

Samuel Lanthaler

• [Google Scholar](#) • [Orcid](#) • [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**
- **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

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|-------------------|--|----------------------------|
| SNSF | SNSF Postdoc.Mobility | Aug 2022 – Aug 2024 |
| | grant by the Swiss National Science Foundation | <i>CHF 67'000/year</i> |
| 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. | <i>CHF 12'000/semester</i> |

Awards and Honors

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|--------------------|--|----------------------------|
| 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

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|------------------------|--------------------------------------|--|
| Journal referee | ◦ Nature Computational Science | ◦ Comm. in Computational Physics |
| | ◦ Journal of Scientific Computing | ◦ Neural Networks |
| | ◦ IMA Journal of Numerical Analysis | ◦ Analysis and Applications |
| | ◦ SIAM J. on Scientific Computing | ◦ Calcolo |
| | ◦ SIAM Journal on Numerical Analysis | ◦ Vietnam Journal of Mathematics |
| | ◦ Inverse Problems | ◦ Connection Science |
| | ◦ Constructive Approximation | ◦ Transactions on Machine Learning Research (TMLR) |
| | ◦ Foundations of Data Science | |

Organization	Minisymposium ICIAM 2023, Tokyo, Japan	Aug 2023
	“Theoretical foundations and algorithmic innovation in operator learning”	
Organization	Minisymposium SIAM UQ 2024, Trieste, Italy	Feb 2024
	“Recent Advances in Scalable Active Learning and Optimal Experimental Design”	
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

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

Presentations

Feb 2024	Minisymposium on “ <i>Operator Learning in Uncertainty Quantification</i> ”, SIAM UQ24, Trieste, Italy
Feb 2024	Brin MRC workshop “ <i>Scientific Machine Learning: Theory and Algorithms</i> ”, University of Maryland, College Park, MD
Jan 2024	Minisymposium on “ <i>Scientific Machine Learning to Advance Modeling and Decision Support</i> ”, Joint Mathematics Meeting, JMM 2024, San Francisco, CA
Aug 2023	Minisymposium on “ <i>Theoretical foundations and algorithmic innovation in operator learning</i> ”, 10th International Congress on Industrial and Applied Mathematics, ICIAM 2023, Tokyo, Japan
July 2023	Keynote speaker at minisymposium on “ <i>Recent developments in operator learning</i> ”, 17th U. S. National Congress on Computational Mechanics, USNMCC17, Albuquerque, NM
Nov 2022	<i>Applied Math Seminar</i> , UC Berkeley
Oct 2022	Seminar at University of Pennsylvania
Sep 2022	Minisymposium on “Provable Guarantees for Learning Dynamical Systems”, SIAM MD22, San Diego, CA
Apr 2022	Minisymposium on “Operator Learning in PDEs, Inverse Problems, and UQ”, SIAM UQ22, Atlanta, GA
Mar 2022	Minisymposium on “Recent Advances on Analysis and Numerics of Multidimensional Compressible Flows”, SIAM PD22 (virtual)
Sep 2021	<i>Swiss Numerics Day 2021</i> , EPF Lausanne, Switzerland

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. “Operator Learning: Algorithms and Analysis”, N. Kovachki, [S. Lanthaler](#), A. M. Stuart, *arXiv:2402.15715* (2024), *to appear in Handbook of Numerical Analysis*
2. “The Parametric Complexity of Operator Learning”, [S. Lanthaler](#), A. M. Stuart, *arXiv:2306.15924* (2024), *submitted to IMA Journal of Numerical Analysis*
3. “The Nonlocal Neural Operator: Universal Approximation”, [S. Lanthaler](#), Z. Li, A. M. Stuart, *arXiv:2304.13221* (2023), *submitted to Constructive Approximation*
4. “Error Bounds for Learning with Vector-Valued Random Features”, [S. Lanthaler](#), N. H. Nelsen, *Advances in Neural Information Processing Systems, NeurIPS* (2023)
5. “Neural Oscillators are Universal”, [S. Lanthaler](#), T. K. Rusch, S. Mishra, *Advances in Neural Information Processing Systems, NeurIPS* (2023)
6. “Operator learning with PCA-Net: upper and lower complexity bounds”, [S. Lanthaler](#), *Journal of Machine Learning Research*, **24**(318):1-67 (2023)
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, *The Eleventh International Conference on Learning Representations, 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

Other co-authored papers (authors ordered by contribution)

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