

Maurizio Drocco, PhD

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SUMMARY

I am a Postdoctoral Researcher at the University of Torino. Formerly, I have been Research Intern at the IBM Thomas J. Watson Lab (NY, USA), at the IBM Dublin Research Lab (Ireland), and at the University of Torino since 2009. I co-authored ~30 papers in international journals and peer-reviewed conference proceedings (Google h-index 8).

My research concerns cross-stack parallel and distributed computing: lock-free synchronization, memory allocators, memory consistency models, up to high-level programming abstractions and semantics.

EDUCATION

Ph.D. in Computer Science

University of Torino

October 2017

Torino, Italy

- thesis: “Parallel Programming with Global Asynchronous Memory: Models, C++ APIs and Implementations” [1]
- supervisor: prof. M. Aldinucci

Master’s Degree in Computer Science

University of Torino

July 2013

Torino, Italy

- grade: summa cum laude and recommendation for publication
- thesis: “Parallel stochastic simulators in systems biology: the evolution of the species” [21]
- supervisor: prof. M. Aldinucci
- awarded “Best Student Award” for outstanding thesis

Bachelor Degree in Computer Science

University of Torino

March 2010

Torino, Italy

- grade: summa cum laude
- thesis: “A Simulator for a new Calculus of Biological Processes (SCWC: Stochastic Calculus of Wrapped Compartments)”
- supervisor: prof. E. Giovannetti

EXPERIENCE

University of Torino

Research Associate

September 2009 – present

Torino, Italy

- member of parallel computing *alpha* group
- participated in research projects: €3.5M H2020 RePhrase, €3.5M EU-FP7 REPARA, €3.5M EU-FP7 ParaPhrase, Regione Piemonte BioBITs
- lead-developed a C++11 PGAS-like memory API for stream processing on HPC clusters, with sequential consistency and automatic memory management through smart global pointers [1]
- contributed to the open-source FastFlow parallel programming framework [30]: CPU+GPU patterns [9], C++11 porting, support for distributed platforms
- co-developed a tool for parallel graph-based processing of biological data, optimized through working set reduction, ad-hoc memory allocators, and cache-friendly data structures [7, 10, 11, 13, 12]

- co-developed a real-time CPU+GPU video restoration filter for high-resolution video streams, supporting extreme noise levels (i.e., up to 90%), presented at Nvidia GTC 2014 [15, 8, 22, 18]
- lead-developed a parallel simulation-mining pipeline for systems biology, with vectorized pattern-matching (through Intel SSE intrinsics) and fine-grained scheduling of simulation quanta based on simulated time for pseudo-optimal load balancing [16, 17, 20, 23, 25, 24, 27, 29, 28, 14, 26]
- key techniques: C++, parallel patterns, distributed programming (MPI, libfabric), memory-driven optimization, GPU programming (OpenCL, CUDA), Intel SSE intrinsics

Research Intern

IBM Thomas J. Watson Research Center

May 2015 – November 2015
Yorktown Heights, NY, USA

- member of the High Performance Analytics group
- mentors: Fabrizio Petrini, Fabio Checconi
- designed multicore optimizations for parallel graph processing (graph500 chart); lead-developed a compressed graph representation optimized for the IBM BlueGene/Q memory system
- lead-developed a Valgrind plugin emulating a distributed-shared memory system for heterogeneous clusters (e.g, multicore, GPU, FPGA, and flash storage) with minimal overhead (i.e., 20x slowdown)
- Key techniques: pthread, gcc atomic built-ins, cache-driven optimizations, sockets, Valgrind plug-ins

Research Intern

IBM Dublin Research Lab

July 2013 – October 2013
Dublin, Ireland

- member of the High Performance Computing group
- mentor: Massimiliano Meneghin
- lead-developed a framework for semi-automatic tuning of structured FastFlow-based parallel applications, on IBM POWER architectures
- key techniques: hardware reconfiguration (e.g. SMT level, cache pre-fetching), performance measurement with PAPI, FastFlow

RESEARCH ACTIVITY

I have co-authored ~30 papers in conference proceedings and scientific journals. I have participated in conferences as author, speaker, reviewer, and member of organizing and program committees.

Journals

- Journal of Supercomputing [4, 5]
- Parallel Processing Letters [2]
- International Journal of High Performance Computing Applications [8, 7]
- Frontiers in Genetics [11]
- BioMed Research International [16]
- Briefings in Bioinformatics [17]
- Theoretical Computer Science [24]
- Transactions on Computational Systems Biology [27]

Conferences

- Local Chair for the “Accelerator Computing” topic, Euro-Par 2018 (Torino, Italy)
- Speaker [3], Euro-Par 2017 (Santiago de Compostela, Spain)
- PC Member, PDP 2018 (Cambridge, UK), 2016 (Heraklion, Greece), 2015 (Turku, Finland)
- PC Member, IPTA 2017 (Guangzhou, China)
- PC Member, ScalCom 2016 (Toulouse, France)
- Speaker [6], PDP 2016 (Heraklion, Greece)

- Speaker [14], ICDCS 2014 (Madrid, Spain)
- Speaker [12], CIBB 2014 (Cambridge, UK)
- Organizing Committee, PDP 2014 (Turin, Italy)

Schools

- UPMARC Multicore Computing Summer School 2016 (Uppsala, Sweden), lectures on parallel programming and memory models
- ParaPhrase International Summer School in Parallel Patterns 2014 (Dublin, Ireland), lectures on skeleton-based parallel programming, FastFlow, large-scale industrial HPC applications
- HiPEAC International ACACES Summer School 2014 (Fiuggi, Italy), lectures on foundational parallel computing, OpenCL compilation on heterogeneous platforms, low-energy HPC; presented the poster “A Dynamic Memory Allocator for heterogeneous platforms” [19]

ACHIEVEMENTS, AWARDS AND GRANTS

Ph.D. Scholarship Award

June 2015

IBM Research

- received a 20,000\$ Scholarship award for accomplishment reached during the internship at IBM Thomas J. Watson Research Center

Best Student Award

October 2014

University of Torino

- received the “Best Student Award” in Computer Science Master programme

Full registration fee

July 2014

HiPEAC consortium

- ACACES Summer School registration fee for selected Ph.D. students from HiPEAC institutions

Ph.D. three years Grant (2014 – 2017)

October 2013

Italian Ministry of Education, Universities and Research

- Ranked 1st in the competitive selection at Computer Science Department, University of Torino

PUBLICATIONS

In reverse chronological order:

- [1] M. Drocco. “Parallel Programming with Global Asynchronous Memory: Models, C++ APIs and Implementations”. PhD thesis. Computer Science Department, University of Torino, Oct. 2017.
- [2] C. Misale et al. “A Comparison of Big Data Frameworks on a Layered Dataflow Model”. In: *Parallel Processing Letters* 27.01 (2017), p. 1740003.
- [3] C. Misale et al. “PiCo: a Novel Approach to Stream Data Analytics”. In: *Euro-Par 2017 Workshops, Proc. of the 1st Intl. Workshop on Autonomic Solutions for Parallel and Distributed Data Stream Processing (Auto-DaSP)*. LNCS. To appear. Aug. 2017.
- [4] M. Torquati et al. “On Dynamic Memory Allocation in Sliding-Window Parallel Patterns for Streaming Analytics”. In: *The Journal of Supercomputing* (Sept. 2017).
- [5] M. Aldinucci et al. “A Parallel Pattern for Iterative Stencil + Reduce”. In: *Journal of Supercomputing* (2016), pp. 1–16.
- [6] M. Drocco, C. Misale, and M. Aldinucci. “A Cluster-As-Accelerator approach for SPMD-free Data Parallelism”. In: *Proc. of Intl. Euromicro PDP 2016: Parallel Distributed and network-based Processing*. Crete, Greece: 2016, pp. 350–353.

- [7] F. Tordini et al. “NuChart-II: the road to a fast and scalable tool for Hi-C data analysis”. In: *International Journal of High Performance Computing Applications (IJHPCA)* (2016), pp. 1–16.
- [8] M. Aldinucci et al. “Parallel Visual Data Restoration on Multi-GPGPUs using Stencil-Reduce Pattern”. In: *International Journal of High Performance Computing Applications* 29.4 (2015), pp. 461–472.
- [9] M. Aldinucci et al. “The Loop-of-Stencil-Reduce paradigm”. In: *Proc. of Intl. Workshop on Reengineering for Parallelism in Heterogeneous Parallel Platforms (RePara)*. Helsinki, Finland: Aug. 2015, pp. 172–177.
- [10] M. Drocco et al. “Memory-Optimised Parallel Processing of Hi-C Data”. In: *Proc. of Intl. Euromicro PDP 2015: Parallel Distributed and network-based Processing*. Mar. 2015, pp. 1–8.
- [11] I. Merelli et al. “Integrating Multi-omic features exploiting Chromosome Conformation Capture data”. In: *Frontiers in Genetics* 6.40 (2015).
- [12] F. Tordini et al. “NuChart-II: a graph-based approach for the analysis and interpretation of Hi-C data”. In: *Computational Intelligence Methods for Bioinformatics and Biostatistics - 11th International Meeting, CIBB 2014, Cambridge, UK, June 26-28, 2014, Revised Selected Papers*. Vol. 8623. LNCS. Cambridge, UK: 2015, pp. 298–311.
- [13] F. Tordini et al. “Parallel Exploration of the Nuclear Chromosome Conformation with NuChart-II”. In: *Proc. of Intl. Euromicro PDP 2015: Parallel Distributed and network-based Processing*. Mar. 2015.
- [14] M. Aldinucci et al. “Exercising high-level parallel programming on streams: a systems biology use case”. In: *Proc. of the 2014 IEEE 34th Intl. Conference on Distributed Computing Systems Workshops (ICDCS)*. Madrid, Spain: 2014.
- [15] M. Aldinucci et al. “FastFlow: Combining Pattern-Level Abstraction and Efficiency in GPGPUs”. In: *GPU Technology Conference (GTC 2014)*. San Jose, CA, USA, Mar. 2014.
- [16] M. Aldinucci et al. “On designing multicore-aware simulators for systems biology endowed with on-line statistics”. In: *BioMed Research International* (2014).
- [17] M. Aldinucci et al. “Parallel stochastic systems biology in the cloud”. In: *Briefings in Bioinformatics* 15.5 (2014), pp. 798–813.
- [18] M. Aldinucci et al. “Parallel video denoising on heterogeneous platforms”. In: *Proc. of Intl. Workshop on High-level Programming for Heterogeneous and Hierarchical Parallel Systems (HLPGPU)*. 2014.
- [19] M. Drocco, M. Aldinucci, and M. Torquati. “A Dynamic Memory Allocator for heterogeneous platforms”. In: *Advanced Computer Architecture and Compilation for High-Performance and Embedded Systems (ACACES) – Poster Abstracts*. Fiuggi, Italy: 2014.
- [20] M. Aldinucci et al. “Parallel stochastic simulators in system biology: the evolution of the species”. In: *Proc. of Intl. Euromicro PDP 2013: Parallel Distributed and network-based Processing*. Belfast, Northern Ireland, U.K.: Feb. 2013.
- [21] M. Drocco. “Parallel stochastic simulators in systems biology: the evolution of the species”. MA thesis. Computer Science Department, University of Torino, Italy, July 2013.
- [22] M. Aldinucci et al. “A Parallel Edge Preserving Algorithm for Salt and Pepper Image Denoising”. In: *Proc. of 2nd Intl. Conference on Image Processing Theory Tools and Applications (IPTA)*. Istanbul, Turkey: Oct. 2012, pp. 97–102.
- [23] M. Aldinucci et al. “On Parallelizing On-Line Statistics for Stochastic Biological Simulations”. In: *Euro-Par 2011 Workshops, Proc. of the 2st Workshop on High Performance Bioinformatics and Biomedicine (HiBB)*. Vol. 7156. LNCS. Bordeaux, France: 2012, pp. 3–12.
- [24] M. Coppo et al. “Simulation techniques for the calculus of wrapped compartments”. In: *Theoretical Computer Science* 431 (2012), pp. 75–95.
- [25] M. Aldinucci et al. “On Designing Multicore-Aware Simulators for Biological Systems”. In: *Proc. of Intl. Euromicro PDP 2011: Parallel Distributed and network-based Processing*. Ayia Napa, Cyprus: Feb. 2011, pp. 318–325.

- [26] C. Calcagno et al. “Modelling Spatial Interactions in the Arbuscular Mycorrhizal Symbiosis using the Calculus of Wrapped Compartments”. In: *Proc. of Third International Workshop on Computational Models for Cell Processes (CompMod)*. Vol. 67. EPTCS. Aachen, Germany, Sept. 2011, pp. 3–18.
- [27] M. Coppo et al. “Modelling Ammonium Transporters in Arbuscular Mycorrhiza Symbiosis”. In: *Transactions on Computational Systems Biology (TCS)* 6575.13 (2011), pp. 85–109.
- [28] M. Coppo et al. “Hybrid Calculus of Wrapped Compartments”. In: *Proc. of 4th Workshop on Membrane Computing and Biologically Inspired Process Calculi (MeCBIC)*. Vol. 40. EPTCS. Jena, Germany, Aug. 2010, pp. 102–120.
- [29] M. Coppo et al. “Stochastic Calculus of Wrapped Compartments”. In: *Proc. of the 8th Workshop on Quantitative Aspects of Programming Languages (QAPL)*. Vol. 28. EPTCS. Paphos, Cyprus, Mar. 2010, pp. 82–98.
- [30] M. Aldinucci and M. Torquati. *FastFlow website*. <http://mc-fastflow.sourceforge.net/>. 2009.