Jacob H. Seidman, PhD

Postdoctoral Researcher · Applied Mathematics and Machine Learning

jhseidman3@gmail.com

Education

University of Pennsylvania *Philadelphia, PA*

Ph.D. Applied Mathematics and Computational Science *2016-2022*

- Advisors: Dr. George J. Pappas and Dr. Victor M. Preciado
- Dissertation: Machine Learning in Function Spaces

Harvard University *Boston, MA*

A.B. Mathematics *2012-2016*

Research Experience

University of Pennsylvania *Philadelphia, PA*

Postdoctoral Researcher *Oct. 2022 - Present*

- **Operator Learning:** Investigating approximation theoretic limitations and unified frameworks of operator learning architectures. Developing models for dimensionality reduction of PDE solution manifolds.

University of Pennsylvania *Philadelphia, PA*

Ph.D. Research *Sep. 2016 - Oct. 2022*

- **Optimization:** Studied convergence theory optimization algorithms. Gave a new and streamlined convergence proof of a classic operator splitting method, and proposed a novel distributed optimization algorithm with convergence proof.
- **Control Theory:** Studied optimal control theory and its connections to the dynamics of machine learning architectures. Gave a convergence proof for an adversarial training algorithm. Programmed experiments validating theoretical results.
- **Operator Learning:** In collaboration with the group of Dr. Paris Perdikaris, proposed and proved universality of a novel parameterized family of operators between function spaces with applications to modeling of physical and controlled systems.

Harvard University *Boston, MA*

Summer Research *Summer 2015*

- **Mathematical Biology:** Studied mathematical population dynamics models for the emergence of multicellularity. Funded by grant from Harvard College Research Program.

Pennsylvania State University *State College, PA*

Penn State REU *Summer 2014*

- **Dynamical Systems:** Participated summer REU program studying the Livsic theorems for hyperbolic dynamical systems.

Presentations

Invited Talks

Spring 2022. *Supervised Learning in Function Spaces*. Johns Hopkins University

- Co-presented 5 hr. practicum session at the Mathematical Institute for Data Science TRIPODS Winter School and Workshop on Interplay between Artificial Intelligence and Dynamical Systems. Videos available at `https://github.com/PredictiveIntelligenceLab/TRIPODS_Winter_School_2022`

Spring 2022. *Supervised Operator Learning*. UC Riverside

- Invited to give guest lecture in course "Multiscale Modeling and Machine Learning" on operator learning techniques and nonlinear representations of manifolds of functions.

Spring 2022. *Learning Operators with Coupled Attention*. Brown University

- Invited to present results on a new operator learning architecture to the CRUNCH group of Dr. George Karniadakis.

Organized Minisymposia

June 2023. *Biophysics-informed Machine Learning*. Platform for Advanced Scientific Computing (PASC), Davos, Switzerland

- Co-organizer and co-chair.

Publications

Seidman, Jacob H., Kissas, Georgios, et al. "Variational Autoencoding Neural Operators" *In Review* (2023).

Seidman, Jacob H.*, Kissas, Georgios*, et al. "NOMAD: Nonlinear Manifold Decoders for Operator Learning." Advances in Neural Information Processing Systems. (2022).

Kissas, Georgios*, **Seidman, Jacob H.***, et al. "Learning Operators with Coupled Attention." Journal of Machine Learning Research 23.215 (2022): 1-63. **NeurIPS Spotlight**

Beckers, Thomas, **Seidman, Jacob H.**, et. al. "Gaussian Process Port-Hamiltonian Systems: Bayesian Learning with Physics Prior". Proceedings of the Conference on Decision and Control (CDC). IEEE, (2022).

Seidman, Jacob H., et al. "Robust deep learning as optimal control: Insights and convergence guarantees." Learning for Dynamics and Control. PMLR, (2020).

Seidman, Jacob H., et al. "A control-theoretic approach to analysis and parameter selection of douglas–rachford splitting." IEEE Control Systems Letters 4.1 (2019): 199-204.

Seidman, Jacob H., et al. "A chebyshev-accelerated primal-dual method for distributed optimization." 2018 IEEE Conference on Decision and Control (CDC). IEEE, (2018).

*authors contributed equally

Awards

2023 **SIAM Travel Grant**, Society for Industrial and Applied Mathematics

2016-2020 **Benjamin Franklin Fellowship**, University of Pennsylvania

Teaching Experience

Fall 2017 **Computer Methods in Mathematical Science**, Grader

Spring 2018 **Ideas in Mathematics**, Teaching Assistant

Academic Service

2022 **International Conference on Machine Learning**, Reviewer

2021 **IFAC Conference on Analysis and Design of Hybrid Systems**, Reviewer

2021 **IEEE Transactions on Automatic Control**, Reviewer