Christopher Thiele

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Personal profile

I am a graduate student in computational and applied mathematics at Rice University. My work focuses on iterative linear solvers, particularly multigrid methods, and their parallel implementation. I have experience in the development of large-scale numerical simulations, mostly in the context of hydrocarbon recovery.

Education

Aug. 2016–present	**Graduate studies at the department for Computational and Applied Mathematics at Rice University, Houston, TX** Intended degree: PhD MA degree awarded in May 2018
Oct. 2014–Jul. 2016	**Master of Science at University of Kaiserslautern, Kaiserslautern, Germany** Major: Mathematics Minor: Computer science *Master's degree was completed at Rice University.*
Oct. 2011–Sep. 2014	**Bachelor of Science at University of Kaiserslautern, Kaiserslautern, Germany** Major: Mathematics Minor: Computer science

Practical experience

Jun. 2020–Jul. 2020	**Internship at Shell Technology Center Houston (STCH), Houston, TX (remotely)** • Machine learning techniques in content-based image retrieval for pore images
May 2019–Aug. 2019	**Internship at Shell Technology Center Houston (STCH), Houston, TX** • Evaluation of second-order optimization methods for machine learning applications • Implementation in Python using TensorFlow

May 2018–Aug. 2018	**Internship at Shell Technology Center Houston (STCH), Houston, TX** • Evaluation of GPU-based iterative solvers (Krylov, multigrid) in a pore-scale fluid simulation software • Implementation in C++ using MPI, OpenMP, Trilinos, AMGX
May 2017–Aug. 2017	**Internship at Shell Technology Center Houston (STCH), Houston, TX** • Improvement of software quality, performance, and scalability of a pore-scale fluid simulation software • Implementation in C++ using MPI, OpenMP, Trilinos • Performance analysis using Intel VTune and ITAC
Dec. 2015–Jul. 2016	**Research Assistant at Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany** • Implementation of hybrid parallel sparse matrix-vector product and conjugate gradient solver • Implementation in C++ using GPI2 (PGAS) and POSIX threads
Aug. 2015–Nov. 2015	**Associate Research Mathematician at Brunel Energy GmbH, Bremen, Germany** • Performance analysis of a large-scale fluid simulation software • Development of an iterative linear solver algorithm for discontinuous Galerkin discretizations • Evaluation of parallel linear algebra frameworks • Implementation in C++ using MPI, OpenMP, Trilinos, and GPI2
Apr. 2014–Jul. 2015	**Research Assistant at Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany** • Finite difference methods for Poisson and Helmholtz problems with absorbing boundary conditions • Implementation in C++ using PETSc, prototyping with MATLAB
Oct. 2013–Apr. 2014	**Internship at Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany** • Introduction to parallel programming models and analysis of performance and scalability • Parallel implementation of basic linear algebra operations in C++ using MPI, GPI2, POSIX threads, and OpenMP

Publications in peer-reviewed journals

C. Liu, F. Frank, **C. Thiele**, F.O. Alpak, S. Berg, W. Chapman, B. Riviere. An efficient numerical algorithm for solving viscosity contrast Cahn–Hilliard–Navier–Stokes system in porous media. *Journal of Computational Physics, 2020.*

C. Thiele, M. Araya-Polo, F.O. Alpak, B. Riviere, F. Frank. Inexact hierarchical scale separation: A two-scale approach for linear systems from discontinuous Galerkin discretizations. *Computers & Mathematics with Applications, 2017.*

Publications in conference proceedings and workshops

C. Thiele, M. Araya-Polo, D. Hohl. Deep learning with a stochastic quasi-Gauss–Newton method. *Workshop "Beyond First Order Methods in ML Systems," Thirty-seventh International Conference on Machine Learning (ICML), 2020.*

C. Thiele, M. Araya-Polo, F.O. Alpak, B. Riviere, D. Hohl. Weak scalability analysis of GPGPU-based iterative solvers in a two-phase pore-scale flow simulator. *Fourth EAGE Workshop on High Performance Computing for Upstream, 2019.*

C. Thiele, M. Araya-Polo, F.O. Alpak, B. Riviere. Distributed parallel hybrid CPU-GPGPU implementation of the phase-field method for accelerated high-accuracy simulations of pore-scale two-phase flow. *SPE Reservoir Simulation Conference, 2019.*

C. Thiele, M. Araya-Polo, F.O. Alpak, B. Riviere, F. Frank. Inexact hierarchical scale separation: An efficient linear solver for discontinuous Galerkin discretizations. *SPE Reservoir Simulation Conference, 2017.*

C. Thiele, M. Araya-Polo, D. Stoyanov, F. Frank, F.O. Alpak. Asynchronous hybrid parallel SpMV in an industrial application. *International Conference on Computational Science and Computational Intelligence, 2016.*

Preprints

C. Thiele, M. Araya-Polo, D. Hohl. Deep neural network learning with second-order optimizers – a practical study with a stochastic quasi-Gauss–Newton method. *arXiv preprint arXiv:2004.03040, 2020.*

M. Grossman, **C. Thiele**, M. Araya-Polo, F. Frank, F.O. Alpak, V. Sarkar. A survey of sparse matrix-vector multiplication performance on large matrices. *arXiv preprint arXiv:1608.00636, 2016.*

Talks

Hybrid-parallel multigrid preconditioners in a pore-scale flow simulation. *Rice Oil & Gas HPC Conference, Mar. 2–4, 2020, Houston, TX, USA.*

p-Multigrid with partial smoothing – an efficient preconditioner for discontinuous Galerkin methods with modal bases. *Finite Element Rodeo, Feb. 28–29, 2020, Waco, TX, USA.*

p-Multigrid methods for discontinuous Galerkin discretizations with modal bases. *Friedrich-Alexander-Universität Erlangen-Nürnberg, Dec. 19, 2019, Erlangen, Germany.* (Invited talk)

Distributed parallel hybrid CPU-GPGPU implementation of the phase-field method for accelerated high-accuracy simulations of pore-scale two-phase flow. *SPE Reservoir Simulation Conference, Apr. 10–11, 2019, Galveston, TX, USA.*

Hierarchical scale separation: A multi-scale solver for linear systems in modal discontinuous Galerkin discretizations. *Finite Element Rodeo, Mar. 1–2, 2019, Austin, TX, USA.*

Improving scalability and performance of linear system solves in pore-scale simulations. *Rice Oil & Gas HPC Conference. Mar. 15–16, 2017, Rice University, Houston, TX, USA.*

Asynchronous hybrid parallel SpMV in an industrial application. *International Conference on Computational Science and Computational Intelligence, Dec. 15–17, 2016, Las Vegas, NV, USA.*

Posters

C. Thiele, M. Araya-Polo, F.O. Alpak, B. Riviere. Hierarchical scale separation: A linear solver based on block relaxation and multigrid. *Rice Oil & Gas HPC Conference, Mar. 4–6, 2019, Houston, TX, USA.*

C. Thiele, M. Araya-Polo, F.O. Alpak, B. Riviere, F. Frank. Inexact hierarchical scale separation: An efficient linear solver for discontinuous Galerkin discretizations. *SPE Reservoir Simulation Conference, Feb. 20–22, 2017, Montgomery, TX, USA.*

Theses

Inexact hierarchical scale separation for linear systems in modal discontinuous Galerkin discretizations. *MA thesis, April 2018, Rice University, Houston, TX, USA.*

Finite-Differenzen-Approximation der zweidimensionalen Helmholtz-Gleichung (Finite difference approximation of the two-dimensional Helmholtz equation). *BS thesis, September 2014, University of Kaiserslautern, Kaiserslautern, Germany.*

Teaching experience

Instructor of record, Computational Science II (CAAM 520), *Spring 2020, Rice University.*

Participation in conferences and workshops

If a talk or poster presentation is indicated, please refer to the respective section for details.

Workshop "Beyond First Order Methods in ML Systems," Thirty-seventh International Conference on Machine Learning (ICML). *Jul. 17, 2020.*

Rice Oil & Gas HPC Conference. *Mar. 2–4, 2020, Houston, TX, USA.* (Talk)

SPE Reservoir Simulation Conference. *Apr. 10–11, 2019, Galveston, TX, USA.* (Talk)

SIAM Conference on Mathematical & Computational Issues in the Geosciences (GS19). *Mar. 11–14, 2019, Houston, TX, USA.*

Rice Oil & Gas HPC Conference. *Mar. 4–6, 2019, Houston, TX, USA.* (Poster)

Finite Element Rodeo. *Mar. 1–2, 2019, Austin, TX, USA.* (Talk)

International Conference for High Performance Computing, Networking, Storage, and Analysis (SC18). *Nov. 11–16, 2018, Dallas, TX, USA.*

Rice Oil & Gas HPC Conference. *Mar. 12–13, 2018, Houston, TX, USA.*

Rice Oil & Gas HPC Conference. *Mar. 15–16, 2017, Houston, TX, USA.* (Talk)

Finite Element Rodeo. *Mar. 3–4, 2017, Houston, TX, USA.*

SPE Reservoir Simulation Conference. *Feb. 20–22, 2017, Montgomery, TX, USA.* (Poster)

International Conference on Computational Science and Computational Intelligence. *Dec. 15–17, 2016, Las Vegas, NV, USA.* (Talk)

International Conference for High Performance Computing, Networking, Storage, and Analysis (SC15). *Nov. 15–20, 2015, Austin, TX, USA.*

Sparse Solvers for Exascale: From Building Blocks to Applications. *Mar. 23–25, 2015, Greifswald, Germany.*

Awards

Alan Weiser Memorial Travel Award. *Rice University, Department of Computational and Applied Mathematics, 2019.*

Ken Kennedy Institute for Information Technology Shell Graduate Fellowship. *Rice University, Ken Kennedy Institute for Information Technology, 2018.*