Darrick Lee

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Academic Employment

09/2022 - present **Postdoctoral Researcher in the Mathematical Foundations of Data Science**
University of Oxford
Advisor: Prof. Harald Oberhauser

08/2021 - 08/2022 **Postdoctoral Researcher**, École Polytechnique Fédérale de Lausanne (EPFL)
Advisor: Prof. Kathryn Hess

Education

2021 **Ph.D.** Applied Mathematics and Computational Sciences, University of Pennsylvania
Advisor: Prof. Robert Ghrist

2018 **M.A.** Applied Mathematics and Computational Sciences, University of Pennsylvania

2016 **B.A.Sc.** Engineering Physics (Electrical Option), University of British Columbia
Minor: Honors Mathematics

Research Interests

applications of higher algebra/geometry in analysis, signature methods for functional data

Publications / Refereed Conference Proceedings

* denotes equal contribution.

7. C. Giusti, **D. Lee**, *Signatures, Lipschitz-free spaces, and paths of persistence diagrams*, SIAM Journal on Applied Algebra and Geometry, 2023+. (accepted for publication, preprint link)
6. X. Xu, **D. Lee**, N. Drougard, R. N. Roy, *Signature methods for brain-computer interfaces*, Scientific Reports, 2023+. (accepted for publication, preprint link)
5. C. Améndola, **D. Lee**, C. Meroni, *Convex hulls of curves: volumes and signatures*, Proceedings of Geometric Science of Information (GSI'23), 2023. (to appear, arXiv:2301.09405)
4. C. Toth*, **D. Lee***, C. Hacker, H. Oberhauser, *Capturing graphs with hypo-elliptic diffusions*, NeurIPS, 2022. (link)
3. C. Giusti, **D. Lee**, *Iterated integrals and population time series analysis*, Proceedings of the Abel Symposium, 2020. (link)
2. **D. Lee** and A. Schnyder, *Structure of vortex-bound states in spin-singlet chiral superconductors*, Physical Review B. 93: 064522, 2016. (link)
1. R. Froese, **D. Lee**, C. Sadel, W. Spitzer and G. Stolz, *Localization for transversally periodic random potentials on binary trees*, Journal of Spectral Theory. 6: 557-600, 2016. (link)

Preprints, Submitted and In Preparation

6. **D. Lee** and H. Oberhauser, *Random surfaces and higher algebra*, 2023. (preprint, arXiv:2311.08366)
5. **D. Lee** and H. Oberhauser, *The signature kernel*, 2023. (book chapter in review, arXiv:2305.04625)
4. Y. Cheng, **D. Lee**, H. Oberhauser, H. Li, *Generalized time-series data classification via component decomposition and alignment*, 2023. (submitted)
3. C. Giusti, **D. Lee**, V. Nanda, H. Oberhauser, *A topological approach to mapping space signatures*, preprint, 2022. (submitted, arXiv:2202.00491)
2. **D. Lee**, R. Ghrist, *Path signatures on Lie groups*, preprint, 2020. (arXiv:2007.06633)
1. D. Bhaskar, **D. Lee**, H. Knútsdóttir, C. Tan, M. Zhang, P. Dean, C. Roskelley, L. Edelstein-Keshet, *A methodology for morphological feature extraction and unsupervised cell classification*, preprint, 2016. (biorXiv:623793v1)

Awards and Honors

2018 - 2021	NSERC Postgraduate Scholarship - Doctoral (PGS-D3)
2018	Good Teaching Award, Department of Mathematics, University of Pennsylvania
2016 - 2021	Benjamin Franklin Fellowship, University of Pennsylvania
2016 - 2017	Fulbright Canada Student Award
2014, 2015	NSERC Undergraduate Student Research Award (USRA)

Research Visits

06/2023	Research Visitor, *MPI for Mathematics, Bonn* (under Prof. Camilo Arias Abad)
06/2022	Research Visitor, *University of Oxford* (under Prof. Harald Oberhauser)
03/2022	Research Visitor, *MPI for Mathematics in the Sciences* (under Prof. Bernd Sturmfels)
05 - 07/2020	Research Visitor, *University of Oxford* (under Prof. Vidit Nanda) *(Cancelled due to COVID-19)*

Recent Invited Seminar and Conference Talks

† denotes online talk.
MS denotes minisymposium.

08/2023	*Structural aspects of signatures and rough paths*, Oslo, Norway
08/2023	†*ICIAM 2023 MS (Integrating rough paths into domain applications)*, Tokyo, Japan
07/2023	*SIAM Applied Algebra & Geometry MS (Applied Topology)*, Eindhoven, Netherlands
06/2023	*Graph Signal Processing Workshop 2023*, Oxford, UK
06/2023	*Higher Geometry Seminar*, MPI for Mathematics, Bonn, Germany
03/2023	†*GEOTOP-A: Web-Seminar Series on Application of Geometry and Topology*
12/2022	*Oxford-Berlin Young Researchers' Meeting on Applied Stochastic Analysis*, Oxford, UK
11/2022	*Stochastic Analysis and Mathematical Finance Seminar*, Oxford, UK
11/2022	†*Algebraic and Combinatorial Perspectives in the Mathematical Sciences*, online
10/2022	*Rough Paths, Algebraic Structures, and Machine Learning*, Kristiansand, Norway
09/2022	*4th IMA Conference on the Mathematical Challenges of Big Data*, Oxford, UK
09/2022	*New Interfaces of Stochastic Analysis and Rough Paths, BIRS Workshop*, Banff, Canada
07/2022	†*Rough Analysis and Data Science Workshop*, Imperial College London, UK
07/2022	†*SIAM Annual Meeting (Signatures, Kernels and Applications)*, Pittsburgh, USA
06/2022	†*SPDEs Seminar*, TU Berlin, Germany
06/2022	†*Persistence, Sheaves and Homotopy Online Seminar*
05/2022	†*Probability, Stochastic Analysis and Statistics in Pisa*, University of Pisa, Italy
03/2022	†*CIMDA-Oxford Seminar*, University of Oxford, UK
02/2022	*Applied Topology Seminar*, EPFL, Switzerland
12/2021	†*Applied Topology Seminar,* University of Oxford, UK
12/2021	†*Topology Seminar*, Bilkent University, Turkey
11/2021	†*Applied Topology in Albany*, University at Albany SUNY, USA
08/2021	*Berkeley Seminar*, Topos Institute, USA
05/2021	†*Geometry/Topology Seminar*, Oregon State University, USA
02/2021	†*Rough Paths Interest Group*, University of Oxford, UK
09/2020	†*Geometry and Topology Seminar*, North Carolina State University, USA
01/2020	*UF Topological Data Analysis Conference*, University of Florida, USA
11/2019	*Applied Topology Seminar*, University at Albany SUNY, USA
11/2019	*Data Science and Applied Topology Seminar*, CUNY Graduate Center, USA

Teaching Experience

Teaching Assistant - EPFL

Fall 2021 MATH 220: Metric and Topological Spaces

Co-Instructor - University of Pennsylvania

08/2020 Pre-Freshman Program
An intensive 4-week program for incoming freshman at Penn, many from low-income and/or first generation backgrounds. Alternated between teaching two classes: single variable calculus and multivariable calculus. This course was taught online.

Teaching Assistant - University of Pennsylvania

Spring 2018 MATH 241: Calculus IV (Partial Differential Equations)

Fall 2017 MATH 360: Advanced Calculus (Analysis)

Lab Teaching Assistant - University of British Columbia

Spring 2016 APSC 101: Introduction to Engineering II

Fall 2015 APSC 100: Introduction to Engineering I

Academic Activities

Mfano Africa Program (Oxford)

07 - 09/2023 **Student**: Shabani Makwaru (University of Dar es Salaam)
Project: Convex hulls and path signatures

Master's Thesis Supervision (Oxford)

05 - 09/2023 **Student**: Vaibhav Mahajan (Oxford)
Coadvisors: Prof. Terry Lyons (Oxford), Dr. Sumanth Swaminathan (Vironix Health)
Project: Ordinal classification in machine learning and chronic kidney disease

Master's Thesis Supervision (EPFL)

05 - 09/2022 **Student**: Hugo Henneuse (Institut Polytechnique de Paris/ENSAE)
Project: Orthogonal Invariants of the Mapping Space Signature

02 - 07/2022 **Student**: Karl Arthursson (KTH Royal Institute of Technology in Stockholm)
Project: Gaussian Process Methods for Static and Dynamic Persistent Homology

Undergraduate Mentorship

Fall 2021 Semester Project: Topics in Applied Algebraic Topology (Student: Xiaohan Wang)

Spring 2021 Directed Reading Program: Mathematics of Data Science (Student: Sam Rosenberg)

Fall 2020 Directed Reading Program: Causal Inference (Student: Sam Rosenberg)

Summer 2020 Independent Study: Stochastic Calculus (Student: Sam Rosenberg)

Spring 2020 Directed Reading Program: Time Series Analysis (Student: Sam Rosenberg)

Seminar Organization

2020-2021 Organizer: Graduate Student Applied Topology Seminar (UPenn)

Spring 2019 Co-organizer: Simplicial Homotopy Theory Seminar (UPenn)

2017 - 2018 Organizer: Graduate Student Applied Topology Seminar (UPenn)

Outreach and Service

2018-2021	Master TA, University of Pennsylvania Helped train, observe and select teaching assistants for the department of mathematics
2018, 2019	Volunteer, University of Pennsylvania Math Festival Coordinated, built and presented topology demonstrations (linkages, picture frame problem, 3D printed examples)
Summer 2017	Summer Discovery Camp Volunteer, Franklin Institute Science Museum Planned and presented 7 science activities for summer campers entering grades 7-9

Undergraduate Employment

05 - 08/2016	USRA Student, UBC Math Department (Vancouver, BC) **Advisor**: Prof. Leah Edelstein-Keshet **Project**: A computational pipeline for morphological cell classification
05 - 08/2015	USRA Student, Université du Québec à Montréal Math Department (Montreal, QC) **Advisor**: Prof. Steven Boyer and Prof. Dale Rolfsen **Project**: Left orderability of knot groups, branched covers, and representations
05 - 12/2014	Research Intern, Max Planck Institute for Solid State Physics (Stuttgart, Germany) **Advisor**: Prof. Andreas Schnyder **Project**: Vortex-bound states in topological superconductors
01 - 04/2013	Modeling and Simulations Intern, Robert Bosch GmbH (Stuttgart, Germany) **Project**: Simulations for micro-electromechanical system (MEMS) design
05 - 08/2012	Research Student, UBC Math Department (Vancouver, BC) **Advisor**: Prof. Richard Froese **Project**: Anderson localization in 1 dimension