Hartwig Anzt

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Summary

Hartwig Anzt is the director of the Innovative Computing Lab (ICL) and Professor in the Electrical Engineering and Computer Science Department of the University of Tennessee. He also holds a Senior Research Scientist Position at Steinbuch Centre for Computing at the Karlsruhe Institute of Technology where he previously held an Early Career Award and a Junior Professorship and in the Faculty of Computer Science. Hartwig Anzt received a Diploma in Industrial Mathematics (2009) from the Karlsruhe Institute of Technology. During his studies, he spent one year at the University of Ottawa. He received a PhD in Applied Mathematics from the Karlsruhe Institute of Technology in 2012. Hartwig Anzt works on numerical methods for high performance computing and specializes on iterative methods and preconditioning techniques for the next generation hardware architectures. He also has a long track record of high-quality development. He is author of the MAGMA-sparse open source software package and managing lead of the Ginkgo math software library. Hartwig Anzt is the PI of Software Technology (ST) projects that are part of the US Exascale Computing Project (ECP), including a coordinated effort aiming at integrating low-precision functionality into high-accuracy simulation codes. He also is a PI in the Horizon 2020 EuroHPC Project MICROCARD on cardio-physiology. Hartwig Anzt is the main author of more than 80 peer-reviewed publications, part of the scientific committee of international conferences, Associate Editor of the SIAM Journal on Scientific Computing (SISC), Associate Editor of ACM Transactions on Parallel Computing, and workshop chair for ISC High Performance 2022.

Professional Background

August 2022 – now	**Director of the Innovative Computing Lab (ICL)**, *University of Tennessee*.
August 2022 – now	**Associate Professor in the Electrical Engineering and Computer Science Department (EECS)**, *University of Tennessee*.
August 2022 – now	**Senior Scientist**, *Karlsruhe Institute of Technology*.
Nov 2021 – July 2022	**Juniorprofessor in the Department for Informatics**, *Karlsruhe Institute of Technology*.
May 2017 – July 2022	**Helmholtz Young Investigator Group Leader**, *Karlsruhe Institute of Technology*. Steinbuch Centre for Comuting (SCC)
May 2018 – July 2022	**KIT Associate Fellow**, *Karlsruhe Institute of Technology*, Karlsruhe.
May 2017 – July 2022	**Research Consultant**, *University of Tennessee*, Knoxville. Innovative Computing Lab (ICL)
June 2015 – May2017	**Research Scientist**, *University of Tennessee*, Knoxville. Innovative Computing Lab (ICL)
June 2013 – May 2015	**PostDoctoral Researcher**, *University of Tennessee*, Knoxville. Innovative Computing Lab (ICL)
March 2010 – May 2013	**Research Associate**, *Karlsruhe Institute of Technology*, Karlsruhe. Institute for Applied and Numerical Mathematics

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Academic Background

2021	**Associate Professor in EECS**, *University of Tennessee*.
2021	**Junior Professor in Informatics**, *Karlsruhe Institute of Technology*.
2020	**Evaluation of the Helmholtz Young Investigator Group**, *Successful completion of the evaluation (with distinction)*, Tenured on Research Group Lead Position.
2020	**Completion of the KIT Academic Leadership Certificate**, *(204 academic units of leadership training)*.
2017–now	**Helmholtz Young Investigator Group Lead**, *Karlsruhe Institute of Technology*, Algorithm Engineering for Exascale.
2013–2015	**PostDoctoral Researcher**, *University of Tennessee*, Numerical Linear Algebra.
Nov. 2012	**PhD, Mathematics**, *Asynchronous and Multiprecision Linear Solvers*, Prof. Dr. Vincent Heuveline, Prof. Dr. Jack Dongarra, Prof. Dr. Rudolf Lohner.
2010–2012	**PhD Student**, *Karlsruhe Institute of Technology*, Mathematics.
Dec. 2009	**Dipl. Math.-techn.**, *Hybrid Parallel Solvers for Computational Fluid Dynamics*, Prof. Dr. Vincent Heuveline, Jun.-Prof. Dr. Jan-Philipp Weiss.
2008–2009	**Graduate Student**, *University of Karlsruhe*, Mathematics, Physics, Computer Science.
2007–2008	**Graduate Student**, *University of Ottawa, CA*, Mathematics, Computer Science.
June 2006	**Prediploma**, *University of Karlsruhe*.
2004–2006	**Student**, *University of Karlsruhe*, Mathematics, Physics, Computer Science.
1995–2004	**Abitur**, *Otto-Hahn-Gymnasium Karlsruhe*, Graduated with distinction, Grade: 1.0.

Third Party Funding

Pending	**Co-PI in BMBF Project**, *WarmWorld*, Total volume €4.5M, **€1.2M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**. Funded by the German BMBF
2021	**PI of Intel OneAPI Center of Excellence**, *US$.1M/year at the University of Tennessee*, Industry collaboration project funded by the Intel Corporation.
2021	**PI in subproject of US Exascale Computing Project**, *GPU-resident sparse direct solvers*, Total volume US$1.2M, **US$.4M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**. Funded by US Department of Energy (DoE)
2021	**Co-PI in subproject of US Exascale Computing Project**, *xSDK Batched Kernels*, Total volume US$1.3M, **US$.15M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**. Funded by US Department of Energy (DoE)
2021	**PI in Fair-RS project on deploying a sustainable research software infrastructure**, Total volume €.5M, **€.4M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**. Funded by the digitalization fund of the Karlsruhe Institute of Technology
2021	**Co-PI in Germany's High Performance Computing Initiative (NHR)**, Karlsruhe Institute of Technology. Funded by the State of Baden-Wuerttemberg and the German Federal Government
2021	**PI in EuroHPC project**, *Numerical modeling of cardiac electrophysiology at the cellular scale – MICROCARD*, Total volume €5.8M, **€0.7M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**. Funded by the European Comission

2019   **PI in subproject of US Exascale Computing Project**, *xSDK Multiprecision effort of the US Exascale Computing Project*, Total volume US$3M, **US$1.5M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**.
Funded by US Department of Energy (DoE)

2021   **PI in KIT Information Technology Project**, *Numerical Libraries accelerating Computational Science*, Total volume €.14M, **US$.14M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**.
Funded by the Information Technology fund of the Karlsruhe Institute of Technology

2017   **PI in Helmholtz Young Investigator Group (HYIG)**, *Fixed-Point Methods for Numerics at Exascale (FiNE)*, (Total volume **€1.5M to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**, Helmholtz Foundation, Karlsruhe Institute of Technology (KIT).

2020   **PI in KIT Young Investigator Project**, *OpenCarp Accelerate*, Total volume €80K, **€40K to Hartwig Anzt's research group at the Karlsruhe Institute of Technology**.

Total volume of personalized third party funding in the last 5 years: ∼ **€5M.**

Research Focus

○ Algorithm engineering for computational mathematics, in particular numerical liner algebra.
○ Design of algorithms for extreme parallelism and GPU computing.
○ Mixed precision and adaptive precision methods.
○ Asynchronous and communication-avoiding algorithms.
○ Sustainable software engineering.
○ Production-ready math libraries.
    – Ginkgo library: `https://ginkgo-project.github.io/`
    – MAGMA-sparse library: `http://icl.cs.utk.edu/magma/`

Professional Activities

Recent Community Event Organization
○ Associate Editor: **SIAM Journal on Scientific Computing (SISC) 2022-2024** `https://www.siam.org/publications/journals/siam-journal-on-scientific-computing-sisc`

○ Associate Editor: **ACM Transactions on Parallel Computing (TOPC) 2022-25** `https://dl.acm.org/journal/topc`

○ Workshop chair: **ISC High Performance 2022** `https://www.isc-hpc.com/`

○ Workshop deputy chair: **ISC High Performance 2021** `https://www.isc-hpc.com/`

○ Workshop deputy chair: **ISC High Performance 2020** `https://www.isc-hpc.com/`

○ Tutorial organizer: **Modern Mixed and Multiprecision Methods**
at International Conference on Supercomputing, ISC 2021, Frankfurt

○ Session organizer: **Multiprecision Numerics in Scientific High Performance Computing**
at Platform for Advanced Scientific Computing, PASC 2021, Geneva

○ Session organizer: **Multiprecision Numerics in Scientific High Performance Computing**
at Siam Conference on Linear Algebra, SIAM LA 2021, New Orleans

○ Workshop co-chair: **ISC High Performance 2021**, **ISC High Performance 2021**

○ Workshop co-chair: **ISC High Performance 2020**, **ISC High Performance 2020**

○ Workshop organizer: **Workshop on Scalable Data Analytics in Scientific Computing (SDASC)** at ISC High Performance 2019

○ Session organizer: **Scientific Computing** at GAMM 2019

Program Committee
○ ISC High Performance (ISC)
○ International Parallel and Distributed Processing Symposium (IPDPS)
○ Platform for Advanced Scientific Computing (PASC)
○ International Workshop on Parallel Matrix Algorithms and Applications (PMAA)
○ International Conference on Computational Science (ICCS)
○ Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems (ScaLA)
○ International European Conference on Parallel and Distributed Computing (EuroPar)

Journal Reviews
○ PLOS One
○ SIAM Journal on Scientific Computing (SISC)
○ Transactions on Parallel and Distributed Systems (TPDS)
○ Parallel Computing (ParCO)
○ Journal of Parallel and Distributed Computing (JPDC)
○ International Journal of High Performance Computing and Applications (IJHPCA)
○ Transactions on Mathematical Software (ACM TOMS)
○ Concurrency and Computation: Practice and Experience (CCPE)
○ Computer Physics Communications (CPC)
○ Numerical Algorithms
○ Journal of Computational Science (JoCS)

Memberships and Community Involvement
○ Executive Board Member of the Young Investigator Network (YIN) of the Karlsruhe Institute of Technology
○ Elected member of the KIT-Konvent, an elected institution participating in the KIT political process.
○ Permanent guest of the KIT-Konvent, an elected institution participating in the KIT political process.
○ Member of the IEEE Society
○ Member of the Society of Industrial and Applied Mathematics (SIAM)
○ Member of the Association for Computing Machinery (ACM)
○ de-RSE Interest group for creating sustained funding for research software
○ Member of the German "Gesellschaft für Angewandte Mathematik und Mechanik"

Teaching Experience

2022 **Numerical Linear Algebra for Scientific High Performance Computing**, *LV 24001380 + 2400140*, Karlsruhe Institute of Technology.

2021 **Numerical Linear Algebra for Scientific High Performance Computing**, *LV 0110650*, Karlsruhe Institute of Technology.

2020 **Numerical Linear Algebra for Scientific High Performance Computing**, *LV 0110650*, Karlsruhe Institute of Technology.

2019 **Scientific Computing for Engineers**, *Invited Lecture in COSC 594 - 005*, University of Tennessee, Knoxville.

2019 **Sustainable Software Development in an Academic Setting**, *Tutorial at 4th International Symposium on Research and Education of Computational Science (RECS)*, University of Tokyo, Japan.

2019 **Selected Topics in Parallel Computing**, *Seminar*, Karlsruhe Institute of Technology.

2019 **Numerical Linear Algebra meets Machine Learning**, *Software Engineering Practice (PSE)*, Karlsruhe Institute of Technology.

2018 **Efficient numerical simulation on multi- and manycore processors**, *Invited Lecture*, Friedrich-Alexander University of Erlangen-Nuremberg.

2018 **Selected Topics in Parallel Computing**, *Seminar*, Karlsruhe Institute of Technology.

2018 **Numerical Linear Algebra for Scientific High Performance Computing**, *LV 0110650*, Karlsruhe Institute of Technology.

2018 **Scientific Computing and Machine Learning on Multi- and Manycore Architectures**, *2018 NCTS Short Course*, National Taiwan University.

2017 **Numerical Linear Algebra for Scientific High Performance Computing**, *LV 0110650*, Karlsruhe Institute of Technology.

Graduated Bachelor and Master Students

2021 **Yannick Funk**.

2019 **Fritz Göbel**.

2018 **Thomas Grützmacher**.

2020 **Xenia-Rosa Volk**.

2020 **Mario Haag**.

2020 **Julius Wörner**.

2020 **Niko Wilhelm**.

2021 **Yannick Funk**.

Graduated PhD students

2019 **Goran Flegar**, *now working at Google*.

PhD committee member

2021 **Soumyadip Ghosh**, *Notre Dame University*, now working at Intel.

2020 **Michael Morgan Wise**, *University of Tennessee*, now working at Dynetics.

2018 **Ernesto Dufechrou**, *University of the Republic Uruguay*, now working at University of the Republic Uruguay.

Scientific Metrics

Citations **1700**, *(Google Scholar, August 2022)*.

h-index **25**, *(Google Scholar, August 2022)*.

i10-index **63**, *(Google Scholar, August 2022)*.

Public Outreach and recent Invited Talks

Hartwig Anzt *Curriculum Vitae*

Slides available online: `https://hartwiganzt.github.io/`

2021 **Mixed Precision Strategies for Memory-Bound Linear Algebra**, *LANS Seminars Series of the Los Alamos National Laboratory, 2021.*

2021 **Pushing the Roofline: A Modular Precision Ecosystem Based on a Memory Accessor**, *FAU Perf Lab Seminar Series*, Friedrich-Alexander-University Erlangen-Nuermberg, 2021.

2021 **Preparing for the Arrival of Intel's Discrete High-Performance GPUs**, *HPCwire.*

2021 **Mixed Precision Preconditioning Strategies in Iterative Sparse Linear Algebra**, *SIAM Conference on Computational Science and Engineering*, Denver, 2021.

2020 **The Foundation of all Digital Research Success: Sustainable High Performance Math Libraries**, *World Laureates Forum*, Shanghai, 2020.

2020 **Is the Nvidia A100 GPU Performance Worth a Hardware Upgrade?**, *HPCwire.*

2020 **Research: A Survey of Numerical Methods Utilizing Mixed Precision Arithmetic**, *HPCwire.*

2020 **The Multiprecision Effort in the US Exascale Computing Project**, *ICERM Workshop at Brown University: Variable Precision in Mathematical and Scientific Computing*, Brown University, 2020.

2019 **The Ginkgo Library Project is Developing a Vision for Multiprecision Algorithms**, *US Exascale Computing Project Podcast*, Episode 47, `https://insidehpc.com/2019/12/podcast-developing-multiprecision-algorithms-with-the-ginkgo-library-project/`.

2019 **The Ginkgo Sparse Linear Algebra Package**, *Supercomputing 2019, Booth Talk.*

2019 **Accepting High-Quality Software Contributions as Scientific Publications**, *Blog Article of the Better Scientific Software (BSSw) initiative.*

2019 **Algorithm design in the advent of exascale computing**, *4th International Symposium on Research and Education of Computational Science (RECS)*, The Computational Science Alliance of the University of Tokyo, 2019.

2019 **Addressing the Communication Bottleneck: Towards a Modular Precision Ecosystem for HPC**, *Focus Session at the ISC High Performance 2019: New Approaches, Algorithms Towards Exascale Computing.*

2019 **The Art of Writing Scientific Software in an Academic Environment**, *Blog Article of the Better Scientific Software (BSSw) initiative.*

2019 **Exploiting Node-level Performance in Sparse Linear Algebra** , *SIAM Conference on Computational Science and Engineering (SIAM CSE 2019), Spokane.*

2019 **An Automated Performance Evaluation Framework for the Ginkgo Software Ecosystem**, *90th Annual Meeting of the International Associaten of Applied Mathematics and Mechanics (GAMM 2019), Vienna.*

Peer-Reviewed Publications

Journal Papers

[1] José I. Aliaga, Hartwig Anzt, Thomas Grützmacher, Enrique S. Quintana-Ortí, and Andrés E. Tomás. Compression and load balancing for efficient sparse matrix-vector product on multicore processors and graphics processing units. *Concurrency and Computation: Practice and Experience*, n/a(n/a):e6515.

[2] Thomas Grützmacher, Hartwig Anzt, and Enrique S. Quintana-Ortí. Using ginkgo's memory accessor for improving the accuracy of memory-bound low precision blas. *Software: Practice and Experience*, n/a(n/a).

[3] Hartwig Anzt, Terry Cojean, Goran Flegar, Fritz Göbel, Thomas Grützmacher, Pratik Nayak, Tobias Ribizel, Yuhsiang Mike Tsai, and Enrique S. Quintana-Ortí. Ginkgo: A modern linear operator algebra framework for high performance computing. *ACM Trans. Math. Softw.*, 48(1), feb 2022.

[4] Ahmad Abdelfattah, Hartwig Anzt, Erik G Boman, Erin Carson, Terry Cojean, Jack Dongarra, Alyson Fox, Mark Gates, Nicholas J Higham, Xiaoye S Li, et al. A survey of numerical linear algebra methods utilizing mixed-precision arithmetic. *The International Journal of High Performance Computing Applications*, 35(4):344–369, 2021.

[5] Hartwig Anzt, Eileen Kuehn, and Goran Flegar. Crediting pull requests to open source research software as an academic contribution. *Journal of Computational Science*, 49:101278, 2021.

[6] Goran Flegar, Hartwig Anzt, Terry Cojean, and Enrique S Quintana-Ortí. Adaptive precision block-jacobi for high performance preconditioning in the ginkgo linear algebra software. *ACM Transactions on Mathematical Software (TOMS)*, 47(2):1–28, 2021.

[7] Pratik Nayak, Terry Cojean, and Hartwig Anzt. Evaluating asynchronous schwarz solvers on GPUs. *The International Journal of High Performance Computing Applications*, 35(3):226–236, 2021.

[8] Hartwig Anzt, Terry Cojean, Chen Yen-Chen, Jack Dongarra, Goran Flegar, Pratik Nayak, Stanimire Tomov, Yuhsiang M. Tsai, and Weichung Wang. Load-Balancing Sparse Matrix Vector Product Kernels on GPUs. *ACM Trans. Parallel Comput.*, 7(1), March 2020.

[9] Emmanuel Agullo, Mirco Altenbernd, Hartwig Anzt, Leonardo Bautista-Gomez, Tommaso Benacchio, Luca Bonaventura, Hans-Joachim Bungartz, Sanjay Chatterjee, Florina M Ciorba, Nathan DeBardeleben, et al. Resiliency in numerical algorithm design for extreme scale simulations. *arXiv preprint arXiv:2010.13342*, 2020.

[10] Hartwig Anzt, Erik Boman, Rob Falgout, Pieter Ghysels, Michael Heroux, Xiaoye Li, Lois Curfman McInnes, Richard Tran Mills, Sivasankaran Rajamanickam, Karl Rupp, Barry Smith, Ichitaro Yamazaki, and Ulrike Meier Yang. Preparing sparse solvers for exascale computing. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 378(2166):20190053, 2020.

[11] Hartwig Anzt, Terry Cojean, Yen-Chen Chen, Goran Flegar, Fritz Göbel, Thomas Grützmacher, Pratik Nayak, Tobias Ribizel, and Yu-Hsiang Tsai. Ginkgo: A high performance numerical linear algebra library. *Journal of Open Source Software*, 5(52):2260, 2020.

[12] Thomas Grützmacher, Terry Cojean, Goran Flegar, Hartwig Anzt, and Enrique S Quintana-Ortí. Acceleration of pagerank with customized precision based on mantissa segmentation. *ACM Transactions on Parallel Computing (TOPC)*, 7(1):1–19, 2020.

[13] Thomas Grützmacher, Terry Cojean, Goran Flegar, Fritz Göbel, and Hartwig Anzt. A customized precision format based on mantissa segmentation for accelerating sparse linear algebra. *Concurrency and Computation: Practice and Experience*, 32(15):e5418, 2020.

[14] Tobias Ribizel and Hartwig Anzt. Parallel selection on GPUs. *Parallel Computing*, 91:102588, 2020.

[15] Hartwig Anzt, Terry Cojean, and Eileen Kühn. Towards a new peer review concept for scientific computing ensuring technical quality, software sustainability, and result reproducibility. *PAMM*, 19(1), 2019.

[16] Hartwig Anzt, Jack Dongarra, Goran Flegar, Nicholas J Higham, and Enrique S Quintana-Ortí. Adaptive precision in block-jacobi preconditioning for iterative sparse linear system solvers. *Concurrency and Computation: Practice and Experience*, 31(6):e4460, 2019.

[17] Hartwig Anzt, Jack Dongarra, Goran Flegar, and Enrique S Quintana-Ortí. Variable-size batched gauss–jordan elimination for block-jacobi preconditioning on graphics processors. *Parallel Computing*, 81:131–146, 2019.

[18] Hartwig Anzt, Goran Flegar, Thomas Grützmacher, and Enrique S Quintana-Ortí. Toward a modular precision ecosystem for high-performance computing. *The International Journal of High Performance Computing Applications*, page 1094342019846547, 2019.

[19] Heike Jagode, Anthony Danalis, Hartwig Anzt, and Jack Dongarra. Papi software-defined events for in-depth performance analysis. *The International Journal of High Performance Computing Applications*, page 1094342019846287, 2019.

[20] Hartwig Anzt, Edmond Chow, and Jack Dongarra. Parilut—a new parallel threshold ilu factorization. *SIAM Journal on Scientific Computing*, 40(4):C503–C519, 2018.

[21] Hartwig Anzt, Thomas K Huckle, Jürgen Bräckle, and Jack Dongarra. Incomplete sparse approximate inverses for parallel preconditioning. *Parallel Computing*, 71:1–22, 2018.

[22] Hartwig Anzt, Moritz Kreutzer, Eduardo Ponce, Gregory D Peterson, Gerhard Wellein, and Jack Dongarra. Optimization and performance evaluation of the idr iterative krylov solver on GPUs. *The International Journal of High Performance Computing Applications*, 32(2):220–230, 2018.

[23] Edmond Chow, Hartwig Anzt, Jennifer Scott, and Jack Dongarra. Using jacobi iterations and blocking for solving sparse triangular systems in incomplete factorization preconditioning. *Journal of Parallel and Distributed Computing*, 119:219–230, 2018.

[24] Hartwig Anzt, Mark Gates, Jack Dongarra, Moritz Kreutzer, Gerhard Wellein, and Martin Köhler. Preconditioned krylov solvers on GPUs. *Parallel Computing*, 68:32–44, 2017.

[25] Hartwig Anzt, Stanimire Tomov, and Jack Dongarra. On the performance and energy efficiency of sparse linear algebra on GPUs. *The International Journal of High Performance Computing Applications*, 31(5):375–390, 2017.

[26] Jack Dongarra, Stanimire Tomov, Piotr Luszczek, Jakub Kurzak, Mark Gates, Ichitaro Yamazaki, Hartwig Anzt, Azzam Haidar, and Ahmad Abdelfattah. With extreme computing, the rules have changed. *Computing in Science & Engineering*, 19(3):52, 2017.

[27] Ahmad Abdelfattah, Hartwig Anzt, Jack Dongarra, Mark Gates, Azzam Haidar, Jakub Kurzak, Piotr Luszczek, Stanimire Tomov, Ichitaro Yamazaki, and Asim YarKhan. Linear algebra software for large-scale accelerated multicore computing. *Acta Numerica*, 25:1–160, 2016.

[28] Hartwig Anzt, Edmond Chow, Jens Saak, and Jack Dongarra. Updating incomplete factorization preconditioners for model order reduction. *Numerical Algorithms*, 73(3):611–630, 2016.

[29] Hartwig Anzt, Jack Dongarra, and Enrique S Quintana-Ortí. Fine-grained bit-flip protection for relaxation methods. *Journal of Computational Science*, 2016.

[30] José Ignacio Aliaga Estellés, Hartwig Anzt, Maribel Castillo Catalán, Juan Carlos Fernández Fernández, Germán León Navarro, Joaquín Pérez, and Enrique S Quintana Ortí. Unveiling the performance-energy trade-off in iterative linear system solvers for multithreaded processors. *Concurrency and Computation: Practice and Experience*, 2015.

[31] Hartwig Anzt, Blake Haugen, Jakub Kurzak, Piotr Luszczek, and Jack Dongarra. Experiences in autotuning matrix multiplication for energy minimization on GPUs. *Concurrency and Computation: Practice and Experience*, 27(17):5096–5113, 2015.

[32] Hartwig Anzt, Stanimire Tomov, Piotr Luszczek, William Sawyer, and Jack Dongarra. Acceleration of GPU-based krylov solvers via data transfer reduction. *The International Journal of High Performance Computing Applications*, 29(3):366–383, 2015.

[33] Jakub Kurzak, Hartwig Anzt, Mark Gates, and Jack Dongarra. Implementation and tuning of batched Cholesky factorization and solve for nvidia GPUs. *IEEE Transactions on Parallel and Distributed Systems*, 27(7):2036–2048, 2015.

[34] Hartwig Anzt, Armen Beglarian, Suren Chilingaryan, Andrew Ferrone, Vincent Heuveline, and Andreas Kopmann. A unified energy footprint for simulation software. *Computer Science-Research and Development*, 29(2):131–138, 2014.

[35] Hartwig Anzt and ES Quintana-Ortí. Improving the energy efficiency of sparse linear system solvers on multicore and manycore systems. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 372(2018):20130279, 2014.

[36] Hartwig Anzt, Stanimire Tomov, Jack Dongarra, and Vincent Heuveline. A block-asynchronous relaxation method for graphics processing units. *Journal of parallel and distributed computing*, 73(12):1613–1626, 2013.

[37] Hartwig Anzt. Asynchronous and multiprecision linear solvers-scalable and fault-tolerant numerics for energy efficient high performance computing. 2012.

[38] Hartwig Anzt, Maribel Castillo, Juan C Fernández, Vincent Heuveline, Francisco D Igual, Rafael Mayo, and Enrique S Quintana-Ortí. Optimization of power consumption in the iterative solution of sparse linear systems on graphics processors. *Computer Science-Research and Development*, 27(4):299–307, 2012.

[39] Hartwig Anzt, Stanimire Tomov, Mark Gates, Jack Dongarra, and Vincent Heuveline. Block-asynchronous multigrid smoothers for GPU-accelerated systems. *Procedia Computer Science*, 9:7–16, 2012.

[40] Hartwig Anzt, Björn Rocker, and Vincent Heuveline. Energy efficiency of mixed precision iterative refinement methods using hybrid hardware platforms. *Computer Science-Research and Development*, 25(3-4):141–148, 2010.

Conference Proceedings

[41] Yannick Funk, Markus Götz, and Hartwig Anzt. *Prediction of Optimal Solvers for Sparse Linear Systems Using Deep Learning*, pages 14–24.

[42] Isha Aggarwal, Aditya Kashi, Pratik Nayak, Cody J Balos, Carol S Woodward, and Hartwig Anzt. Batched sparse iterative solvers for computational chemistry simulations on gpus. In *2021 12th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems (ScalA)*, pages 35–43. IEEE, 2021.

[43] Fritz Göbel, Thomas Grützmacher, Tobias Ribizel, and Hartwig Anzt. Mixed precision incomplete and factorized sparse approximate inverse preconditioning on gpus. In Leonel Sousa, Nuno Roma, and Pedro Tomás, editors, *Euro-Par 2021: Parallel Processing*, pages 550–564, Cham, 2021. Springer International Publishing.

[44] Pratik Nayak, Fritz Göbel, and Hartwig Anzt. A collaborative peer review process for grading coding assignments. In *International Conference on Computational Science*, pages 654–660. Springer, Cham, 2021.

[45] Hartwig Anzt, Yuhsiang M Tsai, Ahmad Abdelfattah, Terry Cojean, and Jack Dongarra. Evaluating the performance of nvidia's a100 ampere GPU for sparse and batched computations. In *2020 IEEE/ACM Performance Modeling, Benchmarking and Simulation of High Performance Computer Systems (PMBS)*, pages 26–38. IEEE, 2020.

[46] Fritz Goebel, Hartwig Anzt, Terry Cojean, Goran Flegar, and Enrique S Quintana-Ortí. Multiprecision block-jacobi for iterative triangular solves. In *European Conference on Parallel Processing*, pages 546–560. Springer, Cham, 2020.

[47] Piotr Luszczek, Yaohung Tsai, Neil Lindquist, Hartwig Anzt, and Jack Dongarra. Scalable data generation for evaluating mixed-precision solvers. In *2020 IEEE High Performance Extreme Computing Conference (HPEC)*, pages 1–6. IEEE, 2020.

[48] Pratik Nayak, Terry Cojean, and Hartwig Anzt. Two-stage asynchronous iterative solvers for multi-GPU clusters. In *2020 IEEE/ACM 11th Workshop on Latest Advances in Scalable Algorithms for Large-Scale Systems (ScalA)*, pages 9–18. IEEE, 2020.

[49] Yuhsiang M Tsai, Terry Cojean, and Hartwig Anzt. Sparse linear algebra on amd and nvidia GPUs–the race is on. In *International Conference on High Performance Computing*, pages 309–327. Springer, Cham, 2020.

[50] Hartwig Anzt, Yen-Chen Chen, Terry Cojean, Jack Dongarra, Goran Flegar, Pratik Nayak, Enrique S. Quintana-Ortí, Yuhsiang M. Tsai, and Weichung Wang. Towards continuous benchmarking: An automated performance evaluation framework for high performance software. In *Proceedings of the Platform for Advanced Scientific Computing Conference*, PASC '19, pages 9:1–9:11, New York, NY, USA, 2019. ACM.

[51] Hartwig Anzt, Terry Cojean, Goran Flegar, T Grutzmacher, Pratik Nayak, and Tobias Ribizel. An automated performance evaluation framework for the ginkgo software ecosystem. In *90th Annual Meeting of the International Associaten of Applied Mathematics and Mechanics, GAMM*, 2019.

[52] Hartwig Anzt and Goran Flegar. Are we doing the right thing? – a critical analysis of the academic hpc community. In *2019 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*, pages 739–745. IEEE, 2019.

[53] Hartwig Anzt, Tobias Ribizel, Goran Flegar, Edmond Chow, and Jack Dongarra. Parilut-a parallel threshold ilu for GPUs. In *2019 IEEE International Parallel and Distributed Processing Symposium (IPDPS)*, pages 231–241. IEEE, 2019.

[54] Tobias Ribizel and Hartwig Anzt. Approximate and exact selection on GPUs. In *2019 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*, pages 471–478. IEEE, 2019.

[55] Hartwig Anzt and Jack Dongarra. A jaccard weights kernel leveraging independent thread scheduling on GPUs. In *2018 30th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD)*, pages 229–232. IEEE, 2018.

[56] Hartwig Anzt, Jack Dongarra, Goran Flegar, and Thomas Grützmacher. Variable-size batched condition number calculation on GPUs. In *2018 30th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD)*, pages 132–139. IEEE, 2018.

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