Andreas Rupp

Curriculum Vitae

Personal Data

Date of birth	April 04, 1992	Office address	LUT University
Place of birth	Roth, Germany		P.O. Box 20
Nationality	German		53851 Lappeenranta

Education

05/2019 **Ph.D. in Applied Mathematics** (minor: soil science), *summa cum laude*, University Erlangen–Nuremberg, Erlangen, Germany

12/2015 **Master of Science in Mathematics** (minor: computer science), University Erlangen–Nuremberg, Erlangen, Germany

08/2014 **Bachelor of Science in Mathematics** (minor: computer science), University Erlangen–Nuremberg, Erlangen, Germany

Awards and Honours

11/2023–10/2028 **Docent** (adjunct professor), *Applied mathematics*, School of Science, Aalto-yliopisto (Aalto University)

09/2023–08/2027 Invited member of the **Young Academy Finland**, Academia Scientiarum Fennica / Finnish Academy of Science and Letters

05/2023–04/2028 **Docent** (adjunct professor), *Numerical analysis of partial differential equations*, School of Engineering Sciences, Lappeenranta–Lahti University of Technology

10/2020 **Staedtler Promotionspreis**, *Staedtler foundation's award for an outstanding doctoral thesis (top ten at University of Erlangen-Nuremberg in 2019)*

Professional Experience

09/2023–08/2027 **Academy Research Fellow**, *Uncertainty quantification for PDEs on hypergraphs*, Lappeenranta–Lahti University of Technology

06/2021–06/2025 **Assistant Professor** (tenure track), Computational Engineering, School of Engineering Science, Lappeenranta–Lahti University of Technology
Leave of absence: 09/2023–06/2025

04/2019–06/2021 **Research Associate**, *DFG EXC 2181 STRUCTURES – Project: Modeling large near-fractal pre-planetary dust aggregates*, Heidelberg University
Principal investigators: Prof. Cornelis Dullemond, Prof. Guido Kanschat

01/2016–04/2019 **Research Assistant**, *DFG RU 2179 MAD Soil – Project: Mechanistic modelling of the formation and consolidation of soil microaggregates*, University Erlangen–Nuremberg
Principal investigators: Dr. Alexander Prechtel, Dr. Nadja Ray

04/2015–04/2019 **Research Assistant**, Chair of Applied Mathematics I, Department of Mathematics, University Erlangen–Nuremberg

Grants and Research Funding

Please visit `https://andreas-rupp.eu/research-projects/` for more details.

03/2024–02/2026 **Funding for Mobility Cooperation with Germany**, *Localized orthogonal decomposition for high-order, hybrid finite elements*, 18,000 €, Principal investigator
Research Council of Finland

01/2024–12/2025 **Program for Project-Related Personal Exchange with Finland**, *High-order hybrid multiscale methods for rough heterogeneous structures*, 15,907 €, Principal investigator in Finland
German Academic Exchange Service

01/2024–04/2028 **Flagship Program**, *Flagship of advanced mathematics for sensing, imaging and modelling*, 7,999,994 € in total (1,033,328 € for Lappeenranta–Lahti University of Technology), Principal investigator
Research Council of Finland

09/2023–08/2027 **Academy Research Fellow**, *Uncertainty quantification for PDEs on hypergraphs*, 667,532 € + 286,086 €, Principal investigator
Academy of Finland

05/2023–04/2025 **Co-Innovation Project**, *3D-Cure: 3D printing for personalized medicine and customized drug delivery*, 2,165,093 € + 927,897 € in total (139,930 € + 59,970 € for Lappeenranta–Lahti University of Technology), Project manager
Business Finland

02/2022–02/2024 **Funding for Mobility Cooperation with Germany**, *Mathematical models and numerical methods for water management in soils*, 18,000 €, Principal investigator
Academy of Finland

01/2022–12/2023 **Program for Project-Related Personal Exchange with Finland**, *Discontinuous Galerkin methods and parameter estimation for microstructure models in porous media*, 15,892 €, Principal investigator in Finland
German Academic Exchange Service

Invited Visiting Researcher

- Bayreuth, DE, multiple
- Bergen, NO, 08/2016
- Berlin, DE, 07/2022
- Dortmund, DE, multiple
- Espoo, FI, multiple
- Hanover, DE, 02/2019
- Heidelberg, DE, multiple
- Helsinki, FI, multiple
- Jena, DE, multiple
- Kigali, RW, multiple
- Kuopio, 10/2021
- Portland, US, 01/2024
- Stuttgart, DE, 06/2017
- Sydney, AUS, 02/2023
- Turku, FI, multiple

Research Output

- 26 peer-reviewed journal articles
- 5 arXiv preprints
- 2 submitted, unpublished manuscripts
- 3 published software packages

Teaching

Lectures at Lappeenranta–Lahti University of Technology

- Mathematical Modeling with PDEs
- Numerical Methods 2
- Scientific Computing
- Seminar on Comp. Engineering

Tutorials at University Erlangen–Nuremberg

- Analysis I, II, III
- Introduction to Functional Analysis
- Numerical Methods for PDEs
- Advanced Numerics for PDEs
- Mathematics for Engineers

Invited Visiting Lecturer

06/2023 **Mathematical Concepts of Artificial Intelligence**, Summer School "First Steps in Biosphere-Atmosphere Modelling", Lahti, Finland

04/2023 **Artificial Intelligence in Atmospheric Science**, University of Helsinki, Helsinki, Finland

03/2023 **Numerical Analysis**, *15 lectures*, African Institute for Mathematical Sciences Rwanda, Kigali, Rwanda

03/2022 **Numerical Methods for Climate Science**, *15 lectures*, African Institute for Mathematical Sciences Rwanda, Kigali, Rwanda

Pedagogical Training

03/2023 **Digital Tools for Effective Teaching**, *4 credits (ECTS)*, Tampere University of Applied Sciences, Lappeenranta, Finland

03/2023 **Building Pedagogical Skills in Modern Learning Environment**, *3 credits (ECTS)*, Tampere University of Applied Sciences, Lappeenranta, Finland

03/2023 **Development Work**, *3 credits (ECTS)*, Tampere University of Applied Sciences, Lappeenranta, Finland

Thesis Supervision

- 1 Ph.D. theses
- 8 Master's theses and equivalent works
- 4 Bachelor's theses

Further Scientific Activities

Expert evaluator

2022/2023 **INRIA team AIRSEA**, jointly with Heikki Haario

Reviewing for Scientific Journals

- Adv Comput Math
- Appl Numer Math
- BIT Numer. Math.
- Commun Comput Phys
- Comput. Appl. Math.
- Comput. Math. with Appl.
- Esaim Math Model Numer Anal
- IMA J. Numer. Anal.
- Int. J. Heat Mass Transf.
- J Sci Comput
- SIAM J Sci Comput

Conference Organization

2023 **BayesComp 2023 Satellite Event: Uncertainty quantification and inverse problems**, March 12 – 14, Levi, Finland, URL: `https://bayescomp2023.com`, A. Rupp, V. Kaarnioja, J. de Wiljes, and M. Simon

2020 **Modeling and Simulation of Transport Phenomena**, October 12 – 15, Treis-Karden, Germany, URL: `http://most2020.math.tu-dortmund.de`, D. Kuzmin, V. Aizinger, F. Frank, A. Rupp, H. Hajduk, and J. Grüll

Organization of Minisymposia

ongoing **Discretization methods involving multiple levels and scales**, M. Hauck, R. Maier, and A. Rupp, SciCADE 2024 – International Conference on Scientific Computation And Differential Equations

ongoing **Structure-preserving finite element methods for computational fluid dynamics**, *invited minisymposium*, D. Kuzmin and A. Rupp, ALGORITMY 2024: Central-European Conference on Scientific Computing

09/2023 **Multilevel and multiscale methods for PDEs**, *3 parts*, R. Maier and A. Rupp, European Conference on Numerical Mathematics and Advanced Applications 2023

09/2023 **Theoretical and computational aspects of the discontinuous Galerkin method**, *3 parts*, V. Aizinger and A. Rupp, European Conference on Numerical Mathematics and Advanced Applications 2023

08/2023 **Regularization models and sampling algorithms in statistics and inverse problems**, *2 parts*, F. Uribe and A. Rupp, ICIAM 2023: The 10th International Congress on Industrial and Applied Mathematics

03/2019 **Advances in hybrid numerical methods for porous media applications**, A. Rupp, A. Ern, and P. Knabner, SIAM Conference on Mathematical & Computational Issues in the Geosciences

03/2019 **Advances in coupling surface flow to subsurface systems**, *2 parts*, I. Rybak and A. Rupp, SIAM Conference on Mathematical & Computational Issues in the Geosciences

Invited Keynote Presentations

2024 **Finnish Mathematical Days**, January 4 – 5, Espoo, Finland, URL: `https://mathdays24.math.aalto.fi/`

Recent Conference Talks

2024 **Seventh Chilean Workshop on Numerical Analysis of Partial Differential Equations**, January 15 – 19, Concepción, Chile

2023 **Inverse Days 2023**, December 11 – 15, Lahti, Finland

2023 **European Conference on Numerical Mathematics and Advanced Applications (ENUMATH) 2023**, September 4 – 8, Lisbon, Portugal

2023 **ICIAM 2023: 2023 International Congress on Industrial and Applied Mathematics**, August 20 – 25, Tokyo, Japan

2023 **The 29th Biennial Numerical Analysis Conference**, June 27 – 30, Glasgow, United Kingdom

2023 **9th Workshop on High-Dimensional Approximation**, February 20 – 24, Canberra, Australia

2022 **MultiMat 2022: 10th International Conference on Numerical Methods for Multi-Material Fluid Flow**, August 22 – 26, Zürich, Switzerland

2022 **28th Nordic Congress of Mathematicians**, August 18 – 21, Espoo, Finland

2022 **15th International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing**, July 17 – 22, Linz, Austria

2022 **European Finite Element Fair 2022**, June 3 – 4, Espoo, Finland

Andreas Rupp

List of Publications

Please visit `https://andreas-rupp.eu/publications/` for the full bibliographic details.

Theses

2019 **Simulating Structure Formation in Soils across Scales using Discontinuous Galerkin Methods**, *Doctoral Thesis*, University Erlangen–Nuremberg,
Shaker: DOI: 10.2370/9783844068016, ISBN: 978-3-8440-6801-6,
OPUS: URN: urn:nbn:de:bvb:29-opus4-112528,
Supervisor: Prof. Peter Knabner (University Erlangen–Nuremberg)
Reviewers: Prof. Albert J. Valocchi (University of Illinois),
Prof. Alexandre Ern (Université Paris-Est)
Shaker Verlag GmbH & OPUS FAU – Online publication system of FAU Erlangen–Nuremberg

2015 **A Discontinuous Galerkin Model of Coupled Surface and Subsurface Flow in a Vertical Two-Dimensional Slice**, *Master's Thesis*, University Erlangen–Nuremberg,
Supervisors: Prof. Vadym Aizinger, Prof. Peter Knabner

2014 **Numerische Studien zur Strukturbildung in Böden durch Mineralreaktionen (Numerical Studies on Mineral Reactions Inducing Structure Formation in Soils)**, *Bachelor's Thesis*, University Erlangen–Nuremberg,
Supervisors: Prof. Peter Knabner, Dr. Alexander Prechtel

Book Contributions

2021 **Numerical Methods for Elliptic and Parabolic Partial Differential Equations: With contributions by Andreas Rupp**, *P. Knabner and L. Angermann*, Springer International Publishing, DOI: 10.1007/978-3-030-79385-2

26 Journal Articles

2023 **Homogeneous multigrid method for HDG applied to the Stokes equation**, *P. Lu, W. Wang, G. Kanschat, and A. Rupp*, IMA Journal of Numerical Analysis, DOI: 10.1093/imanum/drad079

2023 **Hybridizable discontinuous Galerkin method with mixed-order spaces for nonlinear diffusion equations with internal jumps**, *M. Musch, A. Rupp, V. Aizinger, and P. Knabner*, GEM – International Journal on Geomathematics, DOI: 10.1007/s13137-023-00228-7

2023 **Two-level Schwarz methods for hybridizable discontinuous Galerkin methods**, *P. Lu, A. Rupp, and G. Kanschat*, Journal of Scientific Computing, DOI: 10.1007/s10915-023-02121-9

2023 **Analysis of algebraic flux correction schemes for semi-discrete advection problems**, *H. Hajduk and A. Rupp*, BIT Numerical Mathematics, DOI: 10.1007/s10543-023-00957-z

2022 **Analysis of injection operators in geometric multigrid solvers for HDG methods**, *P. Lu, A. Rupp, and G. Kanschat*, SIAM Journal on Numerical Analysis, DOI: 10.1137/21M1400110

2022 **Partial differential equations on hypergraphs and networks of surfaces: Derivation and hybrid discretizations**, *A. Rupp, M. Gahn, and G. Kanschat*, ESAIM: Mathematical Modelling and Numerical Analysis, DOI: 10.1051/m2an/2022011

2021 **Limiter-based entropy stabilization of semi-discrete and fully discrete schemes for nonlinear hyperbolic problems**, *D. Kuzmin, H. Hajduk, and A. Rupp*, Computer Methods in Applied Mechanics and Engineering, DOI: 10.1016/j.cma.2021.114428

2021 **Homogeneous multigrid for embedded discontinuous Galerkin methods**, *P. Lu, A. Rupp, and G. Kanschat*, BIT Numerical Mathematics, DOI: 10.1007/s10543-021-00902-y

2021 **Homogeneous multigrid for HDG**, *P. Lu, A. Rupp, and G. Kanschat*, IMA Journal of Numerical Analysis, DOI: 10.1093/imanum/drab055

2021 **A subcell-enriched Galerkin method for advection problems**, *A. Rupp, M. Hauck, and V. Aizinger*, Computers & Mathematics with Applications, DOI: 10.1016/j.camwa.2021.04.010

2020 **Enriched Galerkin method for the shallow-water equations**, *M. Hauck, V. Aizinger, F. Frank, H. Hajduk, and A. Rupp*, GEM – International Journal on Geomathematics, DOI: 10.1007/s13137-020-00167-7

2020 **FESTUNG 1.0: Overview, usage, and example applications of the MATLAB/GNU Octave toolbox for discontinuous Galerkin methods**, *B. Reuter, H. Hajduk, A. Rupp, F. Frank, V. Aizinger, and P. Knabner*, Computers & Mathematics with Applications, DOI: 10.1016/j.camwa.2020.08.018

2020 **Continuous Galerkin and enriched Galerkin methods with arbitrary order discontinuous trial functions for the elliptic and parabolic problems with jump conditions**, *A. Rupp and S. Lee*, Journal of Scientific Computing, DOI: 10.1007/s10915-020-01255-4

2020 **FESTUNG: A MATLAB/GNU Octave toolbox for the discontinuous Galerkin method. Part IV: Generic problem framework and model-coupling interface**, *B. Reuter, A. Rupp, V. Aizinger, F. Frank, and P. Knabner*, Communications in Computational Physics, DOI: 10.4208/cicp.OA-2019-0132

2020 **Locally bound-preserving enriched Galerkin methods for the linear advection equation**, *D. Kuzmin, H. Hajduk, and A. Rupp*, Computers & Fluids, DOI: 10.1016/j.compfluid.2020.104525

2020 **Numerical benchmark study for flow in highly heterogeneous aquifers**, *C. Alecsa, I. Boros, F. Frank, P. Knabner, M. Nechita, A. Prechtel, A. Rupp, and N. Suciu*, Advances in Water Resources, DOI: 10.1016/j.advwatres.2020.103558

2019 **Application of a cellular automaton method to model the structure formation in soils under saturated conditions: A mechanistic approach**, *A. Rupp, T. Guhra, A. Meier, A. Prechtel, T. Ritschel, N. Ray, and K.U. Totsche*, DOI: 10.3389/fenvs.2019.00170, Frontiers in Environmental Science

2019 **Bound-preserving flux limiting schemes for DG discretizations of conservation laws with applications to the Cahn–Hilliard equation**, *F. Frank, A. Rupp, and D. Kuzmin*, Computer Methods in Applied Mechanics and Engineering, DOI: 10.1016/j.cma.2019.112665

2019 **Beyond Kozeny–Carman: Predicting the permeability in porous media**, *R. Schulz, N. Ray, S. Zech, A. Rupp, and P. Knabner*, Transport in Porous Media, DOI: 10.1007/s11242-019-01321-y

2019 **Discontinuous Galerkin method for coupling hydrostatic free surface flows to saturated subsurface systems**, *B. Reuter, A. Rupp, V. Aizinger, and P. Knabner*, Computers & Mathematics with Applications, DOI: 10.1016/j.camwa.2018.12.020

2018 **Discrete–continuum multiphase model for structure formation in soils including electrostatic effects**, *A. Rupp, K.U. Totsche, A. Prechtel, and N. Ray*, Frontiers in Environmental Science, DOI: 10.3389/fenvs.2018.00096

2018 **Old and new approaches predicting the diffusion in porous media**, *N. Ray, A. Rupp, R. Schulz, and P. Knabner*, Transport in Porous Media, DOI: 10.1007/s11242-018-1099-x

2018 **A local discontinuous Galerkin scheme for Darcy flow with internal jumps**, *A. Rupp, P. Knabner, and C. Dawson*, Computational Geosciences, DOI: 10.1007/s10596-018-9743-7

2017 **Analysis of a mixed discontinuous Galerkin method for instationary Darcy flow**, *V. Aizinger, A. Rupp, J. Schütz, and P. Knabner*, Computational Geosciences, DOI: 10.1007/s10596-017-9682-8

2017 **Discrete–continuum multiscale model for transport, biomass development and solid restructuring in porous media**, *N. Ray, A. Rupp, and A. Prechtel*, Advances in Water Resources, DOI: 10.1016/j.advwatres.2017.04.001

2017 **Convergence order estimates of the local discontinuous Galerkin method for instationary Darcy flow**, *A. Rupp and P. Knabner*, Numerical Methods for Partial Differential Equations, DOI: 10.1002/num.22150

5 Preprints

2023 **Denture reinforcement via topology optimization**, *R. Altunay, K. Vesterinen, P. Alander, E. Immonen, A. Rupp, and L. Roininen*, URL: https://arxiv.org/abs/2309.00396

2023 **A localized orthogonal decomposition strategy for hybrid discontinuous Galerkin methods**, *P. Lu, R. Maier, and A. Rupp*, URL: https://arxiv.org/abs/2307.14961

2023 **Parameter estimation for cellular automata**, *A. Kazarnikov, N. Ray, H. Haario, J. Lappalainen, and A. Rupp*, URL: https://arxiv.org/abs/2301.13320

2023 **Error estimates for completely discrete FEM in energy-type and weaker norms**, *L. Angermann, P. Knabner, and A. Rupp*, URL: https://arxiv.org/abs/2301.06860

2022 **Quasi-Monte Carlo and discontinuous Galerkin**, *V. Kaarnioja and A. Rupp*, URL: `https://arxiv.org/abs/2207.07698`

2 Submitted Manuscripts

2023 **phepy: Visual benchmarks and improvements for out-of-distribution detectors**, *J. Tyree, A. Rupp, P. Clusius, and M. Boy*

2022 **A local discontinuous Galerkin method with varying polynomial orders for advection–diffusion problems**, *A. Rupp, V. Aizinger, and B. Reuter*

3 Software

— **ecdf_estimator: Parameter estimation with empirical cumulative distribution functions**, *A. Rupp*, Python, `https://github.com/AndreasRupp/ecdf_estimator/`

2022 **HyperHDG: Hybrid discontinuous Galerkin methods for PDEs on hypergraphs**, *A. Rupp and G. Kanschat*, C++ and Python, `https://github.com/HyperHDG/`

2014 **FESTUNG: The Finite Element Simulation Toolbox for UNstructured Grids**, *F. Frank, B. Reuter, V. Aizinger, H. Hajduk, and A. Rupp*, MATLAB, `https://github.com/FESTUNG/`

Andreas Rupp

List of Supervised Theses

Please visit `https://andreas-rupp.eu/supervised-theses/` for the full bibliographic details.

1 Ph.D. Theses

ongoing **Topology Optimization of Denture Structures**, *Rabia Altunay*, Lappeenranta–Lahti University of Technology

8 Master's Theses and Equivalent

12/2023 **Spatial decomposition methods for modelling multi-resolution European electricity systems with high shares of renewables**, *G Harish Kaushik*, Lappeenranta–Lahti University of Technology

06/2023 **Modelling Water Reinjection after Methane Extraction in Lake Kivu**, *Jean Modeste Mushimiyimana*, Lappeenranta–Lahti University of Technology

05/2023 **Artificial Intelligence versus Statistical Methods in Parameter Estimation for Discrete Models**, *Ouraga Aime Cevert Ballou*, African Institute for Mathematical Sciences Rwanda

05/2023 **Identifying Hidden Parameters in Cellular Automata with Neural Networks**, *Valery Ashu*, Lappeenranta–Lahti University of Technology

04/2023 **Prudent Response Surface Models: Exploring a Framework for Approximating Simulations with Confidence and Certainty**, *Juniper Tyree*, University of Helsinki

06/2022 **Modeling the Temperature in Lake Kivu**, *Désiré Kabuya*, African Institute for Mathematical Sciences Rwanda

03/2020 **Analysis and Implementation of an Enriched Galerkin Scheme for the Shallow Water Equations**, *Moritz Hauck*, University Erlangen–Nuremberg

07/2018 **A Hybridizable Discontinuous Galerkin Scheme with Different Orders of Approximation Spaces Capable of Dealing with Jump Conditions: Analysis and Implementation**, *Markus Musch*, University Erlangen–Nuremberg

4 Bachelor's Theses

08/2023 **Parameter Estimation for Cellular Automata**, *Joona Lappalainen*, Lappeenranta–Lahti University of Technology

05/2023 **Man vs machine: Beating humans in a multiplayer card game without lookahead**, *Ilmari Vahteristo*, Lappeenranta–Lahti University of Technology

12/2018 **Stabilization Techniques for the Finite Element Method Applied on Advection Dominated Problems**, *Moritz Hauck*, University Erlangen–Nuremberg

12/2018 **Jacobian-Free Newton–Krylov Methods Applied to the Cahn–Hilliard Equation with Degenerate Mobility**, *Tim Roith*, University Erlangen–Nuremberg