

Samuel Lanthaler

• [Google Scholar](#) • [ArXiv](#) • [slanthaler.github.io](#) • slanth@caltech.edu

Personal Information

Citizenship: Switzerland
Address: California Institute of Technology
1200 E. California Blvd., MC 305-16
Pasadena, CA 91125

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 ◦ Advisor: Prof. Siddhartha Mishra	Nov 2018 – Nov 2021
PhD	Physics, EPF Lausanne Lausanne, Switzerland ◦ 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

- 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)

Supervisory and Mentoring Experience

Mentoring activity

Supervision

- **Undergraduate Summer research (Caltech):**
Kieran Hale, 2023; Mario Solis, 2023.

Co-supervision

- **PhD Thesis (ETH Zurich):** Fabian Jin, *ongoing*,
- **Master Theses (ETH Zurich):**
Fabian Jin, 2021, *awarded ETH Medal*; Patrik Hadorn, 2021; Michael Prasthofer, 2021,
- **Semester Theses (ETH Zurich):**
Fabian Jin, 2021; Patrik Hadorn, 2021.

Fellowships and Grants

SNSF **SNSF Postdoc.Mobility** **Aug 2022 – Aug 2024**
grant by the Swiss National Science Foundation *CHF 67'000/year*

ETH Zürich **Excellence Scholarship** **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. *CHF 12'000/semester*

Awards and Honors

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

Polya prize **ETH Zürich** **Dec 2013**
Awarded for best bachelor's degree in mathematics and physics.

Academic Service

Journal referee

- Nature Computational Science
- Journal of Scientific Computing
- IMA Journal of Numerical Analysis
- SIAM J. on Scientific Computing
- Calcolo
- Inverse Problems
- Neural Networks
- Analysis and Applications
- Comm. in Computational Physics
- Vietnam Journal of Mathematics
- Connection Science

Organization	Minisymposium ICIAM 2023, Tokyo, Japan “Theoretical foundations and algorithmic innovation in operator learning”	Aug 2023
Committee	External expert for PhD candidacy exam (Physics, EPFL)	Nov 2022
Outreach	<ul style="list-style-type: none"> ○ Judge at Los Angeles Science Fair, ○ Tour guide for TCV tokamak (EPF Lausanne). 	Mar 2023 2015 – 2018

Languages

ENGLISH: Fluent (C2)	FRENCH: Advanced (C1)
GERMAN: Native	KOREAN: Intermediate (B1)

Presentations

Aug 2023	<i>10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)</i> , Tokyo, Japan
July 2023	Keynote speaker at minisymposium on “ <i>Recent developments in operator learning</i> ” (<i>USNMCC’17</i>), Albuquerque, NM
Nov 2022	<i>Applied Math Seminar</i> , UC Berkeley
Oct 2022	Seminar at <i>University of Pennsylvania</i> , virtual (invited by P. Perdikaris)
Sep 2022	Minisymposium on “ <i>Provable Guarantees for Learning Dynamical Systems</i> ” SIAM MD22, San Diego, CA
Apr 2022	Minisymposium on “ <i>Operator Learning in PDEs, Inverse Problems, and UQ</i> ” SIAM UQ22 (hybrid), Atlanta, GA
Mar 2022	Minisymposium on “ <i>Recent Advances on Analysis and Numerics of Multidimensional Compressible Flows</i> ”, SIAM PD22 (virtual)
Sep 2021	<i>Swiss Numerics Day 2021</i> , EPF Lausanne, Switzerland
Mar 2021	Seminar on “ <i>Physics-Informed Learning Machines for Multiscale and Multiphysics Problems</i> ” (PhILMs), <i>virtual</i> , invited by G.E. Karniadakis, Brown University
Dec 2019	Minisymposium on <i>Incompressible Fluid Mechanics</i> , SIAM PD19 in La Quinta, CA,
Jun 2019	<i>Numerical Methods for Hyperbolic Problems (NumHyp 2019)</i> in Malaga, Spain,
Mar 2019	Workshop on <i>Interfaces and Instabilities in Fluid Dynamics</i> at the Hausdorff Research Institute in Mathematics in Bonn, Germany,
Aug 2018	Invited speaker: <i>Theory of Fusion Plasmas</i> , Varenna-Lausanne intl. workshop,
July 2014	<i>XV Intl. Conference on Hyperbolic Problems (Hyp2014)</i> , in Rio de Janeiro, Brazil

Research stays

Nov 2022	Week long research stay at <i>UC Berkeley</i> (invited by F. Weber)
June 2022	Two-week long research stay at <i>Duke University</i> (invited by T. Elgindi)
April 2016	Two-week long research stay at <i>Centre for Fusion Energy</i> , Culham, UK

Publications and Preprints

1. “The curse of dimensionality in operator learning”, [S. Lanthaler](#), A. M. Stuart, (2023), *preprint*, [arXiv:2306.15924](#)
2. “Error Bounds for Learning with Vector-Valued Random Features”, [S. Lanthaler](#), N. H. Nelsen, (2023), *submitted to NeurIPS 2023*, [arXiv:2305.17170](#)
3. “Neural Oscillators are Universal”, [S. Lanthaler](#), T. K. Rusch, S. Mishra, (2023), *submitted to NeurIPS 2023*, [arXiv:2305.08753](#)
4. “The Nonlocal Neural Operator: Universal Approximation”, [S. Lanthaler](#), Z. Li, A. M. Stuart, (2023), *submitted to Constructive Approximation*, [arXiv:2304.13221](#)
5. “Operator learning with PCA-Net: upper and lower complexity bounds”, [S. Lanthaler](#), (2023), *submitted to Journal of Machine Learning Research*, [arXiv:2303.16317](#)
6. “On concentration in vortex sheets”, [S. Lanthaler](#), *Partial Differ. Equ. Appl.*, **4**(13) (2023)
7. “Nonlinear Reconstruction for Operator Learning of PDEs with Discontinuities”, [S. Lanthaler](#), R. Molinar, P. Hadorn, S. Mishra, (2022), *ICLR (2023)*
8. “On Bayesian data assimilation for PDEs with ill-posed forward problems”, [S. Lanthaler](#), S. Mishra, F. Weber, (2022), *Inverse Problems*, **38**(8):085012 (2022)
9. “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,
10. “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
11. “On the approximation of functions by tanh neural networks”, T. De Ryck, [S. Lanthaler](#), S. Mishra, *Neural Networks*, **143**, (2021), 732-750
12. “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
13. “On the conservation of energy in two-dimensional incompressible flows”, [S. Lanthaler](#), S. Mishra, C. Parés-Pulido, *Nonlinearity*, **34**(2), (2021), 1084
14. “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
15. “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
16. “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

17. “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
18. “Computation of measure-valued solutions for the incompressible Euler equations”, [S. Lanthaler](#), S. Mishra, *Math. Models and Methods Appl. Sci.*, **25**, (2015), 2043–2088

[Other co-authored papers \(authors ordered by contribution\)](#)

19. “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
20. “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
21. “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
22. “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
23. “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