

Samuel Lanthaler

• [Google Scholar](#) • [ArXiv](#) • [Website](#)

Contact Information

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Employment History

Postdoc	California Institute of Technology Pasadena, CA, USA Mentor: Prof. Andrew M. Stuart	Aug 2022 – present
Postdoc/ Lecturer	ETH Zürich Zurich, Switzerland Mentor: Prof. Siddhartha Mishra	Dec 2021 – July 2022

Education

PhD	Mathematics, ETH Zürich Zurich, Switzerland ◦ Title: “Computation and analysis of statistical solutions of the incompressible Euler equations” ◦ Advisor: Prof. Siddhartha Mishra	Nov 2018 – Nov 2021
PhD	Physics, EPF Lausanne Lausanne, Switzerland ◦ Title: “Kinetic-MHD stability of virtually collisionless plasmas” ◦ Advisor: Prof. Jonathan P. Graves	Aug 2015 – Aug 2020
MSc.	Mathematics, ETH Zürich Zurich, Switzerland	Sep 2013 – Mar 2015
BSc.	Mathematics, ETH Zürich Zurich, Switzerland	Sep 2010 – Sep 2013

Teaching Experience

Lecturer	Approximation Theory and Neural Networks California Institute of Technology	Fall 2023
Lecturer	Numerical Methods for Hyperbolic PDEs ETH Zürich	Spring 2022
Head assistant	Linear Algebra ETH Zürich ◦ Conducting and organizing examinations, 350 students , ◦ Organization of exercise classes and exercises, 8 TAs ,	Fall 2019, Fall 2020, Fall 2021
Mentoring activity	Supervision ◦ Undergraduate Summer research (2): Kieran Hale (2023), Mario Solis (2023),	

Co-supervision

- **PhD Thesis** (Fabian Jin, *ongoing*)
- **Master Theses (3)** (Fabian Jin, 2021, *awarded [ETH Medal](#)*; Patrik Hadorn, 2021; Michael Prasthofer, 2021),
- **Semester Theses (2)** (Fabian Jin, 2021; Patrik Hadorn, 2021).

Teaching assistant

- in both **mathematics** and **physics**,
- Numerical Methods for Hyperbolic PDEs (ETHZ; 2019); Mathematical Methods for Physicists (EPFL; 2017, 2018); Advanced Physics (EPFL; 2017); Computational Physics (EPFL; 2015, 2016); Numerical Mathematics (ETHZ; 2013); Differential Geometry (ETHZ; 2012)

Awards and Grants

Grant	SNSF Postdoc.Mobility	Aug 2022 – Aug 2024
	◦ Project: Bayesian data assimilation for high Reynolds number flows	
	◦ grant by the Swiss National Science Foundation	<i>CHF 114'000</i>
ETH Medal	ETH Zürich	May 2022
	Awarded for outstanding doctoral thesis	
GAMM	GAMM Junior Fellow	Jan 2022 – Dec 2024
	Elected by the International Association of Applied Mathematics and Mechanics for outstanding work in doctoral thesis (10 junior fellows per year)	
ETH Medal	ETH Zürich	Jan 2015
	Awarded for outstanding master's thesis	
ESOP	Excellence Scholarship and Opportunity Programme (ETH Zurich)	
	Sep 2013 – Jan 2015	
	A special scholarship to cover the full study and living costs for the duration of master's degree, as well as specific supervision.	
Polya prize	ETH Zürich	Dec 2013
	Awarded for best bachelor's degree in mathematics and physics.	

Academic Service

Journal referee	<ul style="list-style-type: none">◦ Nature Computational Science◦ Journal of Scientific Computing◦ IMA Journal of Numerical Analysis◦ SIAM J. on Scientific Computing◦ Calcolo◦ Inverse Problems	<ul style="list-style-type: none">◦ Neural Networks◦ Analysis and Applications◦ Comm. in Computational Physics◦ Vietnam Journal of Mathematics◦ Connection Science
Organization	Minisymposium ICIAM 2023, Tokyo	Aug 2023
	“Theoretical foundations and algorithmic innovation in operator learning”	
Outreach	<ul style="list-style-type: none">◦ Tour guide for TCV tokamak (EPF Lausanne),◦ Judge at Los Angeles Science Fair.	2015 – 2018 Mar 2023

Languages

ENGLISH: Fluent (C2)
GERMAN: Native

FRENCH: Advanced (C1)
KOREAN: Intermediate (B1)

Presentations

- Aug 2023 *10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)*, Tokyo, Japan
- July 2023 *17th U. S. National Congress on Computational Mechanics (USNMCC'17)*, Albuquerque, NM
- May 2023 *CMX student/postdoc seminar*, Caltech
- Nov 2022 Week long research stay at *UC Berkeley* (invited by F. Weber)
- Nov 2022 *Applied Math Seminar*, UC Berkeley
- Oct 2022 Seminar at *University of Pennsylvania*, virtual (invited by P. Perdikaris)
- Sep 2022 Minisymposium on “Provable Guarantees for Learning Dynamical Systems” SIAM MD22, San Diego, CA
- June 2022 Two-week long research stay at *Duke University* (invited by T. Elgindi)
- Apr 2022 Minisymposium on “Operator Learning in PDEs, Inverse Problems, and UQ” SIAM UQ22 (hybrid), Atlanta, GA
- Mar 2022 Minisymposium on “Recent Advances on Analysis and Numerics of Multidimensional Compressible Flows”, SIAM PD22 (virtual)
- Sep 2021 *Swiss Numerics Day 2021*, EPF Lausanne, Switzerland
- Mar 2021 Seminar on “Physics-Informed Learning Machines for Multiscale and Multiphysics Problems” (PhILMs), *virtual*, invited by G.E. Karniadakis, Brown University
- Dec 2019 Minisymposium on *Incompressible Fluid Mechanics*, SIAM PD19 in La Quinta, CA,
- Jun 2019 *Numerical Methods for Hyperbolic Problems (NumHyp 2019)* in Malaga, Spain,
- Mar 2019 Workshop on *Interfaces and Instabilities in Fluid Dynamics* at the Hausdorff Research Institute in Mathematics in Bonn, Germany,
- Aug 2018 Invited speaker: *Theory of Fusion Plasmas*, Varenna-Lausanne intl. workshop,
- July 2014 *XV Intl. Conference on Hyperbolic Problems (Hyp2014)*, in Rio de Janeiro, Brazil

Publications and Preprints

1. “The curse of dimensionality in operator learning”, S. Lanthaler, A. M. Stuart, (2023), *preprint*, *arXiv:2306.15924*
2. “The curse of dimensionality in operator learning”, S. Lanthaler, A. M. Stuart, (2023), *preprint*, *arXiv:2306.15924*
3. “Error Bounds for Learning with Vector-Valued Random Features”, S. Lanthaler, N. H. Nelsen, (2023), *preprint*, *arXiv:2305.17170*

4. “Neural Oscillators are Universal”, S. Lanthaler, T. K. Rusch, S. Mishra, (2023), *preprint, arXiv:2305.08753*
5. “The Nonlocal Neural Operator: Universal Approximation”, S. Lanthaler, Z. Li, A. M. Stuart, (2023), *preprint, arXiv:2304.13221*
6. “Operator learning with PCA-Net: upper and lower complexity bounds”, S. Lanthaler, (2023), *preprint, arXiv:2303.16317*
7. “On concentration in vortex sheets”, S. Lanthaler, *Partial Differ. Equ. Appl.*, **4**(13) (2023)
8. “Nonlinear Reconstruction for Operator Learning of PDEs with Discontinuities”, S. Lanthaler, R. Molinar, P. Hadorn, S. Mishra, (2022), *ICLR* (2023)
9. “On Bayesian data assimilation for PDEs with ill-posed forward problems”, S. Lanthaler, S. Mishra, F. Weber, (2022), *Inverse Problems*, **38**(8):085012 (2022)
10. “Error estimates for deeponets: A deep learning framework in infinite dimensions”, S. Lanthaler, S. Mishra, G.E. Karniadakis, *Trans Math Appl*, **6**(1), (2022), tnac001,
11. “On universal approximation and error bounds for Fourier neural operators”, N. Kovachki, S. Lanthaler, S. Mishra, *Journal of Machine Learning Research*, **22**(290), (2021), 1-76
12. “On the approximation of functions by tanh neural networks”, T. De Ryck, S. Lanthaler, S. Mishra, *Neural Networks*, **143**, (2021), 732-750
13. “Statistical solutions of the incompressible Euler equations”, S. Lanthaler, S. Mishra, C. Parés-Pulido, *Math. Models Methods Appl. Sci.* (M³AS), **31**(2), (2021), 223-292
14. “On the conservation of energy in two-dimensional incompressible flows”, S. Lanthaler, S. Mishra, C. Parés-Pulido, *Nonlinearity*, **34**(2), (2021), 1084
15. “On the convergence of the spectral viscosity method for the two-dimensional incompressible Euler equations with rough initial data”, S. Lanthaler, S. Mishra, *Found Comput Math*, **20**, (2020), 1309–1362
16. “Guiding-centre theory for kinetic-magnetohydrodynamic modes in strongly flowing plasmas”, S. Lanthaler, J. P. Graves, D. Pfefferlé, W. A. Cooper, *Plasma Phys. Control. Fusion*, **61**, (2019), 074006
17. “Higher order Larmor radius corrections to guiding-centre equations and application to fast ion equilibrium distributions”, S. Lanthaler, D. Pfefferlé, J. P. Graves, W. A. Cooper, *Plasma Phys. Control. Fusion*, **59**, (2017), 044014
18. “Statistical solutions of hyperbolic conservation laws I: Foundations”, U. S. Fjordholm and S. Lanthaler and S. Mishra, *Arch. Ration. Mech. An.*, **226**(2), (2017), 809–849
19. “Computation of measure-valued solutions for the incompressible Euler equations”, S. Lanthaler, S. Mishra, *Math. Models and Methods Appl. Sci.*, **25**, (2015), 2043-2088

Contributions to additional co-authored papers

20. “Three-dimensional magnetohydrodynamic equilibrium of quiescent H-modes in tokamak systems”, W. A. Cooper, J. P. Graves, B. P. Duval, O. Sauter, J. M. Faustin, A. Kleiner, S. Lanthaler, H. Patten, M. Raghunathan, T.-M. Tran, *Pasma Phys. Control. Fusion*, **58**, (2016) 064002
21. “Modelling of advanced three-ion ICRF heating and fast ion generation scheme for tokamaks and stellarators”, J. M. Faustin, J. P. Graves, W. A. Cooper, S. Lanthaler, L. Villard, D. Pfefferlé, J. Geiger, Ye O. Kazakov, D. Van Eester, *Pasma Phys. Control. Fusion*, **59**, (2017) 084001
22. “The DEMO wall load challenge”, R. Wenninger, R. Albanese, R. Ambrosino, F. Arbeiter, J. Aubert, C. Bachmann, L. Barbato, T. Barrett, M. Beckers, W. Biel, L. Boccaccini, D. Carralero, D. Coster, T. Eich, A. Fasoli, G. Federici, M. Firdaouss, J. Graves, J. Horacek, M. Kovari, S. Lanthaler, V. Loschiavo, C. Lowry, H. Lux, G. Maddaluno, F. Maviglia, R. Mitteau, R. Neu, D. Pfefferlé, K. Schmid, M. Siccino, B. Sieglin, C. Silva, A. Snicker, F. Subba, J. Varje and H. Zohm, *Nuclear Fusion*, **57**, (2017) 046002
23. “Stellarator nonlinearly saturated periodicity-breaking ideal magnetohydrodynamic equilibrium states”, W. A. Cooper, D. López-Bruna, M. A. Ochando, F. Castejón, J. P. Graves, A. Kleiner, S. Lanthaler, H. Patten, M. Raghunathan, J. M. Faustin and the TJ-II Team, *Nuclear Fusion*, **58**, (2018) 124002
24. “Reduced models for parallel magnetic field fluctuations and their impact on pressure gradient driven MHD instabilities in axisymmetric toroidal plasmas”, J. P. Graves, D. Zullino, D. Brunetti, S. Lanthaler, C. Wahlberg, *Pasma Phys. Control. Fusion*, **61**, (2019) 104003