Michel Steuwer

Informatics Forum — 1.02
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University Education

2010–2015 **PhD degree in computer science**, *University of Münster*, Germany.
Supervisor: Prof. Sergei Gorlatch

Thesis: *Improving Programmability and Performance Portability on Many-Core Processors*

Awarded with the highest possible grade: **Summa Cum Laude** (*with highest honor*)

Nominated as one of 34 candidates from all German, Austrian, and Swiss Universities for the **prize for best dissertation** awarded by the German Informatics Society.

2005–2010 **Diploma degree in computer science with a minor in mathematics**,
(equivalent to a combined MSc and UG degree) University of Münster, Germany.

Thesis: *SkelCL — A Portable Multi-GPU Skeleton Library*

Professional Experience

since Oct. 2014 **Postdoctoral Research Associate**, *The University of Edinburgh*, UK.

2010–2014 **Research Associate**, *University of Münster*, Germany.

Research Visits

2014 **Visiting researcher (3 Month)**, *The University of Edinburgh*, UK.

2013 **Visiting researcher (4 Month)**, *The University of Edinburgh*, UK.
Funded by the EU HiPEAC Network of Excellence

2012 **Visiting researcher (3 Month)**, *The University of Edinburgh/EPCC*, UK.
Funded by the EU HPC-Europa2 project

Research Community Activities

Memberships and Participation in Research Networks

- Member of ACM and the German Informatics Society (GI: Gesellschaft für Informatik)
- Active participating member of the European Network on High Performance and Embedded Architecture and Compilation (HiPEAC)
- I represent the University of Edinburgh in the recent EU *EuroLab-4-HPC: Open source in high performance computing* initiative

Conference Organisation

- I was the main organiser of the 7th UK Many-Core Developer Conference on May 10th in Edinburgh with over 50 participants, a keynote and 10 talks spanning topics from the landscape of accelerated, heterogeneous and many-core computing.

Organisation of Informal Groups

- I co-organise the *Programming Languages Interest Group* together with James Cheney, a group discussing a broad range of topics related to programming languages.
- I organise the *Humble C++ Programmer Group*, a group discussing practical programming topics in C++ targeted at PhD students to improve their coding skills.

Program Committees

- 9th Int. Symposium on High-Level Parallel Programming and Applications (HLPP 2016)
- 16th IEEE Int. Conference on Scalable Computing and Communications (ScalCom 2016)

Artifact Evaluation Committees

- The 25th Int. Conference on Parallel Architectures and Compilation Techniques (PACT 2016)

Reviewing

External reviewer for conferences:

- International Symposium on Code Generation and Optimization (CGO)
- International Conference on Parallel and Distributed Computing (Euro-Par)
- European MPI Users Group conference (EuroMPI)
- International Symposium on Cluster, Cloud and Grid Computing (CCGrid)
- International Parallel Computing Conference (ParCo)
- Parallel Computing Technologies (PaCT)

Reviewer for journals:

- Science of Computer Programming Journal (Elsevier)
- Software: Practice and Experience (Wiley)
- The Journal of Supercomputing (Springer)

Research Collaborations

- Sam Lindley, LFCS, University of Edinburgh
- Alan Gray, EPCC, University of Edinburgh
- Robert Atkey, University of Strathclyde
- Ryan Newton, University of Indiana Bloomington
- Sergei Gorlatch, University of Münster
- Alastair Murray, Codeplay
- Grigori Fursin and Anton Lokhmotov, dividiti
- Mario Wolczko and Tim Harris, Oracle Labs
- Robert Hundt, Google

Awarded Honours

- PhD thesis honoured with the highest possible grade *Summa cum laude*
- Nominated as one of 34 candidates for the prize for best dissertation completed in 2015 in Informatics at a German, Austrian, or Swiss University. The prize is awarded by the German Informatics Society and the selection is currently ongoing.
- HiPEAC collaboration grants (2016 and 2013) and HPC-Europa2 visitor grant (2012)

Talks and Presentations

08/2016 Invited Talk:
Structured Parallel Programming — From High-Level Functional Expressions to High-Performance OpenCL Code
Center for Advanced Electornics Dresden, Dresden University of Technology, Germany.

05/2016 Invited Talk:
Improving Programmability and Performance Portability on Many-Core Processors
Colloquium of candidates nominated for the *prize for best dissertation* awarded by the German Informatics Society, Schloss Dagstuhl, Germany.

04/2016 Invited Talk: *The lift Project: Performance Portability via Rewrite Rules*
Saarland University, Germany.

01/2016 Invited Talk: *Performance Portable GPU Code Generation*
Imperial College London, UK.

12/2015 Talk: *Functional Programming in C++*
Programming Language Interest Group at Edinburgh University, UK.

10/2015 Invited Talk: *Generating Performance Portable Code using Rewrite Rules*
PENCIL Developer Meeting at Imperial College London, UK.

10/2015 Guest Lecture:
DSLs and rewriting-based optimizations for performance-portable parallel programming
in the Elements of Programming Languages Course at the University of Edinburgh, UK.

09/2015 Talk: *Generating Performance Portable Code using Rewrite Rules:*
From High-Level Functional Expressions to High-Performance OpenCL Code
International Conference on Functional Programming (ICFP) 2015 in Vancouver, Canada.

06/2015 Talk: *Generating Performance Portable Code using Rewrite Rules*
Scottish Programming Languages Seminar in St. Andrews, UK.

05/2014 Invited Talk: *SkelCL: High-Level Programming of Multi-GPU Systems*
Institute for Computational and Applied Mathematics, University of Münster, Germany.

05/2014 Invited Talk: *SkelCL: High-Level Programming of Multi-GPU Systems*
Workshop on Fast Data Processing on GPUs in Dresden, Germany.

01/2014 Talk: *Extending the SkelCL Library for Stencil Computations on Multi-GPU Systems*
HiStencils 2014 workshop in Vienna, Austria.

12/2013 Invited Talk: *SkelCL: High-Level Programming of Multi-GPU Systems*
Research group on elementary particle physics, University of Wuppertal, Germany.

07/2013 Talk: *Introducing and Implementing the Allpairs Skeleton for GPU Systems*
HLPP 2013 workshop in Paris, France.

06/2013 Talk:*High-Level Programming for Medical Imaging on Multi-GPU Systems using the SkelCL Library*
ICCS 2013 conference in Barcelona, Spain.

08/2012 Talk: *Using the SkelCL Library for High-Level GPU Programming of 2D Applications*
ParaPhrase 2012 workshop held in conjunction with Euro-Par 2012 in Rhodes, Greece.

06/2012 Talk: *High-Level Programming for Heterogeneous Systems with Accelerators*
PDESoft 2012 workshop in Münster, Germany.

05/2012 Talk:*Towards High-Level Programming of Multi-GPU Systems Using the SkelCL Library*
AsHES 2012 workshop held in conjunction with IPDPS 2012 in Shanghai, China.

04/2012 Invited talk: *A Skeleton Library for Heterogeneous Multi-/Many-Core Systems*
NAIS workshop in Edinburgh, UK.

01/2012 Talk: *Towards a High-Level Approach for Programming Distributed Systems with GPUs*
COST Action IC0805 ("ComplexHPC") meeting in Timisoara, Romania.

12/2011 Invited talk: *SkelCL — A High-Level Programming Library for GPU Programming*
Jülich Supercomputing Centre (JSC), Germany.

05/2011 Talk: *SkelCL — A Portable Skeleton Library for High-Level GPU Programming*
HIPS 2011 workshop held in conjunction with IPDPS 2011 in Anchorange, Alaska, USA.

09/2008 Invited talk: *Development of an Online Game as a Student Project*
ITSoftTEAM workshop in Chernihiv, Ukraine.

Publications

Thesis

2015 [T1] **M. Steuwer**. "Improving Programmability and Performance Portability on Many-Core Processors". Grade: *Summa Cum Laude*, Supervied by Prof. Sergei Gorlatch, Nominated for the **prize for best dissertation** awarded by the German Informatics Society. PhD thesis. University of Münster, 2015.

Journal Articles

2014 [J1] **M. Steuwer**, M. Haidl, S. Breuer, S. Gorlatch. "High-Level Programming of Stencil Computations on Multi-GPU Systems Using the SkelCL Library". In: *Parallel Processing Letters* 24.3 (2014). **Featured article** and among top 10 **most read** articles on `www.worldscientific.com`.

[J2] M. Olejnik, **M. Steuwer**, J. N. Dybowski, S. Gorlatch, D. Heider. "gCUP: Rapid GPU-based HIV-1 Coreceptor Usage Prediction for Next-Generation Sequencing". In: *Bioinformatics* 30.22 (2014).

[J3] **M. Steuwer**, S. Gorlatch. "SkelCL: A High-Level Extension of OpenCL for Multi-GPU Systems". In: *The Journal of Supercomputing* 69.1 (2014).

[J4] **M. Steuwer**, M. Friese, S. Albers, S. Gorlatch. "Introducing and Implementing the Allpairs Skeleton for GPU Systems". In: *Int. Journal of Parallel Programming* 42.4 (2014).

2013 [J5] P. Kegel, **M. Steuwer**, S. Gorlatch. "dOpenCL: Towards uniform programming of distributed heterogeneous multi-/many-core systems". In: *Journal of Parallel and Distributed Computing* 73.12 (2013).

Conference Proceedings

2016 [C1] **M. Steuwer**, T. Remmelg, C. Dubach. "Matrix Multiplication Beyond Auto-Tuning: Rewrite-based GPU Code Generation". In: *Proceedings of the 2016 International Conference on Compilers, Architecture, and Synthesis of Embedded Systems, CASES*. Pittsburgh, USA, 2016.

2015 [C2] **M. Steuwer**, C. Fensch, S. Lindley, C. Dubach. "Generating Performance Portable Code using Rewrite Rules: From High-Level Functional Expressions to High-Performance OpenCL Code". In: *Proceedings of the 20th ACM SIGPLAN International Conference on Functional Programming, ICFP 2015*. Ed. by Kathleen Fisher and John H. Reppy. **Acceptance Rate 29%**, **4th most downloaded paper** from ACM's DL of ICFP 2015. Vancouver, Canada, 2015.

[C3] J. J. Fumero, T. Remmelg, **M. Steuwer**, C. Dubach. “Runtime Code Generation and Data Management for Heterogeneous Computing in Java”. In: *Proceedings of the Principles and Practices of Programming on the Java Platform, PPPJ 2015*. Ed. by Ryan Stansifer and Andreas Krall. Melbourne, USA, 2015.

2014 [C4] S. Gorlatch, **M. Steuwer**. “Towards High-Level Programming for Systems with Many Cores”. In: *Perspectives of Systems Informatics 9th International Andrei Ershov Memorial Conference (PSI 2014)*. St. Petersburg, Russia, 2014.

2013 [C5] **M. Steuwer**, S. Gorlatch. “High-Level Programming for Medical Imaging on Multi-GPU Systems using the SkelCL Library”. In: *Proc. of the Int. Conference on Computational Science, (ICCS)*. Vol. 18. Procedia Computer Science. Barcelona, Spain, 2013.

[C6] **M. Steuwer**, S. Gorlatch. “SkelCL: Enhancing OpenCL for High-Level Programming of Multi-GPU Systems”. In: *Parallel Computing Technologies 2013*. Lecture Notes in Computer Science. **18 citations** on Google Scholar. St. Petersburg, Russia, 2013.

2012 [C7] **M. Steuwer**, P. Kegel, S. Gorlatch. “A High-Level Programming Approach for Distributed Systems with Accelerators”. In: *New Trends in Software Methodologies, Tools and Techniques – Proceedings of the 11th SoMeT’12*. 2012.

Workshop Proceedings

2016 [W1] T. Remmelg, T. Lutz, **M. Steuwer**, C. Dubach. “Performance Portable GPU Code Generation for Matrix Multiplication”. In: *GPGPU’16: Proceedings of the 9th ACM Workshop on General Purpose Processing using GPUs*. Barcelona, Spain, 2016.

[W2] M. Haidl, **M. Steuwer**, T. Humernbrum, S. Gorlatch. “Multi-Stage Programming for GPUs in Modern C++ using PACXX”. In: *GPGPU’16: Proceedings of the 9th ACM Workshop on General Purpose Processing using GPUs*. Barcelona, Spain, 2016.

[W3] A. Harries, **M. Steuwer**, M. Cole, A. Gray, C. Dubach. “Compositional Compilation for Sparse, Irregular Data Parallelism”. In: *HLPGPGPU’16: Workshop on High-Level Prog. for Heterogeneous and Hierarchical Parallel Systems*. Prague, Czech Republic, 2016.

[W4] C. Cummins, P. Petoumenos, **M. Steuwer**, H. Leather. “Towards Collaborative Performance Tuning of Algorithmic Skeletons”. In: *HLPGPGPU’16: Workshop on High-Level Prog. for Heterogeneous and Hierarchical Parallel Systems*. Prague, Czech Republic, 2016.

[W5] C. Cummins, P. Petoumenos, **M. Steuwer**, H. Leather. “Autotuning OpenCL Workgroup Size for Stencil Patterns”. In: *ADAPT’16: Proceedings of the 2016 International Workshop on Adaptive Self-tuning Computing Systems*. Prague, Czech Republic, 2016.

2014 [W6] J. J. Fumero, **M. Steuwer**, C. Dubach. “A Composable Array Function Interface for Heterogeneous Computing in Java”. In: *ARRAY’14: Proceedings of the 2014 ACM SIGPLAN International Workshop on Libraries, Languages, and Compilers for Array Programming*. Edinburgh, Scotland, 2014.

[W7] S. Breuer, **M. Steuwer**, S. Gorlatch. “Extending the SkelCL Skeleton Library for Stencil Computations on Multi-GPU Systems”. In: *Proceedings of the 1st International Workshop on High-Performance Stencil Computations*. Vienna, Austria, 2014.

2012 [W8] **M. Steuwer**, P. Kegel, S. Gorlatch. “Towards High-Level Programming of Multi-GPU Systems Using the SkelCL Library”. In: *IEEE International Symposium on Parallel and Distributed Processing Workshops*. 2012.

[W9] **M. Steuwer**, S. Gorlatch, M. Buß, S. Breuer. “Using the SkelCL Library for High-Level GPU Programming of 2D Applications”. In: *Euro-Par 2012: Parallel Processing Workshops*. Ed. by C. Ioannis, A. Michael, and B. Rosa, et. al. Lecture Notes in Computer Science. Rhodes Island, Greece, 2012.

[W10] P. Kegel, **M. Steuwer**, S. Gorlatch. “dOpenCL: Towards a Uniform Programming Approach for Distributed Heterogeneous Multi-/Many-Core Systems”. In: *IEEE International Symposium on Parallel and Distributed Processing Workshops*. 2012.

2011 [W11] **M. Steuwer**, P. Kegel, S. Gorlatch. “SkelCL - A Portable Skeleton Library for High-Level GPU Programming”. In: *IEEE International Symposium on Parallel and Distributed Processing Workshops*. 2011.

Book Chapter

2016 [B1] **M. Steuwer**. “Verbesserung der Programmierbarkeit und Performance-Portabilität von Manycore-Prozessoren (Improving Programmability and Performance Portability on Many-Core Processors)”. In: *Ausgezeichnete Informatikdissertationen 2015 (Distinguished Dissertations in Informatics 2015)*. Ed. by Steffen Hölldobler. Lecture Notes in Informatics. German Informatics Society, 2016.

2014 [B2] C. Kessler, S. Gorlatch, J. Emmyren, U. Dastgeer, **M. Steuwer**, P. Kegel. “Skeleton Programming for Portable Many-Core Computing”. In: *Programming Multi-core and Many-core Computing Systems*. Wiley, 2014.

2013 [B3] P. Kegel, **M. Steuwer**, S. Gorlatch. “Uniform High-Level Programming of Many-Core and Multi-GPU Systems”. In: *Transition of HPC Towards Exascale Computing*. Vol. 24. Advances in Parallel Computing. IOS Press, 2013.

Teaching Experience

Fall Term 2015
- Organiser and Lecturer of the C++ programming course *The Humble C++ Programmer* aiming to improve PhD students coding skills.
- Guest Lecture on *DSLs and rewrite-based optimizations for performance-portable parallel programming* in the *Elements of Programming Languages* course held by James Cheney.
- Voluntary assistance in the tutorials of the *Compiling Techniques* course held by Christophe Dubach.

Fall Term 2014
- Guest Lecture in the *Compiling Techniques* course given by Christophe Dubach.

Summer Term 2014
- Supervised MSc student project: *Design and implementation of a high-level API for programming heterogeneous clusters*.

Winter Term 2013/2014
- Supervised MSc student project: *High-level programming of online games in future generation networks*.

Summer Term 2013
- Course Design and Lecturer: *Introduction to programming with C and C++*.
- Teaching assistant: *Multi-core and GPU: Parallel Programming*.

Winter Term 2011/2012
- Teaching assistant: *Operating Systems*.

Summer Term 2012
- Supervised MSc student project: *High-level programming of heterogeneous systems*.
- Teaching assistant: *Multi-core and GPU: Parallel Programming*.

Winter Term 2011/2012	○ Teaching assistant: *Technical aspects of cloud computing*. ○ Teaching assistant: *Operating Systems*.
Summer Term 2011	○ Supervised UG/MSc student project: *Internet- and GPU-based Cloud Computing*. ○ Course Design and teaching assistant: *Multi-core and GPU: Parallel Programming*.
Winter Term 2010/2011	○ Supervised UG student project: *High-level GPU programming*.

Supervised Students

The following students are co-supervised with Sergei Gorlatch at the University of Münster.

since 04/2016 MSc studies of Bastian Hagedorn on
Efficient GPU Code Generation for Stencil Computations via Parallel Patterns

since 06/2015 PhD studies of Ari Rasch on
Parametric Algorithmic Skeletons

since 06/2015 PhD studies of Michael Haidl on
PACXX: A GPU programming model embedded in C++

The following students are co-supervised with Christophe Dubach at the University of Edinburgh.

since 09/2015 PhD studies of Daniel Hillerström on
Efficient Compilation of Handlers for Algebraic Effects

since 09/2015 PhD studies of Larisa Stoltzfus on
Stencil-based Acoustic Applications

since 09/2015 PhD studies of Vanya Yaneva on
Parallel Test Exectuion on GPUs

since 10/2014 PhD studies of Adam Harries on
Sparse and Irregular Data-Parallel Applications on GPUs

since 10/2014 PhD studies of Juan José Fumero on
Heterogeneous Computing in Managed Languages

since 10/2014 PhD studies of Toomas Remmelg on
Automatic Performance Optimisations via Provably Correct Rewrite Rules

The following students have been co-supervised with Sergei Gorlatch at the University of Münster.

07/2014 Bachelor thesis of André Lüers on
Evaluation of the Skeleton Library FastFlow

07/2014 Bachelor thesis of Lars Klein on
A Parallel Implementation of the T-CUP Software using the SkelCL Library

01/2014 Master thesis of Michael Olejnik on
A GPU-based Classification Framework for HIV Resistance Prediction

01/2014 Master thesis of Stefan Breuer on
Extending the SkelCL Library for Stencil Computations

11/2013 Diploma thesis of Wadim Hamm on
Development of a Divide & Conquer Skeleton for SkelCL

07/2013 Bachelor thesis of Matthias Droste on
Evaluation of the Skeleton Library SkePU

06/2013 Bachelor thesis of Kai Kientopf on
Implementation of the Needleman-Wunsch Algorithm and the Breath-First-Search with SkelCL

06/2013 Master thesis of Florian Quinkert on
A Model for Predicting Work Distribution in Heterogeneous Systems and its Implementation in SkelCL

03/2013 Master thesis of Malte Friese on
Extending the Skeleton Library SkelCL with a Skeleton for Allpairs Computations

03/2013 Bachelor thesis of Sebastian Mißbach on
Implementing the LU-Decomposition and the Mersenne-Twister with the SkelCL Library

03/2013 Bachelor thesis of Patrick Schiffler on
Performance Analysis of SkelCL using B+ Tree Traversal and 3D Jacobi Stencil Computation

01/2013 Diploma thesis of Markus Blank-Burian on
Simulation and Analysis of Two-Dimensional Turbulences on Parallel Computer Architectures

06/2012 Diploma thesis of Matthias Buß on
Adding Multidimensional Data Types to the Multi-GPU Skeleton Library SkelCL

09/2011 Bachelor thesis of Michael Olejnik on
Investigating the Use of GPUs for Radix Sort

09/2011 Bachelor thesis of Jan Gerd Tenberge on
Extending the SkelCL Library with Iterators

08/2011 Bachelor thesis of Stefan Breuer on
Enhancing SkelCL's MapOverlap Skeleton

08/2011 Bachelor thesis of Tobias Günnewig on
Developing a Library for Manipulating Source Code of C-based Languages