# 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

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

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

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| 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

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| 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

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| 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

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| 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

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| 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, 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.*

**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

*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.*

# Participation in conferences and workshops

If a talk or poster presentation is indicated, please refer to 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.*