

Martin Kronbichler — Curriculum Vitae

Personal data

Name	Martin Kronbichler
Date of birth	October 9, 1983
Nationality	Italian
Languages	German, English, Italian, Swedish
Family	Married, two children (born 2011, 2018)

Appointments

11/2012–	Post-doctoral researcher and group leader (Wissenschaftlicher Mitarbeiter) with Wolfgang A. Wall, Institute for Computational Mechanics, Technical University of Munich
07/2012–11/2017	Part-time parental leave (approx. 17%)
02/2012–10/2012	Software developer, group for numerical algorithms, Comsol AB, Stockholm
05/2007–01/2012	Scholar of Graduate School in Mathematics and Computation (FMB) at Uppsala University, including about 15% teaching

Academic degrees

2012	Ph.D. in Scientific Computing with Specialization in Numerical Analysis at Uppsala University, advisors: Gunilla Kreiss, Per Lötstedt. Thesis title: “Computational Techniques for Coupled Flow-Transport Problems”
2007	Diploma in engineering mathematics (Technomathematik), minor subjects mechanical engineering and physics, Technical University of Munich.

Garching b. München, February 15, 2018

Scientific achievements

Peer-reviewed journal papers

- [1] S. Schoeder, M. Kronbichler, W. A. Wall: Arbitrary high-order explicit hybridizable discontinuous Galerkin methods for the acoustic wave equation. *Journal of Scientific Computing*, in press (2018), doi:10.1007/s10915-018-0649-2.
- [2] J. M. Hoermann, C. Bertoglio, M. Kronbichler, M. R. Pfaller, R. Chabiniok, W. A. Wall: An adaptive hybridizable discontinuous Galerkin approach for cardiac electrophysiology. *International Journal for Numerical Methods in Biomedical Engineering*, in press (2018), doi:10.1002/cnm.2959.
- [3] B. Krank, M. Kronbichler, W. A. Wall: Wall modeling via function enrichment within a high-order DG method for RANS simulations of incompressible flow. *International Journal for Numerical Methods in Fluids*, 86, 107–129 (2018), doi:10.1002/flid.4409.
- [4] N. Fehn, W. A. Wall, and M. Kronbichler: On the stability of projection methods for the incompressible Navier–Stokes equations based on high-order discontinuous Galerkin discretizations. *Journal of Computational Physics*, 351, 392–421 (2017), doi:10.1016/j.jcp.2017.09.031.
- [5] B. Krank, N. Fehn, W. A. Wall, M. Kronbichler: A high-order semi-explicit discontinuous Galerkin solver for 3D incompressible flow with application to DNS and LES of turbulent channel flow. *Journal of Computational Physics*, 348, 634–659 (2017), doi:10.1016/j.jcp.2017.07.039.
- [6] D. Arndt, W. Bangerth, D. Davydov, T. Heister, L. Heltai, M. Kronbichler, M. Maier, J.-P. Pelteret, B. Turcksin, D. Wells: The deal.II library, version 8.5. *Journal of Numerical Mathematics*, 25(3), 137–145 (2017), doi:10.1515/jnma-2017-0058.
- [7] M. Kronbichler, G. Kreiss: A phase-field microscale enhancement for macro models of capillary-driven contact point dynamics. *The Journal of Computational Multiphase Flows*, 9(3), 114–126 (2017), doi:10.1177/1757482X17700148.
- [8] S. Schoeder, M. Kronbichler, W. A. Wall: Photoacoustic image reconstruction: material detection and acoustical heterogeneities. *Inverse Problems*, 33(5), 055010 (2017), doi:10.1088/1361-6420/aa635b.
- [9] C. Gürkan, M. Kronbichler, S. Fernández-Méndez: eXtended Hybridizable discontinuous Galerkin with Heaviside enrichment for heat bimaterial problems. *Journal of Scientific Computing*, 72(2), 542–567 (2017), doi:10.1007/s10915-017-0370-6.
- [10] M. Kronbichler, A. Diagne, H. Holmgren: A fast massively parallel two-phase flow solver for the simulation of microfluidic chips. *The International Journal of High Performance Computing Applications*, in press (2016), doi:10.1177/1094342016671790.
- [11] B. Turcksin, M. Kronbichler, W. Bangerth: *WorkStream* – a design pattern for multicore-enabled finite element computations. *ACM Transactions on Mathematical Software* 43(1), no. 2, 1–29 (2016), doi:10.1145/2851488.
- [12] W. Bangerth, D. Davydov, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M.

- Maier, B. Turcksin, D. Wells: The deal.II library, version 8.4. *Journal of Numerical Mathematics*, 24(3), 135–141 (2016), doi:10.1515/jnma-2016-1045.
- [13] M. Kronbichler, S. Schoeder, C. Müller, W. A. Wall: Comparison of implicit and explicit hybridized discontinuous Galerkin methods for the acoustic wave equation. *International Journal for Numerical Methods in Engineering* 106(9), 712–739 (2016), doi:10.1007/s10915-015-0066-8.
- [14] W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin: The deal.II library, version 8.3. *Archive of Numerical Software* 4, pp. 1–11 (2016), doi:10.11588/ans.2016.100.23122.
- [15] C. Gürkan, E. Sala-Lardies, M. Kronbichler, S. Fernández-Méndez: Extended hybridizable discontinuous Galerkin (X-HDG) for void problems. *Journal of Scientific Computing* 66(3), pp. 1313–1333 (2016), doi:10.1007/s10915-015-0066-8.
- [16] W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin, T. D. Young: The deal.II library, version 8.2. *Archive of Numerical Software* 3, pp. 1–8 (2015), doi:10.11588/ans.2015.100.18031.
- [17] O. Axelsson, P. Boyanova, M. Kronbichler, M. Neytcheva, X. Wu: Numerical and computational efficiency of solvers for two-phase problems. *Computers & Mathematics with Applications* 65, pp. 301–314 (2013), doi:10.1016/j.camwa.2012.05.020.
- [18] M. Kronbichler, T. Heister, W. Bangerth: High Accuracy Mantle Convection Simulation through Modern Numerical Methods. *Geophysics Journal International* 191, pp. 12–29 (2012), doi:10.1111/j.1365-246X.2012.05609.x.
- [19] M. Kronbichler, K. Kormann: A generic interface for parallel cell-based finite element operator application. *Computers & Fluids* 63, pp. 135–147 (2012), doi:10.1016/j.compfluid.2012.04.012.
- [20] S. Zahedi, M. Kronbichler, G. Kreiss: Spurious currents in finite element based level set methods for two-phase flow. *International Journal for Numerical Methods in Fluids* 69(9), pp. 1433–1456 (2012), doi:10.1002/flid.2643.
- [21] K. Kormann, M. Kronbichler, B. Müller: Derivation of Strictly Stable High Order Difference Approximations for Variable-Coefficient PDE. *Journal of Scientific Computing*, 50(1), pp. 167–197 (2012), doi:10.1007/s10915-011-9479-1.
- [22] W. Bangerth, C. Burstedde, T. Heister, M. Kronbichler: Algorithms and data structures for massively parallel generic adaptive finite element codes. *ACM Transactions on Mathematical Software* 38(2), no. 14 (2011), doi:10.1145/2049673.2049678.
- [23] V. Gravemeier, M. Kronbichler, M.W. Gee, W.A. Wall: An algebraic variational multiscale multigrid method for large-eddy simulation: generalized- α time integration, Fourier analysis and application to turbulent flow past a square-section cylinder. *Computational Mechanics* 47(2), pp. 217–233 (2011), doi:10.1007/s00466-010-0541-x.
- [24] V. Gravemeier, M.W. Gee, M. Kronbichler, W.A. Wall: An algebraic variational multiscale-multigrid method for large-eddy simulation of turbulent flow. *Computer Methods in Applied Mechanics and Engineering* 119, pp. 853–864 (2010), doi:10.1016/j.cma.2009.05.017.

Refereed conference proceedings

- [25] M. Kronbichler, K. Kormann, I. Pasichnyk, M. Allalen: Fast Matrix-Free Discontinuous Galerkin Kernels on Modern Computer Architectures, in J. Kunkel , R. Yokota, P. Balaji, D. Keyes (eds): *High Performance Computing. ISC 2017*. Lecture Notes in Computer Science, vol 10266, pp. 237–255 (2017), doi:10.1007/978-3-319-58667-0_13.
- [26] C. Gürkan, E. Sala-Lardies, M. Kronbichler, S. Fernández-Méndez: Extended Hybridizable Discontinuous Galerkin (X-HDG) for Void and Bimaterial Problems, in *Advances in Discretization Methods: Discontinuities, Virtual Elements, Fictitious Domain Methods*, G. Ventura and E. Benvenuti (editors), Springer International Publishing, Cham, pp. 103–122 (2016), doi:10.1007/978-3-319-41246-7_5.
- [27] K. Kormann, M. Kronbichler: Parallel finite element operator application: Graph partitioning and coloring. *2011 IEEE 7th International Conference on E-Science*, pp. 332–339 (2011), doi:10.1109/eScience.2011.53.
- [28] T. Heister, M. Kronbichler, W. Bangerth. Massively Parallel Finite Element Programming. In R. Keller, E. Gabriel, M. Resch, and J. Dongarra (eds.), *Recent Advances in the Message Passing Interface*, vol. 6305 of Lecture Notes in Computer Science, pp. 122–131. Springer Berlin/Heidelberg (2010), doi:10.1007/978-3-642-15646-5_13.
- [29] T. Heister, M. Kronbichler, W. Bangerth. Generic Finite Element Programming for Massively Parallel Flow Simulations. *Eccomas 2010 Proceedings* (2010).
- [30] M. Kronbichler, G. Kreiss: A hybrid level-set-Cahn-Hilliard model for two-phase flow. *Proceedings of the 1st European Conference on Microfluidics*, Bologna (2008).
- [31] V. Gravemeier, M. Kronbichler, W.A. Wall: Variational multiscale methods for large eddy simulation of turbulent flows: Fourier analysis and application to diffuser flow. *Proceedings of the Fifth International Symposium on Turbulence and Shear Flow Phenomena (TSFP-5)*, N. Adams, J. Eaton, R. Friedrich (eds.), Munich (2007).

Other publications

Technical reports and arXiv preprints

- [32] B. Krank, M. Kronbichler, W. A. Wall: A multiscale approach to hybrid RANS/LES wall modeling within a high-order discontinuous Galerkin scheme using function enrichment. *arXiv preprint*
<https://arxiv.org/abs/1705.08813> (2017).
- [33] M. Kronbichler, W. A. Wall: A performance comparison of continuous and discontinuous Galerkin methods with fast multigrid solvers. *arXiv preprint*
<http://arxiv.org/abs/1611.03029v2> (2016).
- [34] W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin, T. D. Young: The deal.II library, version 8.1. *arXiv preprint*
<http://arxiv.org/abs/1312.2266v4> (2013).
- [35] W. Bangerth, T. Heister, L. Heltai, G. Kanschat, M. Kronbichler, M. Maier, B. Turcksin, T. D. Young: The deal.II library, version 8.0. *arXiv preprint*

<http://arxiv.org/abs/1312.2266v3> (2013).

- [36] M. Kronbichler and G. Kreiss: A Hybrid Level-Set-Phase-Field Method for Two-Phase Flow with Contact Lines. *Technical report 2011-026*, Department of Information Technology, Uppsala University (2011).
- [37] M. Kronbichler, C. Walker, G. Kreiss, and B. Müller: Multiscale Modeling of Capillary-Driven Contact Line Dynamics. *Technical report 2011-024*, Department of Information Technology, Uppsala University (2011).

Open-source code: finite element example implementations

- [38] M. Kronbichler, S. Miller: HDG for convection-diffusion problems, `deal.II` step-51 tutorial program (2013).
- [39] K. Kormann, M. Kronbichler: Solver for nonlinear wave equation using matrix-free tools, `deal.II` step-48 tutorial program (2012).
- [40] K. Kormann, M. Kronbichler: Matrix-free multigrid solver for Poisson equation, `deal.II` step-37 tutorial program (2012).
- [41] M. Kronbichler, T. Heister, W. Bangerth: Parallel Boussinesq/mantle convection solver, `deal.II` step-32 tutorial program (2011).
- [42] T. Heister, M. Kronbichler, W. Bangerth: Parallel Poisson solver scaling to thousands of processors, `deal.II` step-40 tutorial program (2010).
- [43] M. Kronbichler, W. Bangerth: Serial Boussinesq/mantle convection solver, `deal.II` step-31 tutorial program (2009).
- [44] M. Kronbichler, W. Bangerth: Stokes solver, `deal.II` step-22 tutorial program (2008).

Tutorial programs in `deal.II` are accessible online at

http://www.dealii.org/developer/doxygen/deal.II/step_??_.html

Conference talks

- *ENUMATH 2017*, Voss, September 28, 2017: “High-order infrastructure in the `deal.II` finite element library”.
- *ISC High Performance 2017*, Frankfurt, June 20, 2017: “Fast Matrix-Free Discontinuous Galerkin Kernels on Modern Computer Architectures”.
- *19th International Conference on Finite Elements in Flow Problems – FEF 2017*, Rome, April 6, 2017: “A high-order discontinuous Galerkin solver for turbulent incompressible turbulent flow with matrix-free implementation”.
- *SPPEXA Annual Meeting 2017*, Garching, March 20, 2017: “ExaDG: High-order discontinuous Galerkin for the exa-scale”.
- *ECCOMAS Congress 2016*, Crete Island, June 10, 2016: “A high-performance discontinuous Galerkin solver for the simulation of incompressible turbulent flow”.

- *Higher-order DG methods and finite element software for modern architectures*, Bath, May 31, 2016: Invited talk on “Fast matrix-free methods via generic finite element programming”.
- *5th European Trilinos User Group Meeting (EuroTUG 2016)*, Garching, April 20, 2016: “Tuning a large multiphysics code for performance and limitations of the legacy Epetra stack”.
- *SPPEXA Annual Meeting 2016*, Garching, January 27, 2016: Talk on “ExaDG: High-order discontinuous Galerkin for the exa-scale”.
- *Simula workshop on dynamic adaptivity*, Simula Research Laboratory, Oslo, December 9, 2015: Invited talk on “High-performance implementation of adaptive finite elements with matrix-free multigrid methods”.
- *Jahrestagung der Deutschen Mathematiker-Vereinigung 2015*, Hamburg, September 25, 2015: “Hybridizable discontinuous Galerkin methods for incompressible flow”.
- *Platform for Advanced Scientific Computing Conference PASC15*, Zürich, June 2, 2015: “Shared memory parallelization strategies for matrix-free finite element operator evaluation”.
- *3rd German Japan Workshop on Computational Mechanics*, Garching, March 30, 2015: “Hybridized Discontinuous Galerkin methods for large eddy simulation of turbulent flow”.
- *International SPPEXA Workshop: Numerical Methods for High-Performance Computers*, Heidelberg, December 2, 2014: Invited talk on “Fast matrix-free methods for adaptive higher order elements”.
- *11th World Congress on Computational Mechanics*, Barcelona, July 23, 2014: “Hybridized discontinuous Galerkin methods for large eddy simulation of turbulent flow”.
- *42nd SPEEDUP Workshop on High-Performance Computing*, Paul-Scherrer-Institut / ETH Zürich, August 29, 2013: Invited talk on “ASPECT: An advanced mantle convection solver based modern numerical software”.
- *deal.II workshop*, Texas A&M University, College Station, August 20, 2013: Invited talk on “Efficient matrix-free methods in deal.II”.
- *7th International Conference on e-Science*, Stockholm, December 8, 2011: Talk on “Parallel Finite Element Operation Application: Graph Partitioning and Coloring”.
- *ENUMATH 2011*, Leicester, September 8, 2011: Talk on “Multiscale modeling of contact line dynamics”.
- *ENUMATH 2011*, Leicester, September 6, 2011: Talk on “Strictly stable high order finite differences for variable coefficient convection–diffusion equations”.
- *deal.II workshop*, Heidelberg, August 24, 2010: Talk on “Generic and efficient solvers for coupled flow/transport problems”.
- *V European Conference on Computational Fluid Dynamics (Eccomas)*, Lisbon, June 14, 2010: Talk on “A Hybrid Level-Set-Cahn-Hilliard model for Two-Phase Flow”.

- *ENUMATH 2009*, Uppsala, July 2, 2009: Talk on “A conservative level set method with Cahn–Hilliard contact line dynamics”.
- *1st European Conference on Microfluidics*, Bologna, December 11, 2008: Poster on “A hybrid level–set–Cahn–Hilliard model for two-phase flow”.
- *BIT Numerical Circus*, Oslo, August 28, 2008: Talk on “A hybrid level–set–Cahn–Hilliard model for two-phase flow”.

Awards

- “Extreme Scaling Award – Finalist” for excellent strong scaling of our code INDEXA to 147,456 cores of SuperMUC

Referee assignments

- ACM Transactions on Mathematical Software
- Communications in Computational Physics
- European Journal of Mechanics / B Fluids
- International Journal for Numerical Methods in Engineering
- International Journal for Numerical Methods in Fluids
- Journal of Applied Mathematics and Computing
- Journal of Computational Physics
- Microfluidics and Nanofluidics
- SIAM Journal on Numerical Analysis
- SIAM Journal on Scientific Computing
- Transactions in Parallel and Distributed Computing