Marcin **Copik**

SERVERLESS · HPC · PHD RESEARCHER

ETH Zürich

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Summary

In my PhD research, I have been working on serverless programming models to bridge the gap between high-performance computing systems and cloud data centers. I developed tailored solutions for different levels of the FaaS computing stack: from computing and network devices to high-level optimizations, efficient system designs, and performance modeling.

Education

PhD in Computer Science

April 2018 -

ETH ZÜRICH — *Zürich, Switzerland*

- Thesis: High-Performance Serverless for HPC and Clouds
- Advisor: Prof. Torsten Hoefler

Master of Science (MSc) in Simulation Sciences

September 2014 - July 2017

RWTH AACHEN — *Aachen, Germany*

- Grade: 1.5. Interdisciplinary program. Major subject: High-Performance Computing
- Thesis: Parallel Prefix Algorithms for the Registration of Arbitrarily Long Electron Micrograph Series
- Advisor: Prof. Paolo Bientinesi, Prof. Benjamin Berkels

Summer School in Mathematics

August 2014

UNIVERSITY OF PERUGIA — *Perugia, Italy*

- Courses: Stochastic Processes, Functional Analysis

Bachelor of Science (BSc) in Mathematics

September 2012 - June 2014

SILESIAN UNIVERSITY OF TECHNOLOGY — *Gliwice, Poland*

- GPA: 4.6/5.0. Finished two of three years program

Bachelor of Science in Engineering (BSc) in Computer Science

September 2010 - March 2014

SILESIAN UNIVERSITY OF TECHNOLOGY — *Gliwice, Poland*

- Grade 5(A). Major subject: Software Engineering
- Thesis: GPU-accelerated stochastic simulator engine for PRISM model checker
- Advisor: Prof. Tadeusz Czachorski

Experience

Research Assistant

Zürich, Switzerland

ETH ZÜRICH — *April 2018 -*

- Advising for Bachelor and Master thesis projects.
- Conducting interviews for PhD and PostDoc candidates.
- Teaching assistant for Bachelor and Master courses.

Research Intern

Redmond, WA, USA

MICROSOFT — *June - October 2019*

- Analyzing microarchitectural implications of serverless workloads.
- Supervisor: Bobbie Manne.

Mentor

Organization: The STE||AR Group.

GOOGLE SUMMER OF CODE — *2017, 2018*

- Mentoring students working on HPX.
- Students: Ajai V George, Gabriel Laberge (co-mentored).

Student Research Assistant

Aachen, Germany

RWTH AACHEN, HIGH-PERFORMANCE AND AUTOMATIC COMPUTING — *2016 - December 2017*

- Benchmarking linear algebra frameworks.
- Supervisor: Prof. Paolo Bientinesi.

Research Assistant
Baton Rouge, LA, USA

Louisiana State University, STE||AR Group
April 2016 - August 2016

- Integrating single-source GPU programming in HPX.
- Supervisor: Prof. Hartmut Kaiser.

Student Research Assistant
Jülich, Germany

Jülich Supercomputing Centre
October 2014 - March 2016

- Developing tools for performance analysis of parallel applications at Scalasca.
- Supervisor: Dr Pavel Saviankou.

Software Engineer
Organization: The STE||AR Group

Google Summer of Code
2015

- Integrating single-source GPU programming in HPX.
- Supervisor: Dr Hartmut Kaiser.

Software Engineer
Organization: PRISM model checker

Google Summer of Code
2014

- Improving statistical model checking.
- Supervisor: Dr Vojtěch Forejt, Dr Dave Parker.

Student Research Assistant
Gliwice, Poland

The Institute of Theoretical and Applied Informatics
2012 - 2013

- Implementing GPU simulator of Markov Chains.
- Supervisors: Dr Mateusz Nowak, Dr Artur Rataj.

Student Research Assistant
Gliwice, Poland

Silesian University of Technology
2012 - 2013

- Implementing algorithms for registration of respiratory motion.
- Supervisor: Dr Dominik Spinczyk.

Honors & Awards

2023	**SIGHPC Travel Grant**, awarded for travel to ACM/IEEE Supercomputing 2023.
2022	**ACM/IEEE George Michael Memorial HPC Fellowship**, awarded for contributions into high-performance serverless.
2020	**Gold Medal at the ACM Student Research Competition**, ACM/IEEE Supercomputing 2022
2022	**AWS Cloud Credit for Research Application**
2022	**Google Cloud Research Credits**
2021	**Microsoft Research PhD Fellowship**, awarded for the 2021/2022 academic year.
2019	**Gold Medal at the ACM Student Research Competition**, ACM/IEEE Supercomputing 2019

Peer-reviewed Publications

Software Resource Disaggregation for HPC with Serverless Computing
IEEE IPDPS

Copik M., Chrapek M., Schmid L., Calotoiu A., Hoefler T.
2024

User-guided Page Merging for Memory Deduplication in Serverless Systems
IEEE Big Data

Qiu W., **Copik M.**, Wang Y., Calotoiu A., Hoefler T.
2023

- Acceptance Rate 17.5% (92/526)

FMI: Fast and Cheap Message Passing for Serverless Functions
ACM ICS

Copik M., Böhringer R., Calotoiu A., Hoefler T.
2023

- Acceptance Rate 29.4% (40/136)

rFaaS: Enabling High Performance Serverless with RDMA and Leases
IPDPS

Copik M., Taranov K., Calotoiu A., Hoefler T.
2023

- Acceptance Rate 25.7% (95/369)

Performance-Detective: Automatic Deduction of Cheap and Accurate Performance Models
ACM ICS

Schmid L., **Copik M.**, Calotoiu A., Werle D., Reiter A., Selzer M., Koziolek A., Hoefler T.
2022

- Acceptance Rate 24.2% (39/161)

MOM: Matrix Operations in MLIR
IMPACT

Chelini L., Barthels H., Bientinesi P., **Copik M.**, Grosser T., Spaminato D.
2022

Work-stealing Prefix Scan: Addressing Load Imbalance in Large-scale Image Registration — *IEEE TPDS*, 2021

Copik M., Grosser T., Hoefler T., Bientinesi P., Berkels B.

SeBS: A Serverless Benchmark Suite for Function-as-a-Service Computing — *ACM/IFIP Middleware*, 2021

Copik M., Kwasniewski G., Besta M., Podstawski M., Hoefler T.

- Acceptance Rate 31% (33/107)

Extracting Clean Performance Models from Tainted Programs — *ACM PPoPP*, 2021

Copik M., Calotoiu A., Grosser T., Wicki N., Wolf F., Hoefler T.

- Acceptance Rate 21% (31/150)

GraphMineSuite: Enabling High-Performance and Programmable Graph Mining Algorithms with Set Algebra — *VLDB*, 2021

Besta M. [and 18 others, including **Copik M.**]

SISA: Set-Centric Instruction Set Architecture for Graph Mining on Processing-in-Memory Systems — *IEEE MICRO*, 2021

Besta M. [and 18 others, including **Copik M.**]

The Generalized Matrix Chain Algorithm — *CGO*, 2018

Barthels H., **Copik M.**, Bientinesi P.

- Acceptance Rate 28.6% (30/105)

Using SYCL as an Implementation Framework for HPX.Compute — *DHPCC++ Workshop, IWOCL*, 2017

Copik M., Kaiser H.

A GPGPU-based Simulator for Prism: Statistical Verification of Results of PMC — *CS&P*, 2016

Copik M., Rataj A., Woźna-Szczęśniak B.

Methods for abdominal respiratory motion tracking — *Computer Aided Surgery*, 2014

Spinczyk D., Karwan A., **Copik M.**

Presentations and Talks

Cppless: Productive and Performant Serverless Programming in C++ — *November 2023*

Lightning Talk, LLVM-HPC at ACM/IEEE Supercomputing 2023.

High Performance Serverless for HPC and Clouds — *November 2023*

Poster presentation at Doctoral Showcase, SC 2023.

Serverless As a Bridge Between HPC and Clouds — *May 2023*

Invited talk, AWS Cloud for Research at ETH.

Serverless As a Bridge Between HPC and Clouds — *May 2023*

Invited talk, 5th Workshop on Parallel AI and Systems for the Edge (PAISE), IPDPS 2023.

Serverless As a Bridge Between HPC and Clouds — *May 2023*

Poster presentation at PhD Forum, IPDPS 2023.

Software Resource Disaggregation for HPC with Serverless Computing — *November 2022*

ACM/IEEE Supercomputing 2022 Poster, **Gold Medal at the ACM Student Research Competition**.

Software Resource Disaggregation for HPC with Serverless Computing — *November 2022*

SuperCompCloud at ACM/IEEE Supercomputing 2022.

Interactive Computing with Serverless Functions in rFaaS — *November 2022*

Lightning Talk, UrgentHPC at ACM/IEEE Supercomputing 2022.

Extracting Clean Performance Models from Tainted Programs" — *February 2022*

SIAM Conference on Parallel Processing for Scientific Computing (PP22) minisymposium

perf-taint: Taint Analysis for Automatic Many-Parameter Performance Modeling — *November 2019*

ACM/IEEE Supercomputing 2019 Poster, **Gold Medal at the ACM Student Research Competition**.

Parallel Prefix Algorithms for the Registration of Arbitrarily Long Electron Micrograph Series — *November 2017*

ACM/IEEE Supercomputing 2017 Poster, ACM Student Research Competition.

HPX and GPU-parallelized STL — *May 2016*

C++Now 2016 conference.

Skills

Programming	**Experienced:** C++, Python, Java **Familiar:** Matlab, Julia, Mathematica, R, Pascal, x86 ASM
Technologies	MPI, OpenMP, LLVM, OpenCL, SYCL, C++AMP, Docker, Kubernetes
Tools	Git, SVN, Mercurial, CMake, autotools, SLURM
Experience	serverless computing, parallel programming, cloud computing, performance modeling, GPU programming, model checking
Languages	English, German, Polish

Service

PAISE 2024	Organizing committee, publicity co-chair.	*2024*
Supercomputing	Student Volunteer.	*2023*
Supercomputing	Student Volunteer.	*2022*
IJHPCA	Reviewer.	*2022*
LLVM-HPC 2020	Reviewer.	*2020*
ISC 2019	Reviewer.	*2019*

Teaching

Fall 2023	Big Data	*ETH Zürich*
Spring 2023	Parallel Programming	*ETH Zürich*
Spring 2022	Parallel Programming	*ETH Zürich*
Fall 2021	Information Systems for Engineers	*ETH Zürich*
Spring 2021	Parallel Programming	*ETH Zürich*
Fall 2020	Compiler Design	*ETH Zürich*
Spring 2020	Parallel Programming	*ETH Zürich*
Fall 2019	Design of Parallel and High-Performance Computing	*ETH Zürich*
Spring 2019	Parallel Programming	*ETH Zürich*
Fall 2018	Numerical Methods for Computational Science and Engineering	*ETH Zürich*

Students

Matt Nappo	Co-supervised Google Summer of Code Student: Libfabric Implementation of rFaaS	*2023, GSoC*
Boyan Zhou	Master Thesis: Adoption and evolution of C++ in HPC Applications	*2023, ETH Zürich*
Gyorgy Rethy	Master Thesis: Process-as-a-Service computing on modern serverless platforms	*2022, ETH Zürich*
Laurin Brandner	Master Thesis: Serverless workflows benchmarking	*2022, ETH Zürich*
Lukas Möller	Bachelor Thesis: Serverless C++ Executor	*2022, ETH Zürich*
Malte Wächter	Bachelor Thesis: Profiling and optimizations of serverless functions	*2022, ETH Zürich*
Qiu Wei	Master Thesis: Serverless memory deduplication	*2022, ETH Zürich*
Lukas Tobler	Master Thesis: Serverless GPU functions	*2022, ETH Zürich*
Arnet Colin	Bachelor Thesis: Verification of representativeness of benchmarking suite	*2021, ETH Zürich*
Roman Böhringer	Master Thesis: Serverless collectives.	*2021, ETH Zürich*
Emir İşman	Bachelor Thesis: FaaStest collectives: reliable communication in serverless world	*2021, ETH Zürich*
Konrad Handrick	Co-supervised Bachelor Thesis: Offloading serverless with sPIN	*2021, ETH Zürich*
Tobias Lüscher	Bachelor Thesis: TaintImpact: Taint-Based Change Impact Analysis	*2021, ETH Zürich*
Siegfried Hartogs	Bachelor Thesis: Code-driven Language Development: Framework for Analysis of C/C++ Open-Source Projects	*2021, ETH Zürich*
Lukas Gygi	Bachelor Thesis: CppBuild: Large-Scale, Automatic Build System for Open Source C++ Repositories	*2021, ETH Zürich*
Nicolas Wicki	Bachelor Thesis: Control Flow Taint Analysis for Performance Modeling in LLVM	*2020, ETH Zürich*
Philipp Bomatter	Co-supervised Bachelor Thesis: Towards Extreme-Scale Cache Coherence Protocols and Simulations	*2019, ETH Zürich*
Gabriel Laberge	Co-supervised Google Summer of Code Student: Alternative smart executors	*2018, GSoC*
Ajai V George	Google Summer of Code Student: Work on Parallel Algorithms	*2017, GSoC*