Paul Springer

Curriculum Vitae

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Education

06/2014 - present **Postgraduate student**, *Aachen Institute for Advanced Study in Computational Engineering Science (AICES), Rheinisch-Westfälische Technische Hochschule*, Aachen.
Topic: Automatic generation of high-performance tensor contractions.

2012-2014 **M.Sc. in Computer Science**, *Rheinisch-Westfälische Technische Hochschule*, Aachen.
Subsidiary Subject: Physics. Graduated with distinction (GPA: A+).

Summer 2013 **Extreme-Scale Computing Workshop**, *Argonne Training Program on Extreme-Scale Computing*, Chicago, USA.
Two week workshop covering advanced parallel programming techniques and future computer architectures.

2008-2012 **B.Sc. in Computer Science**, *Rheinisch-Westfälische Technische Hochschule*, Aachen.
Subsidiary Subject: Physics. Graduated with distinction (GPA: A).

Semester abroad, *University of Skövde*, Skövde (Sweden).
Fall Semester 2010/11.

2006-2007 **University Entrance Qualification**, *Theodor-Reuter-Berufskolleg*, Iserlohn.

2003-2006 **Advanced Technical College Certificate**, *Theodor-Reuter-Berufskolleg*, Iserlohn.

Apprenticeship as an IT-System Electronics Technician, *Theodor-Reuter-Berufskolleg*, Iserlohn.

Work Experience

Summer 2015 **Software Engineer (Intern)**, *NVIDIA*, Santa Clara, USA.
Working in the field of linear algebra and deep convolutional neural nets (i.e., CUSPARSE, CUBLAS, CUDNN).

Fall 2013 **Software Engineer (Intern)**, *NVIDIA*, Santa Clara, USA.
Porting a scientific application to the GPU and improving the performance of an existing GPU library.

2012-2013 **Student Assistant**, *AICES RWTH*, Aachen.
Implementing and parallelizing a Molecular Dynamics Simulation in C++, to be integrated into the Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) package.

2011-2012 **Student Assistant**, *Computer Center RWTH*, Aachen.
Programming modern vector processors.

2010-2011 **Research Assistant**, *Cognition and Interaction Lab*, University of Skövde, Skövde.
Development of a tool for modeling and visualisation of *neural dynamic fields*.

Teaching

SS 2014 **Automatic Generation & Analysis of Algorithms**.
Series of four lectures covering details about vector extensions (e.g. AVX), auto-vectorization, C/C++ intrinsics, CILK+ and OpenCL on modern CPUs.

SS 2013 **High-Performance Matrix Computations**.
Series of five lectures covering the fundamental architectural differences between CPUs and GPUs, an introduction to CUDA, OpenCL and OpenACC as well as some optimization techniques related to general purpose computing on GPUs.

Publications

2016 P. Springer, Jeff R. Hammond, and. P. Bientinesi. TTC: A high-performance Compiler for Tensor Transpositions. *ACM Transactions on Mathematical Software (TOMS) (in review).*

2015 P. Springer, A.E. Ismail, and. P. Bientinesi. A Scalable, Linear-Time Dynamic Cutoff Algorithm for Molecular Dynamics. *International Supercomputing Conference.*

2015 B. Hentschel, J.H. Göbbert, M. Klemm, P. Springer, A. Schnorr, and T. W. Kuhlen. Packet-Oriented Streamline Tracing on Modern SIMD Architectures. *Proceedings of the Eurographics Symposium on Parallel Graphics and Visualization.*

2014 D. Tameling, P. Springer, P. Bientinesi and A.E. Ismail. Multilevel Summation for Dispersion: A Linear-Time Algorithm for $1/r^6$ Potentials. *Journal of Chemical Physics.*

2012 S. Wienke, P. Springer, C. Terboven, and D. an Mey. OpenACC - First Experiences with Real-World Applications. *Euro-Par 2012 Parallel Processing.*

Master Thesis

Title A Scalable, Linear-Time Dynamic Cutoff Algorithm for Molecular Simulations of Interfacial Systems.

Supervisors Prof. Paolo Bientinesi, Ph.D & Prof. Ahmed E. Ismail, Ph.D.

Description Development of a scalable, linear-time Dynamic Cutoff Method (DCM) for molecular simulations with liquid-vapor and liquid-liquid interfaces. This algorithm is especially tailored for massively parallel architectures and systems with millions of particles.

Grade A+

Bachelor Thesis

Title A Study of Productivity and Performance of Modern Vector Processors.

Supervisor Prof. Dr. Martin Bücker

Description Investigation of performance and productivity of modern vector processors on the example of a magnetoencephalography application using different programming paradigms.

Grade A+

Awards

2015 Intel Modern Code Developer Challenge — Second Place Prize Winner.

2014 Springorum Commemorative Coin (excellent M.Sc., RWTH).

2013 Deans' List, for the best five percent of the class Computer Science.

2012 Schöneborn Preis, for outstanding results during the Bachelor studies.

2011 Deans' List, for the best three percent of the class Computer Science.

2009 Deans' List, for the best three percent of the class Computer Science.

Reviews

Euro-Par 2015 Reviewer for the 21st International European Conference on Parallel and Distributed Computing.

HeteroPar 2014 Reviewer for the 12th International Workshop on Algorithms, Models and Tools for Parallel Computing on Heterogeneous Platforms.

HeteroPar 2013 Reviewer for the 11th International Workshop on Algorithms, Models and Tools for Parallel Computing on Heterogeneous Platforms.

Open Source Software

TTC — The **Tensor Transposition Compiler** (TTC) is an open source parallel compiler for multidimensional tensor transpositions. Given a mathematical description of a tensor transposition, TTC generates high-performance C++ code. See `https://github.com/springer13/TTC` for details.

Projects

Title — **Vectorization in Molecular Dynamics**
Supervisor — Prof. Ahmed E. Ismail, PhD
Description — Implicit (auto-vectorization) and explicit (C/C++ intrinsics) vectorization of computational kernels in MD.

Title — **Parallel Python**
Supervisor — Prof. Paolo Bientinesi, PhD
Description — Using python as a parallel, high-performance programming language.

Title — **Berkeley's Dwarfs on CUDA.**
Supervisor — Prof. Dr. Martin Bücker
Description — Evaluation of the performance of GPUs for some scientific applications (e.g. spectral methods, N-Body methods, dense/sparse linear algebra).

Title — **OpenACC - A Step Towards Heterogeneous Programming.**
Supervisor — Prof. Dr. Felix Wolf
Description — Evaluation of performance and productivity on the example of a small Molecular Dynamics simulation and a Conjugate Gradient solver.

Title — **Parallelization of an N-body Method.**
Supervisor — Prof. Dr. Martin Bücker
Description — Parallelization of a Smooth Particle Hydrodynamics code using OpenMP and MPI.

Title — **LAME - Parallel MP3 encoder.**
Supervisor — Prof. Dr. Felix Wolf
Description — Parallelization and vectorization of the open source LAME MP3 encoder.

Relevant Courses

Lecture — Introduction to High-Performance Computing
Design of parallel algorithms, Cholesky factorization, minimum-degree

Lecture — Parallel Programming I
Parallel architectures, caching, thread affinity, OpenMP, MPI

Lecture — Parallel Programming II
MPI-2, POSIX threads, CUDA, UPC

Lecture — Introduction to Machine Learning
SLP, MLP, back propagation algorithm, genetic algorithms

Lecture — Languages for Scientific Computing
Matlab, Mathematica, Python, C

Lecture — Combinatorial Problems in Scientific Computing
Automatic differentiation, combinatorics involved in the compression of a Jacobian.

Lecture — Computational Physics
Numerical Methods for ODEs and PDEs, Monte Carlo and Molecular Dynamics.

Lecture — Fast Iterative Solvers

Generalized Minimum Residual Method, Conjugate Gradient Method, Multigrid Method.

Languages

German **Native speaker**

English **Fluent**

Computer skills

OS Linux, Mac OS X, Microsoft Windows

Programming C/C++, Matlab, Python, Mathematica, CUDA, OpenCL, OpenACC, MPI, OpenMP