

# Sören von der Gracht, born Schwenker

## Contact Data

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## Current Position

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**Postdoctoral Researcher** with Prof. M. Dellnitz

*Institute of Mathematics, Paderborn University*

09/22–present

Project: Algorithms for Swarm Robotics: Distributed Computing meets Dynamical Systems

## Education

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**Dr. rer. nat.**

*Universität Hamburg, (magna cum laude)*

10/15–12/19

Mathematics

**MSc**

*Universität Hamburg, (excellent with distinction)*

10/13–09/15

Mathematics

**BSc**

*Universität Hamburg, (excellent)*

10/10–09/13

Mathematics

## Employment

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**Postdoctoral Researcher** with Prof. R. Lauterbach and Prof. I. Gasser

*Department of Mathematics, Universität Hamburg*

10/19–09/22

**Postdoctoral Researcher** with Prof. T. Schramm

*Department of Geodesy and Geoinformatics, HafenCity Universität Hamburg*

01/20–12/20

Project: Linear Algebra Driven by Data Science

**Research Associate** with Prof. R. Lauterbach

*Department of Mathematics, Universität Hamburg*

10/15–09/19

**Other**.....

**Parental Leave:** 09/21–11/21 and 04/21–07/21

## Research Interest

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**Network Dynamical Systems:** Genericity, Bifurcation Theory, Application of Representation Theory, Connections to Equivariant Dynamics, Heteroclinic Dynamics, Higher-Order Interactions, Applications to Real-World Systems

**Equivariant Dynamics:** Genericity, Bifurcation Theory

**Representation Theory:** Decomposition of Representations, Monoid Representations, Quiver Representations, Connections to Networks

## Publications\*

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### Original Research Articles.....

**von der Gracht, S.**, E. Nijholt, and B. Rink. "Hypernetworks: Cluster Synchronization Is a Higher-Order Effect". *SIAM Journal on Applied Mathematics* 83.6 (2023), pp. 2329–2353.

**von der Gracht, S.**, E. Nijholt, and B. Rink. "Amplified steady state bifurcations in feedforward networks". *Nonlinearity* 35.4 (2022), pp. 2073–2120.

E. Nijholt, B. Rink, and **Schwenker, S.** "A new algorithm for computing idempotents of  $\mathcal{R}$ -trivial monoids". *Journal of Algebra and its Applications* 20.12 (2021).

E. Nijholt, B. W. Rink, and **Schwenker, S.** "Quiver Representations and Dimension Reduction in Dynamical Systems". *SIAM Journal on Applied Dynamical Systems* 19.4 (2020), pp. 2428–2468.

**Schwenker, S.** "Generic Steady State Bifurcations in Monoid Equivariant Dynamics with Applications in Homogeneous Coupled Cell Systems". *SIAM Journal on Mathematical Analysis* 50 (3 2018), pp. 2466–2485.

R. Lauterbach and **Schwenker, S.** "Equivariant bifurcations in four-dimensional fixed point spaces". *Dynamical Systems* 32.1 (2017), pp. 117–147.

### Submitted.....

C. Bick and **von der Gracht, S.** "Heteroclinic Dynamics in Network Dynamical Systems with Higher-Order Interactions" (2023). arXiv: 2309.02006.

R. Gerlach, **von der Gracht, S.**, and M. Dellnitz. "On the Dynamical Hierarchy in Gathering Protocols with Circulant Topologies" (2023). arXiv: 2305.06632.

**von der Gracht, S.**, E. Nijholt, and B. Rink. "A parametrisation method for high-order phase reduction in coupled oscillator networks" (2023). arXiv: 2306.03320.

**von der Gracht, S.**, E. Nijholt, and B. Rink. "Higher order interactions lead to "reluctant" synchrony breaking" (2023). arXiv: 2311.17186.

### Other publications.....

T. Schramm, I. Gasser, **S. Schwenker**, R. Seiler, A. Lohse, K. Zobel "Linear Algebra driven by Data Science". *Open Educational Resource at the Hamburg Open Online University* (2020), URL: <https://www.hoou.de/projects/linear-algebra-driven-by-data-science/>

E. Nijholt, B. Rink, **S. Schwenker** "Generalised Symmetry in Network Dynamics". *Popular Article in DS Web April* (2020), URL: <https://dsweb.siam.org/The-Magazine/Article/generalised-symmetry-in-network-dynamics>

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\*Family name changed from Schwenker to von der Gracht in 2020

## Theses

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**Dissertation:** *Genericity in Network Dynamics*, Supervisor: Prof. R. Lauterbach

**Master's Thesis:** *Equivariant Bifurcations in  $\mathbb{R}^8$  and the Ize Conjecture*, Supervisor: Prof. R. Lauterbach

**Bachelor's Thesis:** *Instabilität der "logrolling" Lösung in Flüssigkristallen unter Scherströmung (Instability of the "logrolling" solution in liquid crystals under shear flow)*, Supervisor: Prof. R. Lauterbach

## Presentations

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### Invited Conference Presentations.....

**Strange symmetries and strange bifurcations in network dynamical systems:** Dynamical Systems in Porto - Dynamics of singularities and networks (Porto, PT, 15/11/2023)

**How higher order interactions shape the dynamics of hypernetworks:** SIAM Conference on Applications of Dynamical Systems (Portland, OR, USA, 17/05/23)

**Generalising Symmetry via Quiver Representations: Equivariant Dynamics and Applications:** SIAM Conference on Nonlinear Waves and Coherent Structures (Bremen, D, 02/09/22)

**Generalising Symmetry in Equivariant Dynamics using Quiver Representations:** SIAM Conference on Applications of Dynamical Systems (virtual conference, 27/05/21)

**Generalized Feedforward Networks: Algebraic Structure and Steady State Bifurcations:** SIAM Conference on Applications of Dynamical Systems (Snowbird, UT, USA, 19/05/19)

**Generic steady state bifurcations in monoid equivariant dynamical systems:** Workshop on Emerging Topics in Network Dynamical Systems (Lorentz Center, Leiden, NL, 07/06/17)

### Invited Seminar Talks.....

**Higher order interactions shape dynamics differently than diadic interactions:** Oberseminar Angewandte Mathematik (Paderborn University, 09/11/23)

**Amplification in feedforward networks:** Applied Dynamics Seminar (Universität Hamburg, 22/11/22)

**An introduction to dynamical networks and their symmetries:** Oberseminar Angewandte Mathematik (Paderborn University, 10/11/22)

**Amplification in general feedforward networks:** Dynamics Seminar (Vrije Universiteit Amsterdam, 16/06/22)

**Quiver representations as generalised symmetries in network dynamics:** Lowlands Dynamics Seminar (joint virtual seminar of the Vrije Universiteit Amsterdam and the Universität Hamburg, 24/03/21)

**Homogeneous coupled cell systems - Hidden symmetries and representation theory:** Dynamics Seminar (Vrije Universiteit Amsterdam, 23/01/19)

**Homogeneous coupled cell systems: unexpected symmetries and how to exploit them in bifurcation analysis:** Dynamical Systems Seminar (Centro de Matemática da Universidade do Porto, 22/06/18)

**Networks: Nonsymmetric, yet symmetric - An Introduction to Hidden Symmetries in Network Dynamical Systems:** Lothar-Collatz-Seminar (Universität Hamburg, 20/12/17)

**Generische Bifurkationen von Ruhelagen in Monoid-äquivalenten dynamischen Systemen:** AG Dynamische Systeme (Universität Hamburg, 12/05/17)

## Posters.....

**Gathering a robot swarm using circulant communication strategies:** 10th International Congress on Industrial and Applied Mathematics (Tokyo, JP, 25/08/23)

**Generic steady state bifurcations in homogeneous coupled cell networks and related equivariant dynamics:** SIAM Workshop on Network Dynamics (Pittsburgh, PA, USA, 14/07/17)

**Generic Steady State Bifurcations in Homogeneous Coupled Cell Networks:** SIAM Annual Meeting (Pittsburgh, PA, USA, 11/07/17)

## Organized Events

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**Hypernetworks and their dynamics in theory and applications:** Minisymposium at the 10th International Congress on Industrial and Applied Mathematics (25/08/23)

**Novel approaches to networks with varying topologies:** Minisymposium at the SIAM Conference on Applications of Dynamical Systems (17/05/23)

**Dynamics of and on Networks:** Minisymposium at the SIAM Conference on Applications of Dynamical Systems (24/05/21)

**Novel Directions in Network Dynamical Systems:** Minisymposium at the SIAM Conference on Applications of Dynamical Systems (19/05/19)

## Conferences

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**International Workshop: Dynamics in Coupled Network Systems :** Berlin, D, 20/11/2023–22/11/2023

**Dynamical Systems in Porto:** Porto, PT, 01/11/2023–17/11/2023

**10th International Congress on Industrial and Applied Mathematics:** Tokyo, JP, 20/08/23–25/08/23

**SIAM Conference on Applications of Dynamical Systems:** Portland, OR, USA, 14/05/23–18/05/23

**SIAM Conference on Nonlinear Waves and Coherent Structures:** Bremen, D, 30/08/22–02/09/22

**SIAM Conference on Applications of Dynamical Systems:** virtual conference, 23/05/21–27/05/21

**Hamburg Shrinking Targets Workshop:** Hamburg, D, 13/11/19–15/11/19

**Hanseatic Dynamical Systems Days:** Bremen, D, 21/06/19

**SIAM Conference on Applications of Dynamical Systems:** Snowbird, UT, USA, 19/05/19–23/05/19

**Hanseatic Dynamical Systems Days:** Lübeck, D, 23/11/18

**Hanseatic Dynamical Systems Days:** Hamburg, D, 29/06/18

**SIAM Workshop on Network Dynamics:** Pittsburgh, PA, USA, 13/07/17–14/07/17

**SIAM Annual Meeting:** Pittsburgh, PA, USA, 10/07/17–14/07/17

**Workshop on Emerging Topics in Network Dynamical Systems:** Leiden, NL, 06/06/17–09/06/17

**SIAM Conference on Applications of Dynamical Systems:** Snowbird, UT, USA, 21/05/17–25/05/17

**Annual Meeting of the German Mathematical Society 2015:** Hamburg, D, 21/09/15–25/09/15

## Research Stays

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**Vrije Universiteit Amsterdam**

*Invitation by Christian Bick*

**Amsterdam, Netherlands**

14/06/22–17/06/22

**Vrije Universiteit Amsterdam**

*Invitation by Bob Rink*

**Amsterdam, Netherlands**

14/01/19–01/02/19

**Universidade do Porto**

*PPP Projekt Heterokline Dynamik: Stabilität und Bifurkationen*

**Porto, Portugal**

19/06/18–23/06/18

**Vrije Universiteit Amsterdam**

*Invitation by Bob Rink*

**Amsterdam, Netherlands**

15/04/18–20/04/18

**Vrije Universiteit Amsterdam**

*Invitation by Bob Rink and Eddie Nijholt*

**Amsterdam, Netherlands**

21/08/17–25/08/17

## Grants

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**ICIAM:** Financial Support Grant for the 10th International Congress on Industrial and Applied Mathematics 2023

**DAAD:** Travel Award to the 10th International Congress on Industrial and Applied Mathematics 2023

**DAAD:** Travel Award to the SIAM Conference on Applications of Dynamical Systems 2019

**SIAM Student Chapter Universität Hamburg:** Travel Award to the SIAM Annual Meeting and the SIAM Workshop on Network Dynamics 2017

**SIAM:** Travel Award to the SIAM Annual Meeting 2017

**Carl Christiansen-Gedächtnis-Stiftung:** Travel Award to the SIAM Conference on Applications of Dynamical Systems 2017

**MIN-Graduiertenschule der Universität Hamburg:** Travel Award to the SIAM Conference on Applications of Dynamical Systems 2017

**Deutsche Mathematiker-Vereinigung:** DMV Student Grant for the Annual Meeting of the German Mathematical Society 2015

## Professional Societies

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Society for Industrial and Applied Mathematics

## Referee

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Journal of Dynamics and Differential Equations  
Nonlinearity  
SIAM Journal on Applied Dynamical Systems  
Mathematical Reviews – MathSciNet

## Teaching

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<b>Teaching Assistant Analysis III</b> <i>Technische Universität Hamburg</i>	11/21–02/22
<b>Teaching Assistant Differential Equations I</b> <i>Technische Universität Hamburg</i>	10/20–02/21
<b>Development and TA of the MOOC Linear Algebra Driven by Data Science</b> <i>HafenCity Universität Hamburg</i>	01/20–12/20
<b>Teaching Assistant Differential Equations I</b> <i>Technische Universität Hamburg</i>	10/19–02/20
<b>Teaching Assistant Analysis III</b> <i>Technische Universität Hamburg</i>	10/19–02/20
<b>Teaching Assistant Analysis II</b> <i>Technische Universität Hamburg</i>	04/19–09/19
<b>Teaching Assistant Differential Equations I</b> <i>Technische Universität Hamburg</i>	10/18–02/19
<b>Teaching Assistant Analysis III</b> <i>Technische Universität Hamburg</i>	10/17–02/18
<b>Teaching Assistant Differential Equations I</b> <i>Technische Universität Hamburg</i>	10/17–02/18
<b>Teaching Assistant Ordinary Differential Equations and Dynamical Systems</b> <i>Universität Hamburg</i>	04/17–09/17
<b>Teaching Assistant Differential Equations I</b> <i>Technische Universität Hamburg</i>	10/16–02/17
<b>Teaching Assistant Analysis I</b> <i>Technische Universität Hamburg</i>	10/15–02/16
<b>Student Assistant Analysis I &amp; II</b> <i>Universität Hamburg</i>	10/14–08/15
<b>Student Assistant Higher Analysis</b> <i>Universität Hamburg</i>	10/13–03/14
<b>Student Assistant Analysis I &amp; II</b> <i>Universität Hamburg</i>	10/12–09/13

## Other Qualifications and Skills

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**Language:** German (native), English (fluent), French (advanced beginner)

**OS:** Windows

**Text production:** Word,  $\text{\LaTeX}$

**Computer algebra systems:** GAP, MAPLE

**Machine Learning:** Online courses of the Coursera specialisation Deep Learning

**Programming:** basic skills in Python