Nathaël Da Costa

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Education

University of Tübingen *Tübingen, DE*

PhD in Computer Science *September 2023 - Ongoing*

A Differential Geometric Viewpoint on Probabilistic Deep Learning

University of Cambridge *Cambridge, UK*

MMath in Pure Mathematics (Part III of the Mathematical Tripos) *October 2021 - June 2022*

With Merit.

University of Cambridge *Cambridge, UK*

BA in Mathematics (Mathematical Tripos) *October 2018 - June 2021*

First Class, ranked 38th/222.

European School of Luxembourg *Kirchberg, LU*

European Baccalaureate, 92% *April 2008 - July 2018*

98% in Mathematics and Advanced Mathematics.

Experience

Nanyang Technological University *Singapore, SG*

Research Associate *January 2023 - August 2023*

Research on kernel methods on manifolds.

Dreams AI *Hong Kong, HK*

Machine Learning Intern *December 2019 - January 2020*

Studied the geometry of the space of SPD matrices.

MM Flowers *Cambridge, UK*

Data Scientist, Cambridge Mathematics Placement *June 2019 - August 2019*

Used Bayesian networks to learn from data.

Oxford Summer Courses *Cambridge, UK*

Mathematics Tutor *June 2021 - August 2021*

Taught mathematics to students from 14 to 20 years old.

Papers

Journal Publications

Invariant kernels on Riemannian symmetric spaces: a harmonic-analytic approach

Nathaël Da Costa, Cyrus Mostajeran, Juan-Pablo Ortega, Salem Said, *SIAM Journal on Mathematics of Data Science* 7 (2), 752-776, 2025.

A Theory of Generalized Coordinates for Stochastic Differential Equations

Lancelot Da Costa*, Nathaël Da Costa*, Conor Heins, Johan Medrano, Grigorios A Pavliotis, Thomas Parr, Ajith Anil Meera, Karl Friston, *Studies in Applied Mathematics* 154 (5), e70062, 2025.

Geometric Learning with Positively Decomposable Kernels

Nathaël Da Costa, Cyrus Mostajeran, Juan-Pablo Ortega, Salem Said, *Journal of Machine Learning Research* 25 (326), 1-42, 2024.

Differential Geometry with Extreme Eigenvalues in the Positive Semidefinite Cone

Cyrus Mostajeran, Nathaël Da Costa, Graham Van Goffrier, Rodolphe Sepulchre, *SIAM Journal on Matrix Analysis and Applications* 45 (2), 1089-1113, 2024.

Conference Proceedings

Rethinking Approximate Gaussian Inference in Classification

Bálint Mucsányi*, Nathaël Da Costa*, Philipp Hennig, *Advances in Neural Information Processing Systems*, 2025.

Geometric Gaussian Approximations of Probability Distributions

Nathaël Da Costa, Bálint Mucsányi, Philipp Hennig, *International Conference on Geometric Science of Information*, 125-132, 2025.

Geometric statistics with subspace structure preservation for SPD matrices
Cyrus Mostajeran, Nathaël Da Costa, Graham Van Goffrier, Rodolphe Sepulchre, *Mathematical Theory of Networks and Systems*, 2024.

The Gaussian Kernel on the Circle and Spaces that Admit Isometric Embeddings of the Circle
Nathaël Da Costa, Cyrus Mostajeran, Juan-Pablo Ortega, *International Conference on Geometric Science of Information*, 426-435, 2023.

Preprints

Sample Path Regularity of Gaussian Processes from the Covariance Kernel
Nathaël Da Costa, Marvin Pförtner, Lancelot Da Costa, Philipp Hennig, 2023, arXiv:2312.14886.

Talks

2025	**Geometric Gaussian Approximations of Probability Distributions**, International Conference on Geometric Science of Information	*Saint-Malo, Fr*
2025	**Constructive Disintegrations and their Modes**, Fundamentals of Statistical Machine Learning Group	*London, UK*
2025	**Closed-Form Last Layer Optimization**, Methods of Machine Learning Group	*Tübingen, Germany*
2025	**Overconfidence in Classification**, Methods of Machine Learning Group	*Tübingen, Germany*
2025	**Rethinking Approximate Gaussian Inference in Classification**, Workshop on Overparametrization, Regularization, and Uncertainty in Machine Learning.	*Oberwolfach, Germany*
2024	**Invariant Kernels on Homogeneous Spaces**, International Symposium on Mathematical Theory of Networks and Systems	*Cambridge, UK*
2024	**Sample Path Regularity of Gaussian Processes**, Probabilistic Numerics Workshop	*London, UK*
2024	**Weight Space Symmetries of ReLU Networks**, Methods of Machine Learning Group	*Tübingen, DE*
2024	**Gaussian Processes: Theory and Practice**, Cambridge Image Analysis Group	*Cambridge, UK*
2024	**Sample Path Regularity of Gaussian Processes**, Methods of Machine Learning Group	*Tübingen, DE*
2023	**Kernel Methods on Manifolds**, Emergent Algorithmic Intelligence Workshop	*Mainz, DE*
2023	**Kernel Methods on Manifolds**, Non-autonomous Dynamics in Complex Systems Workshop	*Dresden, DE*
2023	**The Gaussian Kernel on the Circle**, International Conference on Geometric Science of Information	*Saint-Malo, FR*
2023	**Differential Geometry with Extreme Eigenvalues in the Positive Semidefinite Cone**, International Congress on Industrial and Applied Mathematics	*Tokyo, JP*
2019	**Predicting the Lifetime of Flowers**, Cambridge Mathematics Placements	*Cambridge, UK*

Scholarships

2018-2022	**CEDIES**, Luxembourg Scholarship for academic achievement (approx. 30,000€).	*Luxembourg, LU*
2019-2022	**Churchill College Prize Scholarship**, Prize for excellent exam results (awarded in 2019, 2020, 2021, 2022).	*Cambridge, UK*

Competitions

2018	**Honorable Mention**, 59th International Mathematical Olympiad (IMO).	*Cluj Napoca, RO*
2018	**Participation**, 49th International Physics Olympiad (IPhO).	*Lisbon, PT*
2018	**Participation**, 10th Benelux Mathematical Olympiad (BxMO).	*Mersch, LU*