

Ioannis Vardas

TU WIEN - FACULTY OF INFORMATICS - INSTITUTE OF COMPUTER ENGINEERING

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Summary

Doctoral candidate in Computer Science and Engineering with a focus on High-Performance Computing, performance optimization, and parallel programming. Proficient in C/C++, Python, and Linux-based operating systems, with proven experience developing performance profiling tools and optimizing MPI applications in HPC systems. Combines strong analytical thinking and problem-solving skills with effective cross-functional collaboration and technical communication abilities. Deep knowledge of the MPI standard and implementations, skilled in CUDA, and OpenMP, with expertise in software performance engineering. Experience simulating custom High-Performance interconnects with similar principles to InfiniBand.

Professional Experience

TU Wien - Faculty of Informatics: Parallel Computing Research Unit

Austria

PRE-DOCTORAL RESEARCHER

June 2021 - Present

- Designed and implemented [mpisee](#), a novel profiling tool for MPI applications that analyzes MPI communication per communicator [3, 11]. Analyzed the performance of MPI applications to determine performance bottlenecks. Made key design decisions about distributed communicator tracking, data collection methodology and analysis framework.
- Designed and implemented process mapping strategies to improve the available memory bandwidth for colocated MPI applications in HPC systems [1, 2, 12]. Resulted in 2.4x faster completion times for sets of applications over a common exclusive allocation and mapping strategy.
- Collaborated with pharmaceutical researchers to integrate and optimize LigandScout software for molecular screening on HPC systems, communicating technical constraints and opportunities to improve task scheduling [10].
- Contributed to improved communication algorithms and interfaces for the MPI Library [9, 8, 7].
- Currently developing a lightweight profiling tool for NVIDIA Collective Communications Library (NCCL) operations and their associated asynchronous CUDA kernels using CUDA Profiling Tools Interface (CUPTI).

ICS-FORTH - Computer Architecture and VLSI Systems Laboratory

Greece

RESEARCH ENGINEER

Dec. 2019 - May 2021

- Conducted research on fault-aware process placement strategies to enhance the resilience of MPI applications on HPC systems [5, 4]. Implemented a simulation environment (using C and Python) for generating synthetic node failures based on the Weibull distribution in a HPC torus cluster. The goal was to improve the performance of such jobs in an error-prone environment via fault-aware process placement.

ICS-FORTH - Computer Architecture and VLSI Systems Laboratory

Greece

GRADUATE RESEARCH ASSISTANT

Sept. 2017 - Nov. 2019

- Extended the [Slurm resource manager](#) to support heterogeneous architectures and optimize process placement of parallel applications [6, 4]. (1) Implemented a Slurm plugin that enables Slurm to support nodes with FPGA-based accelerators. (2) Extended Slurm to launch, manage and run workloads into Virtual Machines. (3) Implemented fault-aware node allocation in Slurm to improve the communication cost and the overhead job due to node failures.

Hellenic Army

Greece

SERVED IN THE HELLENIC ARMED FORCES

Dec. 2016 - Aug 2017

- Served in the Hellenic Army, Research and Informatics Corps

ICS-FORTH - Computer Architecture and VLSI Systems Laboratory

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RESEARCH SCHOLARSHIP

June 2016 - Nov. 2016

- Simulated the behavior of a novel Accurate congestion control for RDMA Transfers on HPC interconnects using Omnet++ [13].

Skills

HPC & Parallel Computing	MPI, CUDA , OpenMP, Software Performance Engineering, Process Mapping
Programming Languages	C, C++ (C++17/20), Python , Java
Development Tools	Git, CMake, Bash scripting, CI/CD pipelines (GitHub Actions), GDB, LLDB, Valgrind
Data Processing & ML	R, PySpark, TensorFlow, PyTorch, Octave
System Administration	Linux-based (RHEL, SLES, Debian), Docker, Singularity, QEMU, Spack
Languages	Greek (native), English (CEFR C2), German (Intermediate)

Education

TU Wien

Austria

DOCTORAL CANDIDATE IN ENGINEERING SCIENCES AND COMPUTER SCIENCES

Present

- **PhD Thesis** (under review): Improving Colocated MPI Application Performance via Process Mapping in HPC Systems: Leveraging Hierarchical Process-to-core Mappings and Communicator-centric Profiling. Advisor: Prof. Jesper Larsson Träff.

University of Crete

Greece

M.Sc. IN COMPUTER SCIENCE AND ENGINEERING

Nov. 2019

- **MSc Thesis**: Process Placement Optimizations and Heterogeneity Extensions to the Slurm Resource Manager[6].
Advisors: Prof. Manolis G.H. Katevenis, Co-Advisor: Dr. Manolis Marazakis.

University of Crete

Greece

B.Sc. IN COMPUTER SCIENCE

Mar. 2016

- **Bachelor Thesis**: Memory Testing through an FPGA with an embedded Processor

Further Education

CERTIFICATES

- Machine learning from Stanford Online by Andrew Ng.
- Modern C++ software design (advanced level) by Klaus Iglberger.

SUMMER SCHOOLS

- ACM Europe Summer School on HPC Computer Architectures for AI and Dedicated Applications, 2022: [Program Schedule](#).
- International Summer School on Advanced Computer Architectures and Compilation for High-Performance and Embedded Systems (ACACES) 2018.

Other Projects

DESIGN OF A RISC-V CORE IN SYSTEM VERILOG

- [Implementation](#) of RV32IC standard with support for stream instructions.
- Developed with Synopsys EDA tools for the purposes of Digital Circuits Design Lab Using EDA Tools.

CACHE SIMULATOR

- Designed and implemented [YAC Simulator](#), a cache simulator written in C/C++ for a simple cache scheme.
- Developed for the purposes of the [CS-255](#) Computer Organization course of the University of Crete.

List of Publications

- [1] Ioannis Vardas et al. “Improved Parallel Application Performance and Makespan by Colocation and Topology-aware Process Mapping”. In: *IEEE/ACM 24th International Symposium on Cluster, Cloud and Internet Computing (CCGrid)*. 2024. doi: [10.1109/CCGrid59990.2024.00023](https://doi.org/10.1109/CCGrid59990.2024.00023).
- [2] Ioannis Vardas et al. “Exploring Mapping Strategies for Co-allocated HPC Applications”. In: *Euro-Par 2023: Parallel Processing Workshops*. Springer Nature Switzerland, 2024, pp. 271–276. doi: [10.1007/978-3-031-48803-0_31](https://doi.org/10.1007/978-3-031-48803-0_31).
- [3] Ioannis Vardas et al. “mpisee: MPI Profiling for Communication and Communicator Structure”. In: *IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*. 2022, pp. 520–529. doi: [10.1109/IPDPSW55747.2022.00092](https://doi.org/10.1109/IPDPSW55747.2022.00092).
- [4] Ioannis Vardas, Manolis Ploumidis, and Manolis Marazakis. “Towards Communication Profile, Topology and Node Failure Aware Process Placement”. In: *SBAC-PAD*. 2020, pp. 241–248. doi: [10.1109/SBAC-PAD49847.2020.00041](https://doi.org/10.1109/SBAC-PAD49847.2020.00041).
- [5] Ioannis Vardas, Manolis Ploumidis, and Manolis Marazakis. “Exploring the Impact of Node Failures on the Resource Allocation for Parallel Jobs”. In: *Euro-Par 2021: Parallel Processing Workshops*. Springer International Publishing, 2022, pp. 298–309. doi: [10.1007/978-3-031-06156-1_24](https://doi.org/10.1007/978-3-031-06156-1_24).
- [6] Ioannis Vardas. “Process Placement Optimizations and Heterogeneity Extensions to the Slurm Resource Manager”. 2019. URL: <https://tinyurl.com/mwujn46s>.
- [7] Jesper Larsson Träff, Ioannis Vardas, and Sascha Hunold. “Modes, Persistence and Orthogonality: Blowing MPI Up”. In: *Proceedings of the SC '24 Workshops*. 2024, pp. 404–413. doi: [10.1109/SCW63240.2024.00061](https://doi.org/10.1109/SCW63240.2024.00061).
- [8] Jesper Larsson Träff and Ioannis Vardas. “Library Development with MPI: Attributes, Request Objects, Group Communicator Creation, Local Reductions, and Datatypes”. In: *Proceedings of the 30th European MPI Users' Group Meeting. EuroMPI '23*. ACM, 2023. doi: [10.1145/3615318.3615323](https://doi.org/10.1145/3615318.3615323).
- [9] Jesper Larsson Träff et al. “Uniform Algorithms for Reduce-scatter and (most) other Collectives for MPI”. In: *IEEE International Conference on Cluster Computing (CLUSTER)*. 2023, pp. 284–294. doi: [10.1109/CLUSTER52292.2023.00031](https://doi.org/10.1109/CLUSTER52292.2023.00031).
- [10] Sascha Hunold et al. “Massively Scaling Molecular Screening Workloads on EuroHPC Supercomputers”. In: *Austrian-Slovenian HPC Meeting 2023 - ASHPC23*. 2023, pp. 51–51. doi: [10.25365/phaidra.423](https://doi.org/10.25365/phaidra.423).
- [11] Sascha Hunold et al. “An Overhead Analysis of MPI Profiling and Tracing Tools”. In: *Proceedings of the PERMAVOST workshop*. ACM, 2022. doi: [10.1145/3526063.3535353](https://doi.org/10.1145/3526063.3535353).
- [12] Philippe Swartvagher et al. “Using Mixed-Radix Decomposition to Enumerate Computational Resources of Deeply Hierarchical Architectures”. In: *Proceedings of the SC '23 Workshops. SC-W '23*. ACM, 2023, pp. 405–415. doi: [10.1145/3624062.3624109](https://doi.org/10.1145/3624062.3624109).
- [13] Dimitris Giannopoulos et al. “Accurate Congestion Control for RDMA Transfers”. In: *Proceedings of the Twelfth IEEE/ACM International Symposium on Networks-on-Chip. NOCS '18*. Torino, Italy, 2018. doi: [10.1109/NOCS.2018.8512155](https://doi.org/10.1109/NOCS.2018.8512155).