

# Steffen W. R. Werner

*Curriculum Vitae as of February 2, 2022*



Born September 6, 1992 in Stendal, Germany

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## Contact

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

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## 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

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## 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* [32]
- 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* [33]
- 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* [34]
- 07/2011 **Abitur (university entrance diploma)**, *Diesterweg-Gymnasium, Tangermünde-Havelberg, Germany*

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## Research Interests

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

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## Publications

### Submitted

- [1] 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). URL: <https://arxiv.org/abs/2201.06518>.
- [2] 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). URL: <https://arxiv.org/abs/2111.06516>.
- [3] 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). URL: <https://arxiv.org/abs/2110.09220>.
- [4] P. Benner, J. Heiland, and S. W. R. Werner. Robust output-feedback stabilization for incompressible flows using low-dimensional  $\mathcal{H}_\infty$ -controllers. e-print 2103.01608, arXiv, 2021. Optimization and Control (math.OC). URL: <https://arxiv.org/abs/2103.01608>.

- [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). URL: <https://arxiv.org/abs/2010.06331>.

### Journal Articles

- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.
- [10] 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.
- [11] 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.
- [12] 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

- [13] 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.
- [14] 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

- [15] 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.
- [16] 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.
- [17] 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).
- [18] 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).
- [19] 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).
- [20] 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).
- [21] 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.
- [22] 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

- [23] 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).
- [24] 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).

- [25] 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).
- [26] 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).
- [27] 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).
- [28] 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).
- [29] 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).
- [30] 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).
- [31] 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

- [32] 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).
- [33] 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).
- [34] S. Werner. Numerische Berechnung der Eigenwerte großer Hamiltonisch-positiver Matrizen. Bachelor's thesis, Otto-von-Guericke-Universität, Magdeburg, Germany, 2014.

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## 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

- 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*

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## 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

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## Language Skills

German Mother tongue  
English Advanced  
French Elementary

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## Programming Skills

Expert MATLAB, LaTeX  
Advanced C, Progress  
Intermediate Java, Python  
Basic BASIC, C++, CSS, Delphi, Haskell, HTML, Javascript, Maple, Pascal, PHP, Prolog, Shell

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## Additional Qualification

- 21/10/2020–23/10/2020 **Good Scientific Practice**, *Course held by Helga Nolte (CoachInScience)*, Magdeburg, Germany  
○ Course content: scientific practice, data management, scientific misconduct
- 23/09/2020–25/09/2020 **Leadership Skills**, *Course held by Sabine Lerch (Soft Skills for Science)*, Magdeburg, Germany  
○ Course content: leadership models, critical feedback, mediation
- 10/12/2019–11/12/2019 **Presentation Skills**, *Course held by the National Institute for Science Communication*, Karlsruhe, Germany  
○ Course content: body language, presentation structures, art of persuasion

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## 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