

Steffen W. R. Werner

Curriculum Vitae as of April 10, 2022



Born September 6, 1992 in Stendal, Germany

Contact

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Google Scholar <https://scholar.google.de/citations?user=F2v1uKAAAAAJ&hl=en>

Professional Experience

- since 09/2021 **Postdoctoral associate**, *Department of Computer Science, Courant Institute of Mathematical Sciences, New York University, New York, USA*
- 10/2016–08/2021 **Doctoral researcher**, *Computational Methods in Systems and Control Theory, Max Planck Institute for Dynamics of Complex Technical Systems, Magdeburg, Germany*
- 05/2016–09/2016, 10/2014–01/2016 **Student employee**, *Computational Methods in Systems and Control Theory, Max Planck Institute for Dynamics of Complex Technical Systems, Magdeburg, Germany*
- Development and maintenance of MATLAB toolboxes and codes
- 01/2016–04/2016 **Industrial intern**, *proALPHA Business Solutions GmbH, Weilerbach, Germany*
- Analysis of modern version control systems
 - Application programming
- 10/2013–09/2014 **Student employee**, *Otto von Guericke University, Magdeburg, Germany*
- Tutor for mathematical courses
 - Tutor for the consultation of the Department of Mathematics

Education

- 10/2016–08/2021 **Doctoral studies (doctor rerum naturalium)**, *Department of Mathematics, Otto von Guericke University, Magdeburg, Germany*, summa cum laude (excellent)
Thesis: *Structure-Preserving Model Reduction for Mechanical Systems* [33]
- 10/2016–09/2019: Project research in the German Research Foundation (DFG) Priority Program 1897 “Calm, Smooth and Smart – Novel Approaches for Influencing Vibrations by Means of Deliberately Introduced Dissipation”
 - 04/2017–08/2021: Associated researcher in the German Research Foundation (DFG) Research Training Group 2297 “Mathematical Complexity Reduction (MathCoRe)”, Magdeburg
- 10/2014–09/2016 **Master of Science**, *Department of Mathematics, Otto von Guericke University, Magdeburg, Germany*, very good with distinction
Thesis: *Hankel-Norm Approximation of Descriptor Systems* [34]
- 10/2011–09/2014 **Bachelor of Science**, *Department of Mathematics, Otto von Guericke University, Magdeburg, Germany*, very good with distinction
Thesis: *Numerische Berechnung der Eigenwerte großer Hamiltonisch-positiver Matrizen* [35]
- 07/2011 **Abitur (university entrance diploma)**, *Diesterweg-Gymnasium, Tangermünde-Havelberg, Germany*

Research Interests

scientific machine learning, model order reduction, numerical linear algebra, mathematical software, differential-algebraic equations, mechanical systems, matrix equations, scientific computing

Publications

Submitted

- [1] S. W. R. Werner and B. Peherstorfer. On the sample complexity of stabilizing linear dynamical systems from data. e-print 2203.00474, arXiv, 2022. Optimization and Control (math.OC). [doi:10.48550/arXiv.2203.00474](https://doi.org/10.48550/arXiv.2203.00474).
- [2] Q. Aumann and S. W. R. Werner. Structured model order reduction for vibro-acoustic problems using interpolation and balancing methods. e-print 2201.06518, arXiv, 2022. Numerical Analysis (math.NA). [doi:10.48550/arXiv.2201.06518](https://doi.org/10.48550/arXiv.2201.06518).
- [3] P. Benner, J. Heiland, and S. W. R. Werner. A low-rank solution method for riccati equations with indefinite quadratic terms. e-print 2111.06516, arXiv, 2021. Numerical Analysis (math.NA). [doi:10.48550/arXiv.2111.06516](https://doi.org/10.48550/arXiv.2111.06516).
- [4] S. W. R. Werner, I. V. Gosea, and S. Gugercin. Structured vector fitting framework for mechanical systems. e-print 2110.09220, arXiv, 2021. Numerical Analysis (math.NA). [doi:10.48550/arXiv.2110.09220](https://doi.org/10.48550/arXiv.2110.09220).
- [5] R. S. Beddig, P. Benner, I. Dorschky, T. Reis, P. Schwerdtner, M. Voigt, and S. W. R. Werner. Structure-preserving model reduction for dissipative mechanical

systems. e-print 2010.06331, arXiv, 2020. Optimization and Control (math.OC). doi:10.48550/arXiv.2010.06331.

Journal Articles

- [6] P. Benner, J. Heiland, and S. W. R. Werner. Robust output-feedback stabilization for incompressible flows using low-dimensional \mathcal{H}_∞ -controllers. *Comput. Optim. Appl.*, 82(1):225–249, 2022. doi:10.1007/s10589-022-00359-x.
- [7] P. Benner, Y. Filanova, D. Karachalios, S. Monem Abdelhafez, J. Przybilla, and S. W. R. Werner. Mathematische Komplexitätsreduktion: Modellreduktion dynamischer Systeme. *Mitteilungen der Deutschen Mathematiker-Vereinigung*, 29(4):198–204, 2021. doi:10.1515/dmvm-2021-0075.
- [8] R. Jendersie and S. W. R. Werner. A comparison of numerical methods for model reduction of dense discrete-time systems. *at-Automatisierungstechnik*, 69(8):683–694, 2021. doi:10.1515/auto-2021-0035.
- [9] P. Benner, S. Gugercin, and S. W. R. Werner. Structure-preserving interpolation for model reduction of parametric bilinear systems. *Automatica J. IFAC*, 132:109799, 2021. doi:10.1016/j.automatica.2021.109799.
- [10] P. Benner, S. Gugercin, and S. W. R. Werner. Structure-preserving interpolation of bilinear control systems. *Adv. Comput. Math.*, 47(3):43, 2021. doi:10.1007/s10444-021-09863-w.
- [11] P. Benner and S. W. R. Werner. Frequency- and time-limited balanced truncation for large-scale second-order systems. *Linear Algebra Appl.*, 623:68–103, 2021. Special issue in honor of P. Van Dooren, Edited by F. Dopico, D. Kressner, N. Mastronardi, V. Mehrmann, and R. Vandebril. doi:10.1016/j.laa.2020.06.024.
- [12] P. Benner and S. W. R. Werner. Hankel-norm approximation of large-scale descriptor systems. *Adv. Comput. Math.*, 46(3):40, 2020. doi:10.1007/s10444-020-09750-w.
- [13] J. Saak, D. Siebelts, and S. W. R. Werner. A comparison of second-order model order reduction methods for an artificial fishtail. *at-Automatisierungstechnik*, 67(8):648–667, 2019. doi:10.1515/auto-2019-0027.

Book Chapters

- [14] P. Benner and S. W. R. Werner. MORLAB—The Model Order Reduction LABoratory. In P. Benner, T. Breiten, H. Faßbender, M. Hinze, T. Stykel, and R. Zimmermann, editors, *Model Reduction of Complex Dynamical Systems*, volume 171 of *International Series of Numerical Mathematics*, pages 393–415. Birkhäuser, Cham, 2021. doi:10.1007/978-3-030-72983-7_19.
- [15] P. Benner and S. W. R. Werner. MORLAB – A model order reduction framework in MATLAB and Octave. In A. M. Bigatti, J. Carette, J. H. Davenport, M. Joswig, and T. de Wolff, editors, *Mathematical Software – ICMS 2020*, volume 12097 of *Lecture Notes in Comput. Sci.*, pages 432–441. Springer International Publishing, Cham, 2020. doi:10.1007/978-3-030-52200-1_43.

Proceedings

- [16] P. Benner and S. W. R. Werner. Frequenz- und zeitbeschränktes balanciertes Abschneiden für Systeme zweiter Ordnung. In T. Meurer and F. Woittennek, editors, *Tagungsband GMA-FA 1.30 'Modellbildung, Identifikation und Simulation in der Automatisierungstechnik' und GMA-FA 1.40 'Systemtheorie und Regelungstechnik', Workshops in Anif, Salzburg, 23.-27.09.2019*, pages 460–474, 2019.
- [17] P. Benner and S. W. R. Werner. MORLAB – Model Order Reduction LABoratory. In T. Meurer and F. Woittennek, editors, *Tagungsband GMA-FA 1.30 'Modellbildung, Identifikation und Simulation in der Automatisierungstechnik' und GMA-FA 1.40 'Systemtheorie und Regelungstechnik', Workshops in Anif, Salzburg, 23.-27.09.2019*, pages 337–342, 2019.
- [18] R. S. Beddig, P. Benner, I. Dorschky, T. Reis, P. Schwerdtner, M. Voigt, and S. W. R. Werner. Model reduction for second-order dynamical systems revisited. *Proc. Appl. Math. Mech.*, 19(1):e201900224, 2019. doi:[10.1002/pamm.201900224](https://doi.org/10.1002/pamm.201900224).
- [19] P. Benner, J. Heiland, and S. W. R. Werner. Robust controller versus numerical model uncertainties for stabilization of Navier-Stokes equations. *IFAC-Pap.*, 52(2):25–29, 2019. 3rd IFAC/IEEE CSS Workshop on Control of Systems Governed by Partial Differential Equation CPDE 2019. doi:[10.1016/j.ifacol.2019.08.005](https://doi.org/10.1016/j.ifacol.2019.08.005).
- [20] P. Benner and S. W. R. Werner. Balancing related model reduction with the MORLAB toolbox. *Proc. Appl. Math. Mech.*, 18(1):e201800083, 2018. doi:[10.1002/pamm.201800083](https://doi.org/10.1002/pamm.201800083).
- [21] P. Benner and S. W. R. Werner. Model reduction of descriptor systems with the MORLAB toolbox. *IFAC-Pap.*, 51(2):547–552, 2018. 9th Vienna International Conference on Mathematical Modelling MATHMOD 2018. doi:[10.1016/j.ifacol.2018.03.092](https://doi.org/10.1016/j.ifacol.2018.03.092).
- [22] P. Benner and S. W. R. Werner. MORLAB - Modellreduktion in MATLAB. In T. Meurer and F. Woittennek, editors, *Tagungsband GMA-FA 1.30 'Modellierung, Identifikation und Simulation in der Automatisierungstechnik' und GMA-FA 1.40 'Theoretische Verfahren der Regelungstechnik', Workshop in Anif, Salzburg, 18.-22.09.2017*, pages 508–517, 2017.
- [23] P. Benner and S. W. R. Werner. On the transformation formulas of the Hankel-norm approximation. *Proc. Appl. Math. Mech.*, 17(1):823–824, 2017. doi:[10.1002/pamm.201710379](https://doi.org/10.1002/pamm.201710379).

Software

- [24] P. Benner and S. W. R. Werner. SOLBT – Limited balanced truncation for large-scale sparse second-order systems (version 3.0), April 2021. doi:[10.5281/zenodo.4600763](https://doi.org/10.5281/zenodo.4600763).
- [25] P. Benner and S. W. R. Werner. SOMDDPA – Second-Order Modally-Damped Dominant Pole Algorithm (version 2.0), April 2021. doi:[10.5281/zenodo.3997649](https://doi.org/10.5281/zenodo.3997649).

- [26] P. Benner and S. W. R. Werner. SOMDDPA – Second-Order Modally-Damped Dominant Pole Algorithm (version 1.1), January 2020. doi:[10.5281/zenodo.3332706](https://doi.org/10.5281/zenodo.3332706).
- [27] P. Benner and S. W. R. Werner. Limited balanced truncation for large-scale sparse second-order systems (version 2.0), January 2020. doi:[10.5281/zenodo.3331592](https://doi.org/10.5281/zenodo.3331592).
- [28] P. Benner and S. W. R. Werner. MORLAB – Model Order Reduction LABoratory (version 5.0), August 2019. see also: <https://www.mpi-magdeburg.mpg.de/projects/morlab>. doi:[10.5281/zenodo.3332716](https://doi.org/10.5281/zenodo.3332716).
- [29] P. Benner and S. W. R. Werner. Limited balanced truncation for large-scale sparse second-order systems (version 1.0), February 2019. doi:[10.5281/zenodo.2553926](https://doi.org/10.5281/zenodo.2553926).
- [30] P. Benner and S. W. R. Werner. SOMDDPA – Second-Order Modally Damped Dominant Pole Algorithm (version 1.0), February 2019. doi:[10.5281/zenodo.2553902](https://doi.org/10.5281/zenodo.2553902).
- [31] P. Benner and S. W. R. Werner. MORLAB – Model Order Reduction LABoratory (version 4.0), December 2018. see also: <https://www.mpi-magdeburg.mpg.de/projects/morlab>. doi:[10.5281/zenodo.1574083](https://doi.org/10.5281/zenodo.1574083).
- [32] P. Benner and S. W. R. Werner. MORLAB-3.0 – model order reduction laboratory, September 2017. see also: <https://www.mpi-magdeburg.mpg.de/projects/morlab>. doi:[10.5281/zenodo.842659](https://doi.org/10.5281/zenodo.842659).

Theses

- [33] S. W. R. Werner. *Structure-Preserving Model Reduction for Mechanical Systems*. Dissertation, Otto-von-Guericke-Universität, Magdeburg, Germany, 2021. doi:[10.25673/38617](https://doi.org/10.25673/38617).
- [34] S. Werner. Hankel-norm approximation of descriptor systems. Master's thesis, Otto-von-Guericke-Universität, Magdeburg, Germany, 2016. doi:[10.25673/4507](https://doi.org/10.25673/4507).
- [35] S. Werner. Numerische Berechnung der Eigenwerte großer Hamiltonisch-positiver Matrizen. Bachelor's thesis, Otto-von-Guericke-Universität, Magdeburg, Germany, 2014.

Contributions to Other Projects

I made contributions to the content of the following software projects:

- J. Saak, M. Köhler, and P. Benner. M-M.E.S.S.-2.2 – The Matrix Equations Sparse Solvers Library, February 2022. see also: <https://www.mpi-magdeburg.mpg.de/projects/mess>. doi:[10.5281/zenodo.5938237](https://doi.org/10.5281/zenodo.5938237).
- J. Saak, M. Köhler, and P. Benner. M-M.E.S.S.-2.1 – The Matrix Equations Sparse Solvers Library, April 2021. see also: <https://www.mpi-magdeburg.mpg.de/projects/mess>. doi:[10.5281/zenodo.4719688](https://doi.org/10.5281/zenodo.4719688).

- J. Saak, M. Köhler, and P. Benner. M-M.E.S.S.-2.0.1 – The Matrix Equations Sparse Solvers Library, February 2020. see also: <https://www.mpi-magdeburg.mpg.de/projects/mess>. doi:10.5281/zenodo.3606345.
- J. Saak, M. Köhler, and P. Benner. M-M.E.S.S.-2.0 – The Matrix Equations Sparse Solvers Library, August 2019. see also: <https://www.mpi-magdeburg.mpg.de/projects/mess>. doi:10.5281/zenodo.3368844.
- J. Saak, M. Köhler, and P. Benner. M-M.E.S.S.-1.0.1 – The Matrix Equations Sparse Solvers Library, April 2016. see also: <https://www.mpi-magdeburg.mpg.de/projects/mess>. doi:10.5281/zenodo.50575.

Presentations

- 29/03/2022 **A New Tangential Interpolation Framework for Model Reduction of Bilinear Systems**, *3rd Workshop on Optimal Control of Dynamical Systems and Applications*, Osijek, Croatia, (invited talk, hybrid conference)
- 20/07/2021 **Robust Output-Feedback Stabilization for Incompressible Flows using Low-Dimensional H-Infinity Controllers**, *SIAM Conference on Control and Its Applications (CT21)*, Spokane, Washington, USA, (invited minisymposium talk, online conference)
- 24/06/2021 **Structure-Preserving Interpolation for Bilinear Systems**, *8th European Congress of Mathematics (8ECM)*, Portorož, Slovenia, (invited minisymposium talk, online conference)
- 16/03/2021 **Structure-Preserving Model Reduction for Bilinear Systems**, *91st GAMM Annual Meeting, Section "Dynamics and Control" (GAMM 2020@21)*, Kassel, Germany, (online conference)
- 11/01/2021 **Model Reduction of Parametric Bilinear Mechanical Systems**, *14th World Congress in Computational Mechanics and ECCOMAS Congress (WCCM-ECCOMAS 2020)*, Paris, France, (online conference)
- 16/07/2020 **MORLAB – A Model Order Reduction Framework in MATLAB & Octave**, *International Congress on Mathematical Software (ICMS 2020)*, Braunschweig, Germany, (online conference)
- 20/05/2020 **Structure-Preserving Interpolation for Bilinear Control Systems**, *Weekly Fellow Seminar Series of "MathCoRe"*, Magdeburg, Germany, (online seminar)
- 25/09/2019 **Frequenz- und zeitbeschränktes balanciertes Abschneiden für Systeme zweiter Ordnung**, *Meeting of the GMA Fachausschuss 1.30 "Modellbildung, Identifikation und Simulation in der Automatisierungstechnik" and GMA Fachausschuss 1.40 "Systemtheorie und Regelungstechnik"*, Anif, Austria
- 25/09/2019 **MORLAB – Model Order Reduction LABORatory**, *Meeting of the GMA Fachausschuss 1.30 "Modellbildung, Identifikation und Simulation in der Automatisierungstechnik" and GMA Fachausschuss 1.40 "Systemtheorie und Regelungstechnik"*, Anif, Austria, (interactive software session)
- 10/09/2019 **Limited Model Reduction for an Artificial Fishtail**, *Meeting of the European SIAM and GAMM Student Chapters (MESIGA 2019)*, Aachen, Germany

- 30/08/2019 **Frequency- and Time-Limited Balanced Truncation for Second-Order Systems**, *4th Workshop on Model Reduction of Complex Dynamical Systems (MODRED 2019)*, Graz, Austria
- 26/06/2019 **How to Reduce the Model of an Artificial Fishtail**, *Weekly Fellow Seminar Series of "MathCoRe"*, Magdeburg, Germany
- 20/05/2019 **Robust Controller versus Numerical Model Uncertainties for Stabilization of Navier-Stokes Equations**, *3rd IFAC/IEEE CSS Workshop on Control of Systems Governed by Partial Differential Equations CPDE and XI Workshop Control of Distributed Parameter Systems, CDPS 2019*, Oaxaca, Mexico, (invited session talk)
- 28/02/2019 **H-Infinity Balanced Truncation for Feedback Control of Flow Problems**, *SIAM Conference on Computational Science and Engineering (CSE19)*, Spokane, Washington, USA, (invited minisymposium talk)
- 22/02/2019 **H-Infinity Balanced Truncation for Feedback Control of Flow Problems**, *Applied Numerical Analysis Seminar, Virginia Polytechnic Institute and State University*, Blacksburg, Virginia, USA, (invited seminar talk)
- 21/09/2018 **MORLAB – A Model Reduction Framework in MATLAB & Octave**, *Meeting of the European SIAM and GAMM Student Chapters (MESIGA 2018)*, Berlin, Germany
- 16/05/2018 **Model Reduction of Linear Dynamical Systems with the MORLAB Toolbox**, *Weekly Fellow Seminar Series of "MathCoRe"*, Magdeburg, Germany
- 20/04/2018 **MORLAB – A Framework for Model Reduction in MATLAB & OCTAVE**, *GAMM-Fachausschuss Dynamik und Regelungstheorie*, Berlin, Germany
- 21/03/2018 **Balancing Related Model Reduction with the MORLAB Toolbox**, *89th GAMM Annual Meeting, Section "Dynamics and Control"*, Munich, Germany
- 22/02/2018 **Model Reduction of Descriptor Systems with the MORLAB Toolbox**, *9th Vienna International Conference on Mathematical Modeling (MATHMOD 2018)*, Vienna, Austria
- 22/09/2017 **MORLAB – Modellreduktion in MATLAB**, *Meeting of the GMA Fachausschuss 1.30 "Modellbildung, Identifikation und Simulation in der Automatisierungstechnik" and GMA Fachausschuss 1.40 "Systemtheorie und Regelungstechnik"*, Anif, Austria
- 17/05/2017 **Model Reduction for Linear Systems**, *Weekly Fellow Seminar Series of "Math-CoRe"*, Magdeburg, Germany
- 09/03/2017 **Hankel-Norm Approximation of Descriptor Systems**, *88th GAMM Annual Meeting, Section "Dynamics and Control"*, Weimar, Germany
- 12/01/2017 **Hankel-Norm Approximation of Descriptor Systems**, *3rd Workshop on Model Reduction of Complex Dynamical Systems (MODRED 2017)*, Odense, Denmark

Posters

- 07/11/2019 **Solving Matrix Equations with the MORLAB Toolbox**, *METT VIII – 8th Workshop on Matrix Equations and Tensor Techniques*, Magdeburg, Germany
- 28/08/2019 **MORLAB – Model Order Reduction LABORatory**, *4th Workshop on Model Reduction of Complex Dynamical Systems (MODRED 2019)*, Graz, Austria

- 27/02/2019 **MORLAB – Model Order Reduction LABORatory**, *SIAM Conference on Computational Science and Engineering (CSE19)*, Spokane, Washington, USA, (invited poster)
- 12/04/2018 **Computing the Hankel-Norm Approximation of Large-Scale Descriptor Systems**, *Model Reduction of Parametrized Systems IV (MoRePaS 2018)*, Nantes, France
- 01/06/2017 **Hankel-Norm Approximation of Descriptor Systems**, *Gene Golub SIAM Summer School: Data Sparse Approximations and Algorithms*, Berlin, Germany

Conference/Workshop Participation without Contribution

- 20/06/2018–
22/06/2018 **International Workshop on Optimal Control of Dynamical Systems and Applications**, *Osijek, Croatia*
- 26/02/2018–
01/03/2018 **12th Elgersburg Workshop**, *Elgersburg, Germany*
- 06/09/2017–
08/09/2017 **2nd MOR PhD Students Workshop**, *Munich, Germany*

Research Stays

- 02/2019–04/2019 **Virginia Polytechnic Institute and State University**, *Blacksburg, Virginia, USA*, local supervisors: Prof. Serkan Gugercin, Prof. Christopher Beattie (3 months)

Teaching

- 11/2019 **Introduction to MATLAB**, *Lecturer (self-directed)*, Max Planck Institute for Dynamics of Complex Technical Systems, Magdeburg, Germany, (one week compact course)
- Winter term
2017/2018 **Funktionentheorie (Complex Analysis)**, *Co-lecturer together with Jan Heiland*, Otto von Guericke University, Magdeburg, Germany
- Summer term
2014 **Consultation hour for the Department of Mathematics**, *Tutor*, Otto von Guericke University, Magdeburg, Germany
- Summer term
2014 **Stochastik für Ingenieure (Stochastic for Engineers)**, *Exercise tutor*, Otto von Guericke University, Magdeburg, Germany
- Winter term
2013/2014 **Explorative Datenanalyse (Exploratory Data Analysis)**, *Exercise tutor*, Otto von Guericke University, Magdeburg, Germany

Supervised Students

Bachelor students

13/06/2019 **Robert Jendersie**, *"Model Order Reduction of Linear Discrete-Time Systems"*,
Co-Advisor: Christian Lessig, Otto von Guericke University, Magdeburg, Germany

Interns

11/2018–03/2019 **Robert Jendersie**, *Implementations in the MORLAB toolbox and other MATLAB related coding tasks*

Awards

03/2020 **Best Paper Award Automatisierungstechnik**, for the contribution *"A comparison of second-order model order reduction methods for an artificial fishtail"*, at -
Automatisierungstechnik, De Gruyter, Austria

06/2019 **SIAM Student Chapter Certificate of Recognition**, Society for Industrial and
Applied Mathematics (SIAM), Philadelphia, USA

Language Skills

German Mother tongue

English Advanced

French Elementary

Programming Skills

Expert MATLAB, LaTeX

Advanced C, Progress

Intermediate Java, Python

Basic BASIC, C++, CSS, Delphi, Haskell, HTML, Javascript, Maple, Pascal, PHP, Prolog,
Shell

Additional Qualification

21/10/2020– **Good Scientific Practice**, Course held by Helga Nolte (CoachInScience), Magde-
23/10/2020 burg, Germany

○ Course content: scientific practice, data management, scientific misconduct

23/09/2020– **Leadership Skills**, Course held by Sabine Lerch (Soft Skills for Science), Magdeburg,
25/09/2020 Germany

○ Course content: leadership models, critical feedback, mediation

10/12/2019– **Presentation Skills**, Course held by the National Institute for Science Communi-
11/12/2019 cation, Karlsruhe, Germany

○ Course content: body language, presentation structures, art of persuasion

Further Activities

since 10/2016 **Student Chapter of SIAM Magdeburg, Germany**

- 04/2017–09/2018, 10/2019–09/2020: IT Officer
- 10/2018–09/2019: President