 January 2019 to 31 July 2022.

Mathematical Institute, University of Oxford, United Kingdom
- Hooke Research Fellowship, 05 September 2016 to 31 December 2018.

St. Anne's College, University of Oxford, United Kingdom
- College Association, January 2017 to 31 December 2018.

Refereed Journal Publications

1. N. B. Rached, A.-L. Haji-Ali, M. Shyam, and R. Tempone. "Multilevel Importance Sampling for McKean-Vlasov Stochastic Differential Equation". In: *Statistics and Computing* 35.1 (Nov. 2024), p. 1. ISSN: 1573-1375. DOI: 10.1007/s11222-024-10508-3.
2. N. Ben Rached, A.-L. Haji-Ali, S. M. Subbiah Pillai, and R. Tempone. "Double-loop importance sampling for McKean–Vlasov stochastic differential equation". In: *Statistics and Computing* 34.6 (2024), pp. 1–25. DOI: 10.1007/s11222-024-10497-3.
3. **M. B. Giles and A.-L. Haji-Ali. "Multilevel Path Branching for Digital Options". In: *Annals of Applied Probability* 34.5 (2024), pp. 4836–4862. ISSN: 1050-5164. DOI: 10.1214/24-AAP2083.**
4. E. Ben Amar, N. Ben Rached, A.-L. Haji-Ali, and R. Tempone. "State-dependent importance sampling for estimating expectations of functionals of sums of independent random variables". In: *Statistics and Computing* 33.2 (Feb. 2023). ISSN: 0960-3174, 1573-1375. DOI: 10.1007/s11222-022-10202-2.

5. M. B. Giles and A.-L. Haji-Ali. "Subsampling and other considerations for efficient risk estimation in large portfolios". In: *Journal of Computational Finance* 26.1 (June 2022). ISSN: 1460-1559, 1755-2850. DOI: 10.21314/jcf.2022.019.

6. A.-L. Haji-Ali, J. Spence, and A. L. Teckentrup. "Adaptive Multilevel Monte Carlo for Probabilities". In: *SIAM Journal on Numerical Analysis* 60.4 (Aug. 2022), pp. 2125–2149. ISSN: 0036-1429, 1095-7170. DOI: 10.1137/21m1447064.

7. N. Ben Rached, A.-L. Haji-Ali, G. Rubino, and R. Tempone. "Efficient importance sampling for large sums of independent and identically distributed random variables". In: *Statistics and Computing* 31.6 (Oct. 2021). ISSN: 0960-3174, 1573-1375. DOI: 10.1007/s11222-021-10055-1.

8. A.-L. Haji-Ali, F. Nobile, R. Tempone, and S. Wolfers. "Multilevel weighted least squares polynomial approximation". In: *ESAIM: Mathematical Modelling and Numerical Analysis* 54.2 (Mar. 2020), pp. 649–677. ISSN: 0764-583X, 1290-3841. DOI: 10.1051/m2an/2019045.

9. **M. B. Giles and A.-L. Haji-Ali. "Multilevel Nested Simulation for Efficient Risk Estimation". In: *SIAM/ASA Journal on Uncertainty Quantification* 7.2 (Jan. 2019), pp. 497–525. ISSN: 2166-2525. DOI: 10.1137/18m1173186.**

10. A.-L. Haji-Ali, H. Harbrecht, M. Peters, and M. Siebenmorgen. "Novel results for the anisotropic sparse grid quadrature". In: *Journal of Complexity* 47 (Aug. 2018), pp. 62–85. ISSN: 0885-064X. DOI: 10.1016/j.jco.2018.02.003.

11. A.-L. Haji-Ali and R. Tempone. "Multilevel and Multi-index Monte Carlo methods for the McKean–Vlasov equation". In: *Statistics and Computing* 28.4 (Sept. 2017), pp. 923–935. ISSN: 0960-3174, 1573-1375. DOI: 10.1007/s11222-017-9771-5.

12. A.-L. Haji-Ali, F. Nobile, L. Tamellini, and R. Tempone. "Multi-Index Stochastic Collocation for random PDEs". In: *Computer Methods in Applied Mechanics and Engineering* 306 (July 2016), pp. 95–122. ISSN: 0045-7825. DOI: 10.1016/j.cma.2016.03.029.

13. **A.-L. Haji-Ali, F. Nobile, L. Tamellini, and R. Tempone. "Multi-index Stochastic Collocation Convergence Rates for Random PDEs with Parametric Regularity". In: *Foundations of Computational Mathematics* 16.6 (Aug. 2016), pp. 1555–1605. ISSN: 1615-3375, 1615-3383. DOI: 10.1007/s10208-016-9327-7.**

14. **A.-L. Haji-Ali, F. Nobile, and R. Tempone. "Multi-index Monte Carlo: When sparsity meets sampling". In: *Numerische Mathematik* 132.4 (June 2015), pp. 767–806. ISSN: 0029-599X, 0945-3245. DOI: 10.1007/s00211-015-0734-5.**

15. A.-L. Haji-Ali, F. Nobile, E. von Schwerin, and R. Tempone. "Optimization of mesh hierarchies in multilevel Monte Carlo samplers". In: *Stochastics and Partial Differential Equations Analysis and Computations* 4.1 (June 2015), pp. 76–112. ISSN: 2194-0401, 2194-041X. DOI: 10.1007/s40072-015-0049-7.

16. **N. Collier, A.-L. Haji-Ali, F. Nobile, E. von Schwerin, and R. Tempone. "A continuation multilevel Monte Carlo algorithm". In: *BIT Numerical Mathematics* 55.2 (Sept. 2014), pp. 399–432. ISSN: 0006-3835, 1572-9125. DOI: 10.1007/s10543-014-0511-3.**

Preprints

17. A.-L. Haji-Ali, H. Hoel, and A. Petersson. *The multi-index Monte Carlo method for semilinear stochastic partial differential equations*. 2025. DOI: 10.48550/arxiv.2502.00393. arXiv: 2502.00393 [math.NA].
18. A.-L. Haji-Ali, M. Pereyra, L. Shaw, and K. Zygalakis. *Bayesian computation with generative diffusion models by Multilevel Monte Carlo*. 2024. DOI: 10.48550/arxiv.2409.15511. arXiv: 2409.15511 [stat.CO].
19. N. B. Rached, A.-L. Haji-Ali, R. Tempone, and L. Wilkosz. *Forward Propagation of Low Discrepancy Through McKean-Vlasov Dynamics: From QMC to MLQMC*. 2024. DOI: 10.48550/arxiv.2409.09821. arXiv: 2409.09821 [math.NA].
20. A.-L. Haji-Ali and A. Stein. *An Antithetic Multilevel Monte Carlo-Milstein Scheme for Stochastic Partial Differential Equations*. 2023. DOI: 10.48550/arxiv.2307.14169. arXiv: 2307.14169 [math.NA].
21. M. B. Giles, A.-L. Haji-Ali, and J. Spence. *Efficient Risk Estimation for the Credit Valuation Adjustment*. 2023. DOI: 10.48550/arxiv.2301.05886. arXiv: 2301.05886 [q-fin.CP].
22. A.-L. Haji-Ali, H. Hoel, and R. Tempone. *Weak convergence analysis in the particle limit of the McKean–Vlasov equations using stochastic flows of particle systems*. 2023. DOI: 10.48550/arxiv.2101.00886. arXiv: 2101.00886 [math.PR].
23. N. B. Rached, A.-L. Haji-Ali, S. M. S. Pillai, and R. Tempone. *Multi-index Importance Sampling for McKean-Vlasov Stochastic Differential Equation*. 2023. DOI: 10.48550/arxiv.2307.05149. arXiv: 2307.05149 [math.NA].

Awards and Fellowships

- Second-place Leslie Fox Prize, June 2019.
- Fulford Non-stipendiary Junior Research Fellowship, Somerville College, University of Oxford, October 2017 to December 2019.
- Hooke Research Fellowship, Mathematical Institute, University of Oxford, September 2016 to December 2019.
- King Abdullah University of Science and Technology Fellowship 2010.
- Academic Excellence Award, King Abdullah University of Science and Technology 2010.

Grants

- Co-Investigator, Knowledge Transfer Partnership and Scottish Whisky Research Institute, Project: "Whisky Colour: correlating human perception and UV-vis spectroscopy", 1 January 2025 to 31 December 2026. Cost to funders: £147K.
- Principal Investigator, Project Grant, Defence Science and Technology Laboratory, Project: "DSTL: Maths for Defence – Recreating Time Series from Alan Deviation", 1 December 2022 to 20 March 2023. Cost to funder: £47K.
- Principal Investigator, Royal Society of Edinburgh Research Grant, Project: "Accelerating the Monte Carlo Method for Detecting Orbital Collisions", 1 May 2019 to 30 April 2020. Cost to funder: £65K.
- Co-Investigator, Knowledge Transfer Partnership, Project: "Putting the Smart into Sensing and Imaging", 24 July 2023 to 23 July 2026. Cost to funder: £295K.
- Co-Investigator, Medical Research Council, Project: "Project: Reliable and Efficient Estimation of the Economic Value of medical Research (REEEVR)", 1 Apr 2022 - 30 Sep 2023, Cost to funder: £337K.
- Co-Investigator, Medical Research Council, Project: "What is the value of adaptive designs? Estimating expected value of sample information for adaptive trial designs", 1 Dec 2019 to 31 May 2022, Cost to funder: £408K.

PhD Supervision

First supervisor:

- Jonathan Spence, 2019-2023, Thesis title: "*Hierarchical and adaptive methods for accurate and efficient risk estimation*", Maxwell Institute, Heriot-Watt University.
- Ian Powell, 2022-ongoing, Maxwell Institute, Heriot-Watt University.

Co-supervisor:

- Anastasia Istratuca, 2021-ongoing, Maxwell Institute, University of Edinburgh, First supervisor: Dr. Aretha Teckentrup.
- Nida Siddiqui, 2021-ongoing, First supervisor: Dr. Haslifah Hasim, Heriot–Watt University.
- Sara Helal, 2022-ongoing, Maxwell Institute, University of Edinburgh, First supervisor: Dr. Victor Elvira.
- Bernhard Heinzelreiter, 2023-ongoing, Maxwell Institute, University of Edinburgh, First supervisor: Prof. John Pearson.

Selected Teaching Experience

- **Project supervision** for PhD and MSc students, Heriot–Watt University and University of Edinburgh.
- **Programme director**. "MSc in Financial Mathematics", Heriot–Watt University joint with University of Edinburgh.
- **MSc course**. "Advanced Derivative Pricing", Heriot–Watt University.
- **MSc course**. "Statistical Machine Learning", Heriot–Watt University.
- **MSc course**. "Risk Theory", Heriot–Watt University.
- **MSc course**. "Machine Learning for Risk and Insurance II", Heriot–Watt University.
- **Short course**. "Specialist 03: Monte Carlo simulations", InFoMM CDT, University of Oxford, March 2018.
- **Tutor** "Stochastic Differential Equations", Mathematical Institute, University of Oxford, October to November 2017 and 2018.
- **Tutor** "Differential Equations", St. Anne's College, University of Oxford, October to November 2017.
- **Tutor** "Constructive Maths", St. Anne's College, University of Oxford, May 2017.
- **Tutor** "Martingale Through Measure Theory", Mathematical Institute, University of Oxford, May 2017 and October to November 2018.
- **Tutor** "Differential Equations II", St. Anne's College, University of Oxford, January to July 2017 and 2018.
- **Tutor** "Numerical Analysis", St. Anne's College, University of Oxford, January to July 2017 and 2018.
- **Project supervisor** "Multilevel Hierarchical Markov Chain Monte Carlo", Centre for Doctoral Training in Mathematical Institute, University of Oxford, January 2017.
- **Short course**. "`mimclib`: A Python library for MLMC and MIMC", UQ School, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, May 2016.

Academic Leadership

- Academic Cohort Director of MAC-MIGS Centre for Doctoral Training, 2019-ongoing.
- Associate Editor for Springer's Statistics and Computing, 2023-ongoing.
- Heriot-Watt Coordinator for Centre of Statistics in University of Edinburgh, 2024-ongoing.
- Member of the Applied Probability Section Committee of the Royal Statistical Society, 2024-ongoing.
- Programme Director for Financial Mathematics MSc in School of Mathematical and Computer Science, Heriot-Watt University, 2022-2024.
- EDI officer for MAC-MIGS Centre for Doctoral Training, 2019-2021.

Technical Skills Proficient in C, C++, Python, TEX, UNIX shell scripting, GNU make, Lisp, MySQL, MATLAB. Basic experience in C#, Javascript and Mathematica.

Research Visits

- Chair of Numerical Analysis and UQ, Heidelberg University, September 2024.
- Junior Research Group on Uncertainty Quantification, Karlsruhe Institute of Technology, September 2024.
- UQ Chair, RWTH Aachen, December 2023.
- Isaac Newton Institute, Cambridge, United Kingdom, June 2023.
- Heilbronn Focused Research Group, "UQ For SciML", Dundee, United Kingdom, May 2022.
- UQ Chair, RWTH Aachen, December 2022.
- Isaac Newton Institute, Cambridge, United Kingdom, April 2022.
- University of Dundee, United Kingdom, May 2022.
- Isaac Newton Institute, Cambridge, United Kingdom, April 2018.
- École Polytechnique Fédérale de Lausanne, Switzerland, July 2017.
- RWTH Aachen University, Germany, June 2017.
- École Polytechnique Fédérale de Lausanne, Switzerland, April 2016.
- École Polytechnique Fédérale de Lausanne, Switzerland, August 2015.
- University of Pavia, Pavia, Italy, July 2015.
- Königlich Technische Hochschule, Stockholm, Sweden, June 2015.
- University of Austin, Austin, Texas, USA, July 2014.
- Universidad de la República, Montevideo, Uruguay, December 2013.
- University of Austin, Austin, Texas, USA, June 2013.

Selected Outreach

Organization:

- Co-organized mini-symposium "Decision making under uncertainty" in BAMC, April 2022.
- Co-organized mini-symposium "Monte Carlo methods for discontinuous functions" in MCM 2021.
- Co-organized mini-symposium "Theory and Applications of Particle Systems" in MCM 2021.
- Co-organized SIAM UKIE annual meeting, January 2019.
- Co-organized mini-symposium: "Forward and inverse UQ with hierarchical models", MCQMC, Rennes, France, United Kingdom, July 2018.
- Co-organized mini-symposium: "Numerical Methods for PDEs in Uncertainty Quantification", SciCADE, University of Bath, United Kingdom, September 2017.

Invited Talks and Seminars:

- Upcoming plenary talk, SNIPSS 2025 - "Stochastic Numerics and Inverse Problems in Southern Sweden", Linnaeus University, Växjö, Sweden, August 2025.
- "Computational Mathematics and Applications Seminar", Mathematical Institute, Oxford, January 2025.
- "Mathematical Physics and Harmonic Analysis Seminar", Texas A&M University, College Station, December 2024.
- "Probability Seminar", University of Leeds, November 2024.
- "Modern Applied and Computational Mathematics (MACM) Seminar", Karlsruhe Institute of Technology, Germany, September 2024.
- "The Linnaeus University Workshop on S(P)DEs, their numerics and applications", Linnaeus University, Växjö, Sweden, December 2023.
- "Workshop on Monte Carlo methods in Warsaw", Poland, December 2023.
- "ERA Seminar", Technische Universität München, Germany, December 2022.
- "Stochastic Numerics and Statistical Learning: Theory and Applications Workshop",

Online, May 2022.
- "Multilevel and multifidelity sampling methods in UQ for PDEs", Vienna, Austria, May 2022.
- "British Applied Mathematics Colloquium", Loughborough University, United Kingdom, April 2022.
- University of Dundee, School of Science and Engineering, United Kingdom, October 2021.
- "Applied Maths Seminar", University of Leicester, Online, February 2021.
- "AvH RWTH UQ: hybrid seminar", Online, February 2021.
- "LMS/MAC-MIGS Workshop on Inverse Problems and Optimisation for PDEs", Online, May 2020.
- "One World Stochastic Numerics and Inverse Problems", Online, May 2020.
- "Multilevel and multifidelity sampling methods in UQ for PDEs", Online, May 2020.

Other Talks:
- "SIAM Conference on Uncertainty Quantification", Trieste, Italy, February 2024.
- MCQMC, Linz, Austria, July 2022.
- MCM, Mannheim, Germany, August 2021.
- MCQMC, Renne, France, July 2018.
- UNQW03, "Reducing dimensions and cost for UQ in complex systems", Isaac Newton Institute, Cambridge, United Kingdom, March 2018.
- BIRS, "Computational Uncertainty Quantification", Banff, Canada, October 2017.
- LMS-EPSRC Symposium, "Model Order Reduction", Durham, August 2017.
- MCM2017, Montreal, July 2017.
- Applied maths seminar, University of Warwick, December 2016.
- Numerical analysis seminar, University of Bath, November 2016.
- UQ Summer School, WIAS Berlin, September 2016.
- SIAM UQ, Lausanne, April 2016.