

# 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

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| Aug. 2016–present   | <b>Graduate studies at the department for Computational and Applied Mathematics at Rice University, Houston, TX</b><br>Intended degree: PhD  |
| Oct. 2014–Jul. 2016 | <b>Master of Science at University of Kaiserslautern, Kaiserslautern, Germany</b><br>Major: Mathematics<br>Minor: Computer Science<br><i>Master's degree was completed at Rice University.</i> |
| Oct. 2011–Sep. 2014 | <b>Bachelor of Science at University of Kaiserslautern, Kaiserslautern, Germany</b><br>Major: Mathematics<br>Minor: Computer Science   |

## Practical experience

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| May 2019–Aug. 2019 | <b>Internship at Shell Technology Center Houston (STCH), Houston, TX</b> <ul style="list-style-type: none"><li>• Evaluation of second-order optimization methods for machine learning applications</li><li>• Implementation in Python using TensorFlow</li></ul>                                     |
| May 2018–Aug. 2018 | <b>Internship at Shell Technology Center Houston (STCH), Houston, TX</b> <ul style="list-style-type: none"><li>• Evaluation of GPU-based iterative solvers (Krylov, multigrid) in a pore-scale fluid simulation software</li><li>• Implementation in C++ using MPI, OpenMP, Trilinos, AMGX</li></ul> |

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| May 2017–Aug. 2017  | <b>Internship at Shell Technology Center Houston (STCH), Houston, TX</b> <ul style="list-style-type: none"> <li>• Improvement of software quality, performance, and scalability of a pore-scale fluid simulation software</li> <li>• Implementation in C++ using MPI, OpenMP, Trilinos</li> <li>• Performance analysis using Intel VTune and ITAC</li> </ul>  |
| Dec. 2015–Jul. 2016 | <b>Research Assistant at Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany</b> <ul style="list-style-type: none"> <li>• Implementation of hybrid parallel sparse matrix-vector product and conjugate gradient solver</li> <li>• Implementation in C++ using GPI2 (PGAS) and POSIX threads</li> </ul>  |
| Aug. 2015–Nov. 2015 | <b>Associate Research Mathematician at Brunel Energy GmbH, Bremen, Germany</b> <ul style="list-style-type: none"> <li>• Performance analysis of a large-scale fluid simulation software</li> <li>• Development of an iterative linear solver algorithm for discontinuous Galerkin discretizations</li> <li>• Evaluation of parallel linear algebra frameworks</li> <li>• Implementation in C++ using MPI, OpenMP, Trilinos, and GPI2</li> </ul> |
| Apr. 2014–Jul. 2015 | <b>Research Assistant at Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany</b> <ul style="list-style-type: none"> <li>• Finite difference methods for Poisson and Helmholtz problems with absorbing boundary conditions</li> <li>• Implementation in C++ using PETSc, prototyping with MATLAB</li> </ul>  |
| Oct. 2013–Apr. 2014 | <b>Internship at Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany</b> <ul style="list-style-type: none"> <li>• Introduction to parallel programming models and analysis of performance and scalability</li> <li>• Parallel implementation of basic linear algebra operations in C++ using MPI, GPI2, POSIX threads, and OpenMP</li> </ul>  |

## Publications in peer-reviewed journals

C. Liu, F. Frank, **C. Thiele**, F.O. Alpak, S. Berg, W. Chapman, and B. Riviere. An efficient numerical algorithm for solving viscosity contrast Cahn–Hilliard–Navier–Stokes system in porous media. *Journal of Computational Physics*, 2019.

**C. Thiele**, M. Araya-Polo, F.O. Alpak, B. Riviere, and 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

**C. Thiele**, M. Araya-Polo, F.O. Alpak, B. Riviere, and 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, *in press*.

**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.

## Talks

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.

## Participation in conferences and workshops

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

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.*