

Michael Griebel



Academic career

1985	Diploma in Computer Science, TU Munich (advisor: F. L. Bauer)
1985 - 1990	Research Assistant, Institute for Informatics, TU Munich
1989	PhD in Computer Science, TU Munich (advisor: C. Zenger)
1990 - 1993	Assistant Professor (C1), Institute for Informatics, TU Munich
1993	Habilitation in Computer Science, TU Munich (advisor: C. Zenger)
1994 - 1995	Assistant Professor (C2, Wissenschaftlicher Oberassistent), Institute for Informatics, TU Munich
1995	Venia Legendi in Computer Science, TU Munich
1995 - 1995	Priv.-Doz., Institute for Informatics, TU Munich
Since 1996	Professor (C4) of Scientific Computing and Numerical Simulation, University of Bonn
2000	Visiting Professor, University of California, San Diego, CA, USA
2003 - 2016	Founding Director, Institute for Numerical Simulation, University of Bonn
2009	Visiting Professor, Paris Diderot University (Paris 7), France
2013	Visiting Professor at the School of Mathematics, University of New South Wales, Sydney, Australia
2013 - 2016	Associate Dean of the Faculty of Mathematics and Natural Sciences, University of Bonn
Since 2010	Director, Fraunhofer Institute for Algorithms and Scientific Computing (SCAI), Bonn
Since 2013	Member of the Collaborative Research Center SFB 1060 "The Mathematics of Emergent Effects" of the Deutsche Forschungsgemeinschaft, University of Bonn

Honours

2004	Fellow, Institute for Pure and Applied Mathematics, University of California, Los Angeles, CA, USA
2007	International Fellow, Australian Research Council (ARCIF), University of New South Wales, Sydney, NSW, Australia
2016	John von Neumann Visiting Professorship, TU Munich
2017	Visiting Professorship at Institute for Applied Mathematics, University of New South Wales, Australia

Offers

1995	C4 professorship in numerical mathematics, Düsseldorf
1998	C4 professorship in simulation of large systems, Stuttgart
1998	Research position at the Lawrence Livermore National Laboratory, CA, USA
2002	C4 professorship in technomathematics, TU Kaiserslautern, joint with leading position at the Fraunhofer Institute for Industrial Mathematics (Fraunhofer-Institut für Techno- und Wirtschaftsmathematik, ITWM)

Invited Lectures

2006	International Congress on the Applications of Mathematics, Santiago de Chile, Chile
2006	World Congress on Computational Mechanics, Los Angeles, CA, USA
2006	International Congress of Mathematicians, Madrid, Spain
2006	Numerical Methods in Finance. An AMaMeF Conference, INRIA, Rocquencourt, France
2007	ENUMATH, Graz, Austria
2007	European Postgraduate Fluid Dynamics Conference, Birmingham, England, UK
2008	IUTAM, Symposium on Modeling Nanomaterials and Nanosystems, Aalborg, Denmark
2008	Summer School on Nanotechnology and Mathematics, Santiago de Compostela, Spain
2009	Algorithms and Complexity for Continuous Problems, Dagstuhl, Wadern
2010	Zürich Summer School, Sparse Tensor Discretizations of High-Dimensional Problems, Switzerland
2012	ESF-JSPS Frontier Science Conference for Young Researchers: Mathematics for Innovation Large and Complex Systems, Tokyo, Japan
2016	SIAM Conference on Uncertainty Quantification, Lausanne, Switzerland
2019	SIAM Conference International Conference on Data Mining, Calgary, Canada

Research Projects and Activities

DFG Collaborative Research Center SFB 1060 “The Mathematics of Emergent Effects”,
Principal Investigator

DFG Collaborative Research Center / Transregio SFB/TR 32 “Patterns in Soil-Vegetation-Atmosphere Systems - Monitoring, Modelling and Data Assimilation”

DFG Priority Program SPP 1648 “Software for Exascale Computing”,
Principal Investigator

DFG Priority Program SPP 1506 “Transport Processes at Fluidic Interfaces”,
Principal Investigator

DFG project “Likelihood Approximation for Discrete Choice Models with Sparse Grids”

DFG Cluster of Excellence “Hausdorff Center for Mathematics”,
Principal Investigator

Research profile

A main focus of current research is the approximation of high-dimensional functions and the solution of partial differential equations in high dimensions. Our central tool in this respect is the dimension-adaptive sparse grid method and its generalizations. Another focus is the development of efficient numerical methods for the treatment of two-phase-flow problems and for the simulation of materials on the atomistic and the continuous scale with special emphasis on nano-technology. Finally, adaptive discretizations for partial differential equations, multi-level solvers of the arising linear systems and their parallelization have been investigated.

A main focus of future research will be numerical data analysis. This involves high dimensional regression, density estimation and classification problems in high-dimensional spaces. The emphasis will be on the development of new numerical techniques and on proposing stable algorithms as well as on establishing theoretical results. The research will be driven by real data applications in econometrics and finance and by data-oriented problems from material science. Since data often stem from a low-dimensional manifold embedded in ambient space, we aim

at exploiting this structure by applying adaptive sparse grid algorithms for the h-version, the p-version and the kernel-based versions of approximation. Moreover, we will develop nonlinear methods beyond the Hilbert space setting. To this end, we will replace the conventional Euclidean cost function by more appropriate distance measures such as Banach space norms or Bregman divergences. Here, we again aim at deriving both, a theoretical foundation and stability conditions with error estimates for practical purposes. Finally, we plan to study the relation of our nonlinear methods to deep neural networks.

Editorships

- Numerische Mathematik (Managing Editor)
- Springer Lecture Notes in Computational Science and Engineering
- Springer Texts in Computational Science and Engineering

Selected PhD students

Frank Kiefer (2001): “Multiskalen-Verfahren für Konvektions-Diffusions Probleme”,
now Programme Director, DFG

Jochen Garcke (2004): “Maschinelles Lernen durch Funktionsrekonstruktion mit verallgemeinerten dünnen Gittern”,
now Professor, University of Bonn

Jan Hamaekers (2009): “Tensor Product Multiscale Many-Particle Spaces with Finite-Order Weights for the Electronic Schrödinger Equation”,
now Head of Department “Virtual Material Design”, Fraunhofer SCAI

Habilitations

Gerhard Zumbusch (2001), now Professor, University of Jena

Thomas Gerstner (2007), now Professor, University of Frankfurt

Marc Alexander Schweitzer (2008), now Professor, University of Bonn

Christian Rieger (2016): “Spectral Approximation in Reproducing Kernel Hilbert Spaces”,
now Professor, Philipps University Marburg

Selected publications

- [1] Bastian Bohn, Jochen Garcke, and Michael Griebel. A sparse grid based method for generative dimensionality reduction of high-dimensional data. *J. Comput. Phys.*, 309:1–17, 2016.
- [2] Michael Griebel and Peter Oswald. Schwarz iterative methods: infinite space splittings. *Constr. Approx.*, 44(1):121–139, 2016.
- [3] Michael Griebel, Frances Y. Kuo, and Ian H. Sloan. The smoothing effect of integration in \mathbb{R}^d and the anova decomposition. *Math. Comp.*, 82(281):383–400, 2013.
- [4] Michael Griebel, Stephan Knapek, and Gerhard Zumbusch. *Numerical simulation in molecular dynamics*, volume 5 of *Texts in Computational Science and Engineering*. Springer, Berlin, 2007. Numerics, algorithms, parallelization, applications.
- [5] Hans-Joachim Bungartz and Michael Griebel. Sparse grids. *Acta Numer.*, 13:147–269, 2004.
- [6] T. Gerstner and M. Griebel. Dimension-adaptive tensor-product quadrature. *Computing*, 71(1):65–87, 2003.
- [7] D. W. Brenner, A. Caglar, S. J. V. Frankland, and M. Griebel. Molecular simulation of the influence of chemical crosslinks on the shear strength of carbon nanotube-polymer interfaces. *Journal of Physical Chemistry B*, 106(12):3046–3048, 2002.
- [8] Thomas Dornseifer, Michael Griebel, and Tilman Neunhoffer. *Numerical simulation in fluid dynamics*. SIAM Monographs on Mathematical Modeling and Computation. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 1998. A practical introduction, Translated from the German by Oliver Ernst.
- [9] Thomas Gerstner and Michael Griebel. Numerical integration using sparse grids. *Numer. Algorithms*, 18(3-4):209–232, 1998.
- [10] Michael Griebel. Multilevel algorithms considered as iterative methods on semidefinite systems. volume 15, pages 547–565. 1994. Iterative methods in numerical linear algebra (Copper Mountain Resort, CO, 1992).