



# Curriculum Vitae

Prof. Dr. Miriam **Mehl**

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## Personal Data

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## University Education

- 1993 **Abitur**, Gymnasium Vaterstetten
- 1993 – 1997 **Study of Mathematics**, Technische Universität München, Germany.
- 1997 **Diploma in Mathematics**, Technische Universität München, Germany.
- 2001 **Dr. rer. nat.**, Ein interdisziplinärer Ansatz zur dreidimensionalen numerischen Simulation von Strömung, Stofftransport und Wachstum in Biofilmsystemen auf der Mikroskala (An interdisciplinary Approach to Three-Dimensional Numerical Simulation of Flow, Transport, and Growth in Biofilm Systems on the Microscale), Technische Universität München, Germany.
- 2010 **Habilitation** (Informatics), A Combination of Efficient Numerical and Computer Science Methods for the Simulation of Fluid-Dynamics Applications, Technische Universität München, Germany.

## Professional Experience

- 1997 – 2001 **Research Assistant**, Fakultät für Informatik, Technische Universität München, Germany
- 2001 – 2010 **Postdoctoral Researcher** (part time), Fakultät für Informatik, Technische Universität München, Germany
- September 2001 Birth of son Maximilian
- September 2003 Birth of son Benjamin
- since 2010 **Carl-von-Linde Junior Fellow**, Institute for Advanced Study, Technische Universität München, Germany.
- since 2010 **akademische Oberrätin auf Zeit**, Institut für Informatik, Technische Universität München
- since October 2012 **Univ.-Prof. (W2, stand-in)**, Fakultät für Mathematik, Technische Universität München

## Professional Activities

- since 2011 **Reviewer** Computing and Visualization in Science

## Awards and Honours

- 1993–1997 Bayerische Begabtenförderung
- 2010–2013 Carl-von-Linde Junior Fellowship, Institute for Advanced Study, Technische Universität München
- 2011 Invited Participation at the Workshop *Multiphysics Simulation: Challenges and Opportunities* des Institute for Computation in Science (ICiS) des Argonne National Laboratory (Chicago, USA)

## Memberships

- since 2012 **GAMM Activity Group** Computational Science and Engineering

## Projects

- 2008–2012 A High-End Toolbox for Simulation and Optimisation of Multi-Physics PDE Models (Förderprogramm 'Bayern exzellent': Munich Centre of Advanced Computing (MAC))
- 2009–2012 Computational Steering of Complex Flow Simulations (Förderprogramm 'Bayern exzellent': Munich Centre of Advanced Computing (MAC))
- 2008–2012 Simulation of  $CO_2$  Sequestration (Strategic Partnership with the King Abdullah University of Science and Technology (KAUST))
- 2008–2011 Distributed stochastic simulation for the hydroelastic analysis of very large floating structures (International Graduate School of Science and Engineering, Excellence Initiative of the German Federal and State Governments)

- 2007–2010 Development of New Methods for the Production of Highly Reactive Polyisobutenes (International Graduate School of Science and Engineering, Excellence Initiative of the German Federal and State Governments)
- 2008–2008 Particle Transport in a Drift Ratchet as an Application Example for High Performance CFD and FSI (DEISA (Distributed European Infrastructure for Supercomputing Applications) extreme computing initiative (DECI))
- 2003–2009 Numerical Simulation of Fluid-Structure-Interactions on Cartesian Grids (Forschergruppe 'Fluid-Structure Interaction: Modelling, Simulation, Optimisation' FOR493, German Research Foundation (DFG))
- 2004–2008 Modellierung und Weiterentwicklung von Mikropumpen (German Research Foundation (DFG))
- 2001–2004 Course Development for the Virtual University Bavaria (VHB, Virtuelle Hochschule Bayern)
- 2001–2007 Efficient Parallel Simulation of Fluid Flow on Cartesian Grids (Competence Network for Technical, Scientific High Performance Computing in Bavaria, High-Tech-Offensive Bayern)
- 1998-2001 Design of efficient computation methods for problems of fluid dynamics (FORTWIHR, Forschungsverbund Technisch Wissenschaftliches Hochleistungsrechnen, Bayerische Forschungstiftung)
- 1998-2001 SFB438 - Z2: Mathematical Modelling, Simulation and Verification of material-oriented processes and intelligent systems ( Sonderforschungsbereich SFB 438, German Research Foundation (DFG))
- 1998-2001 SFB411 - C4: Principles of aerobic biological wastewater treatment (Sonderforschungsbereich SFB 411, German Research Foundation (DFG))

## Teaching

- WS12 **Lecture** *Numerical Programming I*
- WS11 **Seminar** *Fluid-Structure Interaction*
- WS11 **Lecture** *Scientific Computing I*
- SS11 **Lecture** *Introduction to Scientific Computing II*
- SS06–SS09 **Lecture** *Introduction to Scientific Computing II*
- WS02–WS04 **Lecture** *Introduction to Scientific Computing I*
- SS09 **Seminar** *Benefits of Hierarchy and Adaptivity*
- WS08–WS09 **Honours Module** *Supervised Teaching*
- WS08–WS09 **Lab Course** *Scientific Computing Lab*
- SS06–SS08 **Lab Course** *Computational Fluid Dynamics*
- WS05–WS07 **Lab Course** *Computational Methods in Science and Engineering*
- SS04-SS05 **Lab Course** *Scientific Computing and Visualization*
- SS02 **Tutorials** *Introduction to Programming*
- WS98-WS00 **Tutorials** *Numerical Mathematics*

## Publications

### Reviewed Articles

H.-J. Bungartz, M. Mehl, and M. Schäfer. *Fluid-Structure Interaction – Modelling, Simulation, Optimisation, Part II*. LNCSE. Springer, Berlin, Heidelberg, 2010.

P. Neumann, H.-J. Bungartz, M. Mehl, T. Neckel, and T. Weinzierl. Coupled approaches for fluid dynamic problems using the pde framework peano. *Commun. Comput. Phys.*, 12(1):65–84, January 2012.

T. Weinzierl and M. Mehl. Peano – a traversal and storage scheme for octree-like adaptive cartesian multiscale grids. *SIAM Journal on Scientific Computing*, 33(5):2732–2760, October 2011.

H.-J. Bungartz, B. Gatzhammer, M. Lieb, M. Mehl, and T. Neckel. Towards Multi-Phase Flow Simulations in the PDE Framework Peano. *Computational Mechanics*, 48(3):365–376, 2011.

M. Mehl, T. Neckel, and Ph. Neumann. Navier-Stokes and Lattice-Boltzmann on octree-like grids in the Peano framework. *International Journal for Numerical Methods in Fluids*, 65(1):67–86, 2010.

H.-J. Bungartz, M. Mehl, T. Neckel, and T. Weinzierl. The PDE Framework Peano Applied to Fluid Dynamics: an Efficient Implementation of a Parallel Multiscale Fluid Dynamics Solver on Octree-like Adaptive Cartesian Grids. *Computational Mechanics*, 46(1):103–114, 2010.

M. Brenk, H.-J. Bungartz, M. Mehl, I.L. Muntean, T. Neckel, and T. Weinzierl. Numerical Simulation of Particle Transport in a Drift Ratchet. *SIAM Journal of Scientific Computing*, 30(6):2777–2798, October 2008.

M. Brenk, H.-J. Bungartz, M. Mehl, I.L. Muntean, T. Neckel, and K. Daubner. An Eulerian Approach for Partitioned Fluid-Structure Simulations on Cartesian Grids. *Computational Mechanics*, 2008.

F. Günther, M. Mehl, M. Pögl, and Ch. Zenger. A Cache-Aware Algorithm for PDEs on Hierarchical Data Structures Based on Space-Filling Curves. *SIAM Journal on Scientific Computing*, 28(5):1634–1650, 2006.

M. Mehl, T. Weinzierl, and Ch. Zenger. A Cache-Oblivious Self-Adaptive Full Multi-grid Method. *Numerical Linear Algebra with Applications*, 13(2-3):275–291, 2006.

M. Kuehn, M. Mehl, M. Hausner, H.-J. Bungartz, and S. Wuertz. Time-Resolved Study of Biofilm Architecture and Transport Processes Using Experimental and Simulation Techniques: The Role of EPS. *Water Science & Technology*, 43(6):143–151, 2001.

H.-J. Bungartz, M. Kuehn, M. Mehl, M. Hausner, and S. Wuertz. Fluid flow and transport in defined biofilms: Experiments and numerical simulations on a microscale. *Water Science & Technology*, 41(4-5):331–338, June 2000.

### Other Publications

D.E. Keyes, L. Curfman McInnes, C. Woodward, W.D. Gropp, E. Myra, M. Pernice, J. Bell, J. Brown, A. Clo, J. Connors, E. Constantinescu, D. Estep, K. Evans, Ch. Farhat, A. Hakim, G. Hammond, G. Hansen, J. Hill, T. Isaac, X. Jiao, K. Jordan, D. Kaushik, E. Kaxiras, A. Koniges, K. Lee, A. Lott, Q. Lu, J. Magerlein, R. Maxwell, M. McCourt, M. Mehl, R. Pawlowski, A. Peters, D. Reynolds, B. Riviere, U. Rude, T. Scheibe, J. Shadid, B. Sheehan, M. Shephard, A. Siegel, B. Smith, X. Tang,

C. Wilson, and B. Wohlmuth. Multiphysics Simulations: Challenges and Opportunities. Technical Report ANL/MCS-TM-321, Argonne National Laboratory, Dec 2011. Workshop Report, Park City, Utah, July 30 - August 6, 2011, sponsored by the Institute for Computing in Science (ICiS).

Michael Bader, Hans-Joachim Bungartz, and Miriam Mehl. Encyclopedia of parallel computing. volume 19, chapter Space-Filling Curves, pages 1862–1867. Springer, Berlin/Heidelberg/New York, 2011.

H.-J. Bungartz, B. Gatzhammer, M. Mehl, and T. Neckel. Partitioned simulation of fluid-structure interaction on cartesian grids. In Hans-Joachim Bungartz, Miriam Mehl, and Michael Schäfer, editors, *Fluid-Structure Interaction – Modelling, Simulation, Optimisation, Part II*, volume 73 of *LNCSE*, pages 255–284. Springer, Berlin, Heidelberg, 2010.

A. Atanasov, H.-J. Bungartz, J. Frisch, M. Mehl, R.-P. Mundani, E. Rank, and Ch. van Treek. Computational steering of complex flow simulations. In S. Wagner, M. Steinmetz, A. Bode, and M. Brehm, editors, *High Performance Computing in Science and Engineering – Garching/Munich 2010*. Springer, Berlin, Heidelberg, 2010.

H.-J. Bungartz, M. Mehl, and Ch. Zenger. Computer science and fluid mechanics – an essential cooperation. In E. Hirschel and E. Krause, editors, *100 Volumes Notes on Numerical Fluid Mechanics and Multidisciplinary Design (NNFM) and 40 Years Numerical Fluid Mechanics*, volume 100 of *Notes on Numerical Fluid Mechanics and Multidisciplinary Design*, pages 437–450. Springer-Verlag, Berlin Heidelberg, 2009.

B. Gatzhammer and M. Mehl. Fsi\*ce – a modular simulation environment for fluid-structure interactions. In Andreas Meister, Michael Schäfer, and Stefan Turek, editors, *Fluid-Structure Interaction: Theory, Numerics, and Applications*, LNCSE. Springer-Verlag, Berlin, Heidelberg, 2009. accepted.

H.-J. Bungartz, M. Mehl, T. Weinzierl, and W. Eckhardt. Dastgen - a data structure generator for parallel c++ hpc software. In Marian Bubak, G. Dick van Albada, Peter M.A. Sloot, and Jack J. Dongarra, editors, *ICCS 2008: Advancing Science through Computation, Part III*, volume 5103 of *Lecture Notes in Computer Science*, pages 213–222. Springer-Verlag, Heidelberg, Berlin, June 2008.

I.L. Muntean, M. Mehl, T. Neckel, and T. Weinzierl. Concepts for efficient flow solvers based on adaptive cartesian grids. In Siegfried Wagner, Matthias Steinmetz, Arndt Bode, and Matthias Brehm, editors, *High Performance Computing in Science and Engineering, Garching 2007*. Springer, Berlin Heidelberg New York, 2008.

M. Mehl, T. Neckel, and T. Weinzierl. Concepts for the efficient implementation of domain decomposition approaches for fluid-structure interactions. In U. Langer, M. Discacciati, D.E. Keyes, O.B. Widlund, and W. Zulehner, editors, *Domain Decomposition Methods in Science and Engineering XVII*, volume 60 of *Lecture Notes in Science and Engineering*, pages 591–598. Springer, Berlin Heidelberg New York, 2008.

M. Brenk, H.-J. Bungartz, M. Mehl, and T. Neckel. Fluid-structure interaction on cartesian grids: Flow simulation and coupling environment. In Hans-Joachim Bungartz and Michael Schäfer, editors, *Fluid-Structure Interaction - Modelling, Simulation, Optimisation*, volume 53 of *LNCSE*, pages 233–269. Springer-Verlag, Berlin, Heidelberg, August 2006.

F. Günther, M. Mehl, M. Pögl, and Ch. Zenger. A cache-aware algorithm for pdes on hierarchical data structures. In J. Dongarra, K. Madsen, and J. Wasniewski, editors, *PARA 2004*, volume 3732 of *LNCS*, pages 874–882. Springer, Berlin, Heidelberg, 2006.

H.-J. Bungartz, M. Mehl, and T. Weinzierl. A parallel adaptive cartesian pde solver using space-filling curves. In Wolfgang E. Nagel, Wolfgang V. Walter, and Wolfgang Lehner, editors, *Euro-Par 2006, Parallel Processing, 12th International Euro-Par Conference*, volume 4128 of *LNCS*, pages 1064–1074. Springer-Verlag, Berlin, Heidelberg, 2006.

M. Mehl. Cache-optimal data-structures for hierarchical methods on adaptively refined space-partitioning grids. In M. Gerndt and D. Kranzlmüller, editors, *High Performance Computing and Communications. Second International Conference, HPCC 2006, Munich, Germany, September 13-15, 2006. Proceedings*, volume 4208 of LNCS. Springer, Berlin Heidelberg, 2006.

M. Langlotz, M. Mehl, T. Weinzierl, and Ch. Zenger. Skvg: Cache-optimal parallel solution of pdes on high performance computers using space-trees and space-filling curves. In A. Bode and F. Durst, editors, *High Performance Computing in Science and Engineering, Garching 2004*, pages 71–82. Springer-Verlag, Berlin Heidelberg New York, August 2005.

F. Günther, A. Krahnke, M. Langlotz, M. Mehl, M. Pögl, and Ch. Zenger. On the parallelization of a cache-optimal iterative solver for pdes based on hierarchical data structures and space-filling curves. In Dieter Kranzlmüller, Peter Kacsuk, and Jack Dongarra, editors, *Recent Advances in Parallel Virtual Machine and Message Passing Interface. 11th European PVM/MPI Users Group Meeting Budapest, Hungary, September 19 - 22, 2004. Proceedings*, volume 3241 of LNCS, pages 425–429. Springer, Berlin Heidelberg, 2004.

H.-J. Bungartz, M. Kuehn, M. Mehl, and S. Wuertz. Space- and time-resolved simulations of processes in biofilm systems on a microscale. In Wolfgang Alt, Mark Chaplain, Michael Griebel, and Jürgen Lenz, editors, *Polymer and Cell Dynamics - Multiscale Modelling and Numerical Simulations*, pages 175–188. Birkhäuser, Basel, October 2003.

H.-J. Bungartz and M. Mehl. Beyond models: Requirements and chances of computational biofilms. In S. Wuertz, P. Wilderer, and P. Bishop, editors, *Biofilms in Wastewater Treatment: An Interdisciplinary Approach*, pages 60–87. IWA Publishing, 2003.

P. Marbach, O. Mihatsch, M. Schulte, and J.N. Tsitsiklis. Reinforcement learning for call admission control and routing in integrated service networks. volume 10 of *Advances in Neural Information Processing Systems*. MIT Press, 1998.

B. Gatzhammer, M. Mehl, and T. Neckel. Partitioned fluid-structure interaction coupling methods for black-box solvers. In Marek Behr, Jens Lang, Ernst Rank, and Michael Schäfer, editors, *2nd International Conference on Computational Engineering (ICCE 2011)*, pages 76–77, Darmstadt, October 2011. Graduate School of Computational Engineering, typographics GmbH.

J. Benk, M. Mehl, and M. Ulbrich. Sundance pde solvers on cartesian fixed grids in complex and variable geometries. In *Proceedings of the ECCOMAS Thematic Conference CFD & Optimization, Antalya, Turkey, May 23-25, 2011*, May 2011.

T. Neckel, M. Mehl, and Ch. Zenger. Enhanced divergence-free elements for efficient incompressible flow simulations in the framework Peano. In *Proceedings of the Fifth European Conference on Computational Fluid Dynamics, ECCOMAS CFD 2010, 14th-17th June 2010, Lissabon*, Lissabon, 2010.

M. Mehl, B. Gatzhammer, and T. Neckel. Partitioned fluid-structure interaction simulations using a hierarchical cartesian flow solver. In *Proceedings of the Fifth European Conference on Computational Fluid Dynamics, ECCOMAS CFD 2010, 14th-17th June 2010, Lissabon*, Lissabon, 2010.

B. Gatzhammer, M. Mehl, and T. Weinzierl. A coupling tool for the partitioned simulation of fluid-structure interactions. In T. Kvamsdal, B. Pettersen, P. Bergan, E. Onate, and J. Garcia, editors, *Computational Methods in Marine Engineering*, volume 3, pages 147–150, Trondheim, June 2009. International Center for Numerical Methods in Engineering (CIMNE), CIMNE.

T. Neckel, M. Mehl, H.-J. Bungartz, and T. Aoki. Cfd simulations using an amr-like approach in the pde framework peano. In *CFD2008*, Tokyo, December 2008. CFD22.

M. Mehl, M. Brenk, I.L. Muntean, T. Neckel, and T. Weinzierl. A modular and efficient simulation environment for fluid-structure interactions with large domain deformation. In M. Papadrakakis and B. H. V. Topping, editors, *Proceedings of the Sixth International Conference on Engineering Computational Technology, Athens, September 2008*, Kippen, Stirlingshire, United Kingdom, September 2008. Civil-Comp Press.

Ch. Zenger, M. Bader, and M. Mehl. Cache oblivious memory management for pde-solvers. In Randolph E. Banks, editor, *Schnelle Löser für partielle Differentialgleichungen*, volume 23 of *Oberwolfach Reports*, page 57. Mathematisches Forschungsinstitut Oberwolfach, 2008.

M. Mehl, M. Brenk, I.L. Muntean, T. Neckel, and T. Weinzierl. Benefits of structured cartesian grids for the simulation of fluid-structure interactions. In *Proceedings of the Third Asian-Pacific Congress on Computational Mechanics*, Kyoto, Japan, December 2007.

M. Brenk, H.-J. Bungartz, M. Mehl, I.L. Muntean, T. Neckel, and T. Weinzierl. A coupling environment for fluid-structure interactions on cartesian grids. In P. Bergan, J. Garcia, E. Onate, and T. Kvamsdal, editors, *International Conference on Computational Methods in Marine Engineering*, Barcelona, June 2007. International Center for Numerical Methods in Engineering (CIMNE).

M. Mehl. An eulerian divergence preserving approach for partitioned fluid-structure simulations on cartesian grids. In *ECCOMAS Thematic Conference on Computational Methods for Coupled Problems in Science and Engineering 2007*. International Center for Numerical Methods in Engineering (CIMNE), May 2007.

H.-J. Bungartz and M. Mehl. Cartesian discretisations for fluid-structure interaction - efficient flow solver. In *Proceedings ECCOMAS CFD 2006, European Conference on Computational Fluid Dynamics, Egmond an Zee, September 5th-8th 2006*, 2006. to appear.

M. Mehl and Ch. Zenger. Cache-oblivious parallel multigrid solvers on adaptively refined grids. In Frank Hülsemann, Markus Kowarschik, and Ulrich Rüde, editors, *Proceedings of the 18th Symposium Simulationstechnique (ASIM 2005)*, volume 15 of *Fortschritte in der Simulationstechnik - Frontiers in Simulation*, pages 173–179, Erlangen, September 2005. SCS European Publishing House.

M. Brenk, H.-J. Bungartz, M. Mehl, R.-P. Mundani, A. Düster, and D. Scholz. Efficient interface treatment for fluid-structure interaction on cartesian grids. In *Proc. of the ECCOMAS Thematic Conf. on Comp. Methods for Coupled Problems in Science and Engineering*. International Center for Numerical Methods in Engineering (CIMNE), 2005.