Paul Schwerdtner

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Summary

- Computational research scientist with expertise in large-scale data analysis.
- Specialist in high-performance computing and uncertainty quantification for high-fidelity simulations.
- Developer of numerical methods for nonlinear surrogate modeling using advanced machine-learning.
- Experienced in controller design and system identification for structured, large-scale dynamical systems.

Work experience

Courant Institute of Mathematical Sciences, New York University
New York, NY
Postdoctoral Fellow
06/2023 – present

Developing, implementing, and benchmarking scientific machine learning algorithms:

1. Designing streaming-based data processing methods for learning nonlinear manifolds on peta-bytes of simulation data in collaboration with National Laboratories.
2. Conducting multilevel Monte Carlo simulations for uncertainty quantification with large-scale wildfire simulations in collaboration with Google Research.
3. Investigating randomized and energy-preserving time-integration methods for fast and stable predictions.

Institute of Mathematics, Technische Universität Berlin
Berlin, Germany
Scientific Assistant
10/2018 – 03/2023

Conducted research in structured dynamical systems:

1. Developed novel optimization-based model order reduction algorithm for highly accurate structured approximations.
2. Investigated novel optimization-based controller design and system identification techniques for learning and controlling dissipative-Hamiltonian dynamics.

Neurocat GmbH (AI-Startup)
Berlin, Germany
Research Scientist
10/2018 – 01/2021

Investigated robustness of computer vision models with vehicle applications:

1. Contributed to proprietary AI robustness assessment SAAS tool for computer vision models.
2. Benchmarked robustness of computer vision systems in major German automated driving consortium “KI-Absicherung”.

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

Control systems research with HVAC applications:

1. Designed and implemented constraint-aware controller algorithms using reference governors.
2. Designed robustness enhancing objective function for model predictive control applications.

Institute of Mathematics, Technische Universität Berlin
Berlin, Germany
Student Assistant
11/2016 – 04/2018

Implemented numerical software for analyzing large-scale linear dynamical systems.

Continental AG
Silao, Mexico
Research and Design Intern
11/2015 – 03/2016

Optimized injection parameters for sensor-molding and proposed deep-learning-based design of experiments.

Education

Ph.D. Mathematics
Technische Universität Berlin — *Berlin, Germany* — 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
Technische Universität Berlin — *Berlin, Germany* — 10/2016 – 04/2018

Thesis: *On Fixed Order H-infinity Controller Design for Delay Systems*

Focus: numerical mathematics and simulation, mechatronics

Final grade: **1.0** (German scale: 1.0 = highest, 4.0 = lowest passing)

B.S. Engineering Science
Technische Universität Berlin — *Berlin, Germany* — 10/2012 – 04/2016

Thesis: *Numerical Simulation of non-autonomous Dynamical Systems to Investigate Disk-Brake Squeal*

Focus: fluid mechanics

Final grade: **1.1** (German scale: 1.0 = highest, 4.0 = lowest passing)

Prizes and extracurricular activities

GAMM Junior Award
01/2020 – 12/2022

Recognition for young researchers in applied mathematics

Awarded by the International Association of Applied Mathematics and Mechanics (GAMM).

Awards young researchers with an excellent master thesis in the field of Applied Mathematics or Mechanics.

Part of GAMM Juniors Speaker team in 2021.

Contributions to DIN-SPEC 92001
10/2018 – 03/2019

Contribution to standardization in artificial intelligence

Co-authored the *DIN-SPEC 92001-1: Artificial Intelligence – Life Cycle Processes and Quality Requirements*.

Promotion of artificial intelligence software safety.

BIMoS Fellowship
10/2018 – 12/2019

Berlin international school for model and simulation based research

Received funding for independent research (EUR 22,000).

Software & Tools

- Python (JAX/Flax, NumPy, pandas). Previously: TensorFlow/Keras
- HPC with SLURM, Google Cloud VMs
- SQL/NoSQL, MATLAB, Julia

Publications

[1] **P. Schwerdtner** and M. Schaller, *Structured Optimization-Based Model Order Reduction for Parametric Systems*, SIAM J. Sci. Comput., 2025.

[2] **P. Schwerdtner**, F. Law, Q. Wang, C. Gazen, Y.-F. Chen, M. Ihme, and B. Peherstorfer, *Uncertainty quantification in coupled wildfire–atmosphere simulations at scale*, PNAS Nexus, 2024.

[3] **P. Schwerdtner**, P. Schulze, J. Berman, and B. Peherstorfer, *Nonlinear embeddings for conserving Hamiltonians and other quantities with Neural Galerkin schemes*, SIAM J. Sci. Comput., 2024.

[4] 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.

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

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

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

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

[9] 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.

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

[11] **P. Schwerdtner**, E. Mengi, and M. Voigt, *Certifying Global Optimality for the $\mathcal{L}_\infty$-Norm Computation of Large-Scale Descriptor Systems*, IFAC-PapersOnLine, 2020.

[12] 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*, Journal of Clinical Medicine, 2020.

[13] **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.

[14] 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.

[15] **P. Schwerdtner** and M. Voigt, *Computation of the $\mathcal{L}_\infty$-Norm Using Rational Interpolation*, IFAC-PapersOnLine, 2018.

[16] N. Aliyev, P. Benner, E. Mengi, **P. Schwerdtner**, and M. Voigt, *Large-Scale Computation of $\mathcal{L}_\infty$ Norms by a Greedy Subspace Method*, SIAM J. Matrix Anal. Appl., 2017.

Preprints

[1] **P. Schwerdtner** and B. Peherstorfer, *Greedy construction of quadratic manifolds for nonlinear dimensionality reduction and nonlinear model reduction*, arXiv, 2024.

[2] **P. Schwerdtner**, P. Mohan, A. Pachalieva, J. Bessac, D. O'Malley, and B. Peherstorfer, *Online learning of quadratic manifolds from streaming data for nonlinear dimensionality reduction and nonlinear model reduction*, arXiv, 2024.

[3] **P. Schwerdtner**, S. Gugercin, and B. Peherstorfer, *Empirical sparse regression on quadratic manifolds*, arXiv, 2024.

[4] P. Weder, **P. Schwerdtner**, and B. Peherstorfer, *Nonlinear model reduction with Neural Galerkin schemes on quadratic manifolds*, arXiv, 2024.