KATHRIN HELLMUTH

Curriculum Vitae

Department of Mathematics, University of Würzburg — Emil-Fischer-Straße 40, 97074 Würzburg, Germany — kathrin.hellmuth@uni-wuerzburg.de — +49 151 2097 0553 — personal website

RESEARCH INTERESTS

- *Inverse problems:* parameter identification, identifiability analysis, experimental design, numerical reconstruction, Bayesian inversion
- *Applied PDEs:* kinetic theory, modelling physical phenomena on different levels (microscopic, mesoscopic, macroscopic), particle methods, scaling limits
- *Mathematical biology:* chemotaxis

EMPLOYMENT

Research and Teaching Assistant *10/2020 - 03/2025*
Department of Mathematics, University of Würzburg, Germany

EDUCATION

PhD in Mathematics *since 10/2020*
Department of Mathematics, University of Würzburg, Germany *degree expected 03/2025*
Thesis: Identifiability analysis for the kinetic chemotaxis inverse problem: Reconstructing the kinetic tumbling kernel from macroscopic data
Advisor: Prof. Dr. Christian Klingenberg

M.Sc. and B.Sc. in Mathematics *(grades both 1.0)* *2014-2020*
Department of Mathematics, University of Würzburg, Germany
Thesis: Computing the Black Scholes equation with uncertain volatility using the stochastic Galerkin method and a Bi-Fidelity approach
Advisor: Prof. Dr. Christian Klingenberg

German High School Degree (Abitur) *(grade 1.0)* *2014*

AWARDS AND HONORS

Springer Price for the best PhD contributed talk (Application) *2022*
XVIII International Conference on Hyperbolic Problems (HYP2022) 2022, Malaga, Spain

Travel grants
The 19th International Conference on Hyperbolic Problems (HYP2024) 2024, Shanghai, China *07/2024*
XVIII International Conference on Hyperbolic Problems (HYP2022) 2022, Malaga, Spain *06/2022*
SIAM Conference on Analysis of Partial Differential Equations (PD22), online conference *03/2022*

PhD scholarship
German Academic Scholarship Foundation (Studienstiftung des deutschen Volkes; top 1%), Bonn, Germany *2021-2025*
Marianne-Plehn-Program part-time position, Munich, Germany *2021-2024*

Study scholarship
Hanns-Seidel-Stiftung, Munich, Germany *2015-2020*
Max Weber-Programm of the Free State of Bavaria (top 3% of Bavarian students; non-material support), Munich, Germany *2014-2020*

Vogel Award for an excellent Master thesis in digitalization and AI *2020*
Vogel Stiftung, Würzburg, Germany

Otto-Volk-Urkunde for an excellent Master and Bachelor thesis *2017, 2020*
Otto-Volk-Stiftung, Würzburg, Germany

PUBLICATIONS

Refereed Journal Article

[3] **Kinetic chemotaxis tumbling kernel determined from macroscopic quantities** *2024*
SIAM Journal on Mathematical Analysis, vol. 56, no. 1, pp. 568-587, (arxiv)
jointly with C. Klingenberg, Q. Li, M. Tang

[2] **Computing Black Scholes with Uncertain Volatility—A Machine Learning Approach** *2022*
Mathematics, vol. 10, no. 3, 489, special issue "Numerical Analysis with Applications in Machine Learning", (arxiv)
jointly with C. Klingenberg

[1] **Multiscale convergence of the inverse problem for chemotaxis in the Bayesian setting** *2021*
Computation, vol. 9, no. 11, 119, special issue "Inverse Problems with Partial Data", (arxiv)
jointly with C. Klingenberg, Q. Li, M. Tang

Submitted

[6] **Preserving positivity of Gauss-Newton Hessian through random sampling** (arxiv)
jointly with C. Klingenberg, Q. Li

[5] **A kinetic chemotaxis model and its diffusion limit in slab geometry** (arxiv)
jointly with H. Egger, N. Philippi, M. Schlottbom

[4] **Reconstructing the kinetic chemotaxis kernel using macroscopic data: well-posedness and ill-posedness** (arxiv)
submitted to SIAM Journal on Applied Mathematics, minor revision
jointly with C. Klingenberg, Q. Li, M. Tang

Conference Proceedings

[9] **Multi-scale PDE inverse problem in bacterial movement** (link) *2023*
SEMA SIMAI Springer Series: Proceedings of HYP 2022
jointly with C. Klingenberg, Q. Li

[8] **Inverse problems for kinetic equations - an application to chemotaxis** (link) *2021*
Oberwolfach Reports. Rep. 18, no. 3, pp. 2316–2318

[7] **An inverse problem for chemotaxis** (link) *2021*
Oberwolfach Reports. Rep. 18, no. 2, pp. 1080–1083

Science communication

[10] **Route planning for bacteria** *2022*
Snapshots of modern mathematics from Oberwolfach, no.12 (link)
jointly with C. Klingenberg

TEACHING EXPERIENCE

University of Würzburg

Mathematics for Machine Learning
Lecture, graduate level course *fall 2024*
Exercise class, graduate level course *fall 2023, fall 2022*

Partial Differential Equations in Mathematical Physics
Exercise class, graduate level course *spring 2024, fall 2021*

Linear Algebra I
Exercise class, first semester B.Sc. course *spring 2021, fall 2020*

Analysis I
Student teaching assistant, first semester B.Sc. course *fall 2019*

INVITED TALKS

Workshop on "Kinetic Equations and Machine Learning" *06/2024*
Shanghai Jiao Tong University, Shanghai, China

Kinetic Equations and Inverse Problems: Reconstruction of the mesoscopic chemotactic scattering kernel from macroscopic data. *01/2024*
RWTH Aachen University, Aachen, Germany

An inverse problem for chemotaxis: parameter reconstruction of the mesoscopic tumbling kernel from macroscopic data. *01/2024*
University of Augsburg, Augsburg, Germany

Multiscale Parameter Identification - mesoscopic kernel reconstruction from macroscopic data *09/2023*
Mini-Symposium Inverse Problems of Transport Equations and Related Topics, 11th Applied Inverse Problems Conference, Göttingen, Germany

Kinetic inverse problems: kernel reconstruction from macroscopic data - an application to chemotaxis *11/2022*
Johann Radon Institute for Computational and Applied Mathematics of the Austrian Academy of Sciences (RICAM), Linz, Austria

ORGANIZATION OF SCIENTIFIC EVENTS

Minisymposium "Kinetic Models and Inverse Problems" *03/2022*
SIAM Conference on Analysis of Partial Differential Equations (PD22), online conference

SERVICE

Outreach
Organizational support of a statewide mathematics contest for schoolchildren (Mathematik-Olympiade Bayern) *03/2023*

Women in STEM
Mentoring of a 9th grade STEM interested school girl with the CyberMentor program *2021-2022*

Teaching Organization *06-10/2023*
Revision of online learning course material for university teaching in Mathematics

LANGUAGES

German	mother tongue	**Italian**	fluent
English	fluent	**Spanish**	beginner

PROGRAMMING SKILLS

All computer programs used in our papers were written by myself in **Matlab** and **Python**.

WORKSHOPS AND CONFERENCES THAT I GAVE A TALK AT

GIP 2024 Annual Meeting *09/2024*
Siegen, Germany

The 19th International Conference on Hyperbolic Problems (HYP2024) *07/2024*
Shanghai, China

Workshop on "Kinetic Equations and Machine Learning" *06/2024*
Shanghai, China

Chemnitz Symposium on Inverse Problems *11/2023*
Würzburg, Germany

16th Hirschegg Workshop on Conservation Laws *09/2023*
Hirschegg, Austria

11th Applied Inverse Problems Conference *09/2023*
Göttingen, Germany

SIAM Conference on Computational Science and Engineering (CSE23) *03/2023*
Amsterdam, Netherlands

Junior Researchers Meeting *09/2022*
University of Wisconsin-Madison, WI, USA

XVIII International Conference on Hyperbolic Problems (HYP2022) *06/2022*
University of Málaga, Spain

Inverse problems in biology *03/2022*
Institut Henri Poincaré, Paris, France

SIAM Conference on Analysis of Partial Differential Equations (PD22) *03/2022*
online conference

Tissue growth and movement (Poster presentation) *01/2022*
Institut Henri Poincaré, Paris, France

Small Collaboration: Advanced Numerical Methods for Nonlinear Hyperbolic Balance Laws and Their Applications (hybrid meeting) *08/2021*
MFO Oberwolfach, Germany

Small Collaboration: Modeling Phenomena from Nature by Hyperbolic Partial Differential Equations (hybrid meeting) *04/2021*
MFO Oberwolfach, Germany

REFERENCES

Dr. Qin Li
Department of Mathematics
University of Wisconsin-Madison
Van Vleck Hall, 480 Lincoln Dr.
Madison, WI, 53705, USA
Email: qinli@math.wisc.edu
Phone: +1 (608)262-2881

Dr. Min Tang
Institute of Natural Sciences and School of Mathematics
Shanghai Jiaotong University
800 Dongchuan road,
Shanghai, 200240, CHINA
Email: tangmin@sjtu.edu.cn
Phone: +86 21-54742607

Dr. Christian Klingenberg
Department of Mathematics
University of Würzburg
Emil-Fischer-Straße 40
97074 Würzburg, GERMANY
Email: christian.klingenberg@uni-wuerzburg.de
Phone: +49 931 31-85045

Dr. Matthias Schlottbom
Department of Applied Mathematics
University of Twente
Zilverling (building no. 11), Hallenweg 19
7522 NH Enschede, THE NETHERLANDS
Email: m.schlottbom@utwente.nl
Phone: +31 53 489 5458

Dr. Herbert Egger
RICAM Johann Radon Institute for Computational and Applied Mathematics and
Institute for Numerical Mathematics
Johannes-Kepler University Linz
Science Park 2, Altenberger Str. 69
4040 Linz, AUSTRIA
Email: herbert.egger@jku.at
Phone: +43 732 2468 4051

date: October 21, 2024