Paul Schwerdtner

New York, NY. +1 914-885-5542

[paul.schwerdtner@nyu.edu] [algopaul.github.io] [Google Scholar Profile]

Summary

Computational research scientist with expertise in high-performance computing and uncertainty quantification for numerical simulations and large-scale data analysis. My work combines rigorous numerical analysis tools with modern scientific machine learning for accelerating physics simulations, large-scale data analysis, and robust optimal controller design for complex dynamical systems. I focus on validating algorithms through large-scale computational experiments.

Recent Publications

Hankel Singular Value Regularization for Highly Compressible State Space Models
[request preprint] P. Schwerdtner, J. Berman, B. Peherstorfer — **in review • NeurIPS 2025**

Empirical sparse regression on quadratic manifolds
[full text] P. Schwerdtner, S. Gugercin, B. Peherstorfer — **SIAM J. Sci. Comput 2025** *(in production)*

Online learning of quadratic manifolds from streaming data for [...] model reduction
[full text] P. Schwerdtner, P. Mohan, A. Pachalieva, J. Bessac, D. O'Mally et al. — **Proc. Royal Society A 2025**

Uncertainty quantification in coupled wildfire–atmosphere simulations at scale
[full text] P. Schwerdtner, F. Law, Q. Wang, C. Gazen, Y.-F. Chen, M. Ihme et al. — **PNAS Nexus 2024**

Work experience

Courant Institute of Mathematical Sciences, New York University — *New York, NY*
Postdoctoral Fellow (Current) — *06/2023 – present*

- Implemented **streaming-based** post-processing pipeline to handle **peta-bytes** of fluid simulation data for quadratic manifold computation to accelerate physics simulations at Los Alamos National Labs and National Renewable Energy Labs.
- Added **multilevel Monte Carlo** simulation framework to **Google Research project** swirl_lm to combine large-scale physics simulations with DNN estimates for reliable **wildfire prediction**.
- Developed control theory based regularization approach for **highly compressible deep state space models** used in sequence analysis; investigated randomized and energy-preserving time integration for stable neural emulators.

Institute of Mathematics, Technical University Berlin — *Berlin, Germany*
Scientific Assistant — *10/2018 – 03/2023*

- Developed novel **optimization-based** model order reduction algorithm for **Hamiltonian approximations** of large-scale dynamical systems.
- Investigated optimization-based controller design for **structured system identification** of dissipative systems from **frequency domain data**.

Neurcat GmbH (AI-Startup) — *Berlin, Germany*
Scientific Assistant — *10/2018 – 01/2021*

- Contributed to proprietary **AI robustness assessment** SAAS tool for **computer vision** models with automotive applications.
- Implemented **adversarial attacks and defenses** for computer vision systems in major German autonomous driving consortium "KI-Absicherung"

Mitsubishi Electric Research Laboratories — *Cambridge, MA*
Research Intern — *04/2018 – 09/2018*

- Designed and implemented **constraint-aware controller** algorithms using reference governors for multi-room HVAC systems.
- Developed and lab-tested robustness enhancing objective function for **model predictive control** of systems with uncertainties.

Continental AG *Silao, Mexico*
Research and Design Intern *11/2015 − 03/2016*
- Optimization of injection-molding parameters for sensor fabrication
- Proposed and developed DNN-based design of experiment for cheaper parameter determination

Education

Ph.D. Mathematics *Berlin, Germany*
Technical University Berlin *10/2018 − 01/2023*
    Thesis: *Structured Optimization-Based Reduction, Identification, and Control*
    Research: Model order reduction, system identification, and robust control for large-scale and structured dynamical systems

M.S. Engineering Science *Berlin, Germany*
Technical University Berlin *10/2016 − 04/2018*
    Thesis: On Fixed Order H-infinity Controller Design for Delay Systems
    Final grade: 1.0 (German scale: 1.0 = highest, 4.0 = lowest passing)

B.S. Engineering Science *Berlin, Germany*
Technical University Berlin *10/2012 − 09/2016*
    Thesis: Numerical Simulation of non-autonomous Dynamical Systems to Investigate Disk-Brake Squeal
    Final grade: 1.1 (German scale: 1.0 = highest, 4.0 = lowest passing)

Prizes and extracurricular activities

GAMM Junior Award *10/2018 − 01/2023*
Recognition for young researchers in applied mathematics

Contributions to DIN-SPEC 92001 *10/2018 − 03/2019*
Contribution to national standardization document for artificial intelligence safety evaluation

BIMoS Fellowship *10/2018 − 12/2019*
Received funding for independent research from Berlin international school for simulation research

Software & Tools

- Python: jax, flax, numpy, pandas, hydra, absl-py
- HPC management with SLURM or Google Cloud VMs
- Additional languages: SQL/NoSQL, MATLAB, Julia

Publications

1. **P. Schwerdtner**, S. Gugercin, B. Peherstorfer, *Empirical sparse regression on quadratic manifolds,* **SIAM J. Sci. Comput.** (in production), 2025.
2. P. Weder, **P. Schwerdtner**, B. Peherstorfer, *Nonlinear model reduction with Neural Galerkin schemes on quadratic manifolds*, **J. Comput. Phys.**, 2025.
3. **P. Schwerdtner**, et al., *Online learning of quadratic manifolds from streaming data for nonlinear dimensionality reduction and nonlinear model reduction*, **Proc. Royal Society A**, 2025
4. **P. Schwerdtner** and M. Schaller, *Structured Optimization-Based Model Order Reduction for Parametric Systems*, **SIAM J. Sci. Comput.**, 2025.
5. T. Holicki, J. Nicodemus, **P. Schwerdtner**, B. Unger, *Energy matching in reduced passive and port-Hamiltonian systems,* **SIAM J. Control Optim.**, 2025
6. **P. Schwerdtner**, F. Law, Q. Wang, C. Gazen, Y.-F. Chen, M. Ihme, B. Peherstorfer, *Uncertainty quantification in coupled wildfire–atmosphere simulations at scale*, **PNAS Nexus**, 2024.
7. **P. Schwerdtner**, P. Schulze, J. Berman, B. Peherstorfer, *Nonlinear embeddings for conserving Hamiltonians and other quantities with Neural Galerkin schemes,* **SIAM J. Sci. Comput.**, 2024.

8. J. Berman, **P. Schwerdtner**, B. Peherstorfer, *Neural Galerkin schemes for sequential-in-time solving of partial differential equations with deep networks*, Handbook of Numerical Analysis (Volume: **Numerical Analysis Meets Machine Learning**), 2024.

9. **P. Schwerdtner**, T. Moser, V. Mehrmann, M. Voigt, *Optimization-based model order reduction of port-Hamiltonian descriptor systems*, **Systems Control Lett.**, 2023.

10. **P. Schwerdtner** and M. Voigt, *SOBMOR: Structured Optimization-Based Model Order Reduction*, **SIAM J. Sci. Comput**., 2023.

11. **P. Schwerdtner** and M. Voigt, *Fixed-Order H-Infinity Controller Design for Port-Hamiltonian Systems*, **Automatica J. IFAC**, 2023.

12. S. A. Bortoff, **P. Schwerdtner**, C. Danielson, S. D. Cairano, and D. J. Burns, *H-Infinity Loop-Shaped Model Predictive Control With HVAC Application*, **IEEE Trans. Control Syst. Technol.**, 2022.

13. **P. Schwerdtner** and M. Voigt, *Adaptive Sampling for Structure-Preserving Model Order Reduction of Port-Hamiltonian Systems*, **IFAC-PapersOnline**, 2021.

14. **P. Schwerdtner**, E. Mengi, and M. Voigt, *Certifying Global Optimality for the L-infinity-Norm Computation of Large-Scale Descriptor Systems*, **IFAC-PapersOnLine**, 2020.

15. M. W. H. Böse, D. Hildebrand, F. Beuer, C. Wesemann, **P. Schwerdtner**, S. Pieralli, and B. C. Spies, *Clinical Outcomes of Root-Analogue Implants Restored with Single Crowns or Fixed Dental Prostheses: A Retrospective Case Series*, **J. Clinical Medicine**, 2020.

16. **P. Schwerdtner**, S. A. Bortoff, C. Danielson, S. D. Cairano, and D. J. Burns, *Projection-Based Anti-Windup for Multivariable Control with Heat Pump Application*, **18th European Control Conference (ECC)**, 2019.

17. S. A. Bortoff, **P. Schwerdtner**, C. Danielson, S. D. Cairano, and D. J. Burns, *H-infinity loop-shaped model predictive control with heat pump application*, **18th European Control Conference (ECC)**, 2019.

18. **P. Schwerdtner** and M. Voigt, *Computation of the L-infinity-Norm Using Rational Interpolation*, **IFAC-PapersOnLine**, 2018.

19. N. Aliyev, P. Benner, E. Mengi, **P. Schwerdtner**, and M. Voigt, *Large-Scale Computation of L-infinity Norms by a Greedy Subspace Method*, **SIAM J. Matrix Anal. Appl.**, 2017.