

Curriculum Vitae - Paolo Burgio

PhD Electronic Engineering
BSC, MSC Computer Engineering



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Research interests

- Embedded systems and embedded Machine Learning
- Autonomous Driving Systems
- Reconfigurable computing and programming models

Education and Training

BSC and MSC degrees in Computer Engineering in 2003 and 2007 respectively, at University of Bologna (IT).

- MSC thesis title: “Microprocessor System-on-Chip (MPSoCs) bus arbiter with Time Division Multiple Access (TDMA) predictable policy and QoS guarantee”
- Jointly between MicRel Lab @UNIBO (IT) and ESLAB@ Linköping Universitet (SE), where I spent 6 months. My advisors were prof. Luca Benini and prof. Petru Eles, respectively. See publication [6].

PhD (*doctor aeuropaeus*) in Electronic Engineering in 2013, at University of Bologna (IT) and Université de Bretagne-Sud (FR)

- PhD thesis title: “Use of shared memory in the context of embedded multi-core processor: exploration of the technology and its limits”

Work experiences and achievements – timeline

January 2008 – June 2008

Intern researcher at ESLAB, Linköping Universitet (SE).

- Work on real-time algorithms (MS thesis + post thesis research fellowship) for bus scheduling. Published at RTAS on 2011 (See publication [6]).

June 2008 – December 2009

Intern researcher @MicRel Lab (prof. Luca Benini’s group), Università di Bologna, Italy.

- In cooperation with the group of prof. Buttazzo at Scuola Superiore Sant’Anna of Pisa (IT).
- Joint research on cooperative shared bus allocation and task scheduling on RT systems. Published at ICCD 2010 [1]

January 2010 – December 2013

PhD student at MicRel Lab (my advisor was prof. Luca Benini).

- Main research activity: exploring the applicability of shared memory paradigm for many-core embedded computers
 - Publications: [2, 3, 4, 8, 9, 10, 13] (among the others, DATE 2012, 2013 and 2014 and two Journals)

- Since January 2011, I started a **joint PhD program between Università di Bologna and Université de Bretagne-Sud** (for the latter, my advisor was prof. Philippe Coussy).
 - Research on hardware acceleration for embedded systems. Published at DSD 2012 [7], DATE 2014 [12] and EUC [14]
- In 2011 I started a cooperation with the AI group (prof. Michela Milano) at University of Bologna, for the optimal scheduling of tasks on Heterogeneous systems
 - Published at Computing Frontiers –CF 2011 [5]
- In 2012, I held a **joint/visiting position at Politecnico di Torino** in the domain of computer vision embedded systems
 - A report of my research in years 2011/2012 was published in an issue of HiPEAC Info

January 2014 – today

Senior research staff (since 2018, Assistant Professor – RTD/A) at Università di Modena e Reggio Emilia / Mantova Campus

- Current research activities: **low-power edge computers for embedded machine learning systems and autonomous driving systems**
 - Currently leading a team of 10-15 junior researchers
- Teaching activity ongoing since 2011 (see below)
- Industrial projects: leading industrial research projects for developing autonomous driving software
- **EU projects: leading the integration work-package** for the PRYSTINE EU Project, and UNIMORE *de-facto* PI for the FRACTAL EU project and AI4CSM project
- I am **faculty advisor** for the Formula Student project at UNIMORE

Awards and grants

- *August 2010*: full grant for participating to the ACACES 2010 Summer School – Full inscription
- *January 2011*: HiPEAC grant for participating to the CGO 2011 conference – Full inscription & travel
- *March 2012*: HiPEAC mobility grant for internship (UBS, Lorient, FR) – 5K Euros
- *March 2013*: Best poster award at Design, Testing and Automation in Europe – DATE 2013 – 500 Euros
- *October 2015*: Best paper award at CSI Symposium on Real-Time and Embedded Systems and Technologies (RTEST)
- *December 2019*: my project proposal “*Progettazione di una scatola nera di nuova generazione con funzionalità avanzate per veicoli semi-autonomi, sensorizzati, e connessi*” won the bando “*Laboratorio regionale per l'imprenditorialità*” of Emilia Romagna region – Two founded positions for junior and senior researchers for 1 year
- *December 2019*: Certificate of Merit by the University of Modena and Reggio Emilia for the aforementioned project
- *2020*: multiple honors at challenges on autonomous driving systems, by the research (sub) group called *ADX/Thundershot* that I currently lead

Committees (relevant)

- Editor for the following journals: Frontiers – special issue, Micromachines - special issue
- TPCs for the following Journals (‘T’ is for ‘Transactions’): TCAT, TOMM, TVT, MICPRO, TMCCA
- TPCs for the following conferences: ECRTS/WATERS, DATE, HPC, DSD, VTC, DTS, VEHITS

Teaching experiences (all)

- *2020 – today*: “Computing paradigms and languages” (@BSC) at Univ. of Modena
- *2018 – today*: “Industrial informatics” (@BSC) at Univ. of Modena, Mantova Campus
- *2019 - 2020*: “High performance Computing” (@MSC) at Univ. of Modena
- *2016 - 2019*: “Parallel Programming” (Both @BSC and MSC) at Univ. of Modena
- *2014, 2015*: “Programming Basics” (C/C++) at Univ. of Modena
- *2009 to 2011*: Class in “HW/SW codesign” at Univ. of Bologna

Technical skills and competences

- Embedded programming: C, C++, OpenMP, OpenCL, CUDA for GPU programming, Arduino Core
- Programming languages: C, C++, C#, .NET fwk&core, Javascript/jQuery, C++/SystemC, C/OpenMP, Unix Bash Scripting, PHP, Java, Node.js
- Software development environment: MS Visual Studio (Code), Xamarin Studio, MongoDB, MS SQL Server, Eclipse, MS Internet Information Services - IIS, MySQL
- Operating systems: Windows Server, GNU/Linux, Erika RTOS

Projects - timeline (relevant)

- *As junior researcher/PhD student*
 - EU FP7 PREDATOR (2009) – real-time multicore systems
 - EU FP7 PRO3D (2010) – computing vision and embedded systems
 - EU FP7 VERTICAL (2011) – low-power and next-generation cloud/embedded systems
 - EU FP7 SMECY (2012) – computer vision and embedded systems
- *As senior researcher/postdoc*
 - EU FP7 P-SOCRATES (2013-2015) – embedded intelligence and machine learning
 - H2020 HERCULES (2014-17) – autonomous driving systems; embedded system - coordination
 - ECSEL PRYSTINE (2018 – ongoing) – embedded machine learning for autonomous driving systems – lead of integration and SW development (50+ partners)
 - Emilia Romagna regional project *IoMiMuovo* to fight Covid19 by monitoring people density on busses – Scientific coordination

Personal skills and competences

- *Languages*: Mothertongue italian. I have good knowledge of English, both spoken and written, which I currently use in my work. As I lived in France, I learned French. I am currently learning Spanish.
- *Soft skills*: team management and team building, and motivational skills; very good at adapting to new challenges and goals, thanks to my PhD and R&D career; high attitude at problem-solving and lateral thinking
- *Other initiatives*: co-founder of HiPeRT srl, the spinoff of HiPeRT Lab @UNIMORE (which I also co-funded); co-founder of iotty srl. This latter activity I dropped as I got a permanent position, in 2019
- *Personal*: enthusiast guitar player and singer (metal, electronic and rock), DIY, travels and backpacking; like most of Italians, I love cooking and football

Full list of publications (as of Dec 7th, 2023)

2010

- [1] “Adaptive TDMA bus Allocation and Elastic Scheduling: a unified approach for enhancing robustness in multi-core RT systems”, Paolo Burgio, Martino Ruggiero, Francesco Esposito, Mauro Marinoni, Giorgio Buttazzo and Luca Benini, in: *28th IEEE International Conference on Computer Design (ICCD)*, Amsterdam, Netherlands, 2010
- [2] “Vertical stealing: Robust, Locality-Aware Do-All Workload Distribution for 3D MPSoCs”, Andrea Marongiu, Paolo Burgio and Luca Benini, in: *International Conference on Compilers Architectures and Synthesis for Embedded Systems (ESWEEK/CASES)*, Scottsdale, Arizona, 2010
- [3] “Evaluating OpenMP support costs on MPSoC”, Andrea Marongiu, Paolo Burgio and Luca Benini, in: *13th Euromicro Conference on Digital System Design (DSD)*, Lille, France, 2010

2011

- [4] “Supporting OpenMP on a multi-cluster embedded MPSoC”, Andrea Marongiu, Paolo Burgio, Luca Benini, *Microprocessors and Microsystems Journal*, Volume 35, Issue 8, November 2011, Pages 668-682, ISSN 0141-9331, 10.1016/j.micpro.2011.08.010.
- [5] “MPOpt-Cell: a high-performance data-flow programming environment for the CELL BE processor”, Alessio Franceschelli, Paolo Burgio, Giuseppe Tagliavini, Andrea Marongiu, Martino Ruggiero, Michele Lombardi, Alessio Bonfietti, Michela Milano and Luca Benini, in: *Computing Frontiers (CF) 2011*, Ischia, Italy, pages 11:1--11:2, ACM, 2011
- [6] “Bus Access Design for Combined Worst and Average Case Execution Time Optimization of Predictable Real-Time Applications on Multiprocessor Systems-on-Chip”, Jakob Røsen, Carl-Fredrik Neikter, Petru Eles, Zebo Peng, Paolo Burgio and Luca Benini, in: *Real-Time and Embedded Technology and Applications Symposium (RTAS)*, 2011 17th IEEE, Chicago, IL, pages 291 - 301, 2011 – MSC thesis

2012

- [7] “OpenMP-based Synergistic Parallelization and HW Acceleration for On-Chip Shared-Memory Clusters”, Paolo Burgio, Andrea Marongiu, Dominique Heller, Cyrille Chavet, Philippe Coussy and Luca Benini, in: *15th Euromicro Conference on Digital Systems Design (DSD)*, Cesme, Izmir, Turkey, pages 751 - 758, 2012.
- [8] “Fast and lightweight support for nested parallelism on cluster-based embedded many-cores”, Andrea Marongiu, Paolo Burgio and Luca Benini, in: *Design, Automation Test in Europe Conference Exhibition (DATE)*, 2012, pages 105-110, 2012

2013

- [9] “Enabling Fine-Grained OpenMP Tasking on Tightly-Coupled Shared Memory Clusters”, Paolo Burgio, Giuseppe Tagliavini, Andrea Marongiu and Luca Benini, in: *Design, Automation Test in Europe Conference Exhibition (DATE)*, 2013.
- [10] “Variation-tolerant OpenMP Tasking on Tightly-coupled Processor Clusters”, Abbas Rahimi, Paolo Burgio, Andrea Marongiu and Luca Benini, in: *Design, Automation Test in Europe Conference Exhibition (DATE)*, 2013.
- [11] “Architecture and Programming Model Support for Efficient Heterogeneous Computing on Tightly-Coupled Shared-Memory Clusters”, Paolo Burgio, Andrea Marongiu, Robin Danilo, Philippe Coussy, Luca Benini, in: *Design and Architectures for Signal and Image Processing (DASIP)*, 2013.

2014

- [12] "A tightly-coupled hardware controller to improve scalability and programmability of shared-memory heterogeneous clusters", Paolo Burgio, Robin Danilo, Andrea Marongiu, Philippe Coussy, Luca Benini, in: *Design, Automation Test in Europe Conference Exhibition (DATE)*, 2014.
- [13] "Tightly-coupled hardware support to dynamic parallelism acceleration in embedded shared memory clusters", Paolo Burgio, Giuseppe Tagliavini, Francesco Conti, Andrea Marongiu, Luca Benini, in: *Design, Automation Test in Europe Conference Exhibition (DATE)*, 2014.
- [14] "A HLS-based toolflow to design next-generation heterogeneous many-core platforms with shared memory", Paolo Burgio, Andrea Marongiu, Philippe Coussy, Luca Benini, in: *International Conference on Embedded and Ubiquitous Computing (EUC)*, 2014.

2015

- [15] "A memory-centric approach to enable timing-predictability within embedded many-core accelerators", Paolo Burgio, Andrea Marongiu, Paolo Valente and Marko Bertogna, in *Real-Time and Embedded Systems and Technologies (RTEST)*, 2015 CSI Symposium on , vol., no., pp.1-8, 7-8 Oct. 2015. – Best paper award
- [16] "Efficient implementation of Genetic Algorithms on GP-GPU with scheduled persistent CUDA threads", Nicola Capodieci and Paolo Burgio, in *Parallel Architectures, Algorithms and Programming (PAAP)*, 2015 Seventh International Symposium on , vol., no., pp.6-12, 12-14 Dec. 2015
- [17] "P-SOCRATES: A parallel software framework for time-critical many-core systems", Luís Miguel Pinho, Vincent Nélis, Patrick Meumeu Yonsi, Eduardo Quiñones, Marko Bertogna, Paolo Burgio, Andrea Marongiu, Claudio Scordino, Paolo Gai, Michele Ramponi and Michal Mardiak (2015), in: *Microprocessors and Microsystems*, "":""(-)
- [18] "Simulating next-generation Cyber-physical computing platforms", Paolo Burgio, Carlos Alvarez, Eduard Ayguadé, Antonio Filgueras, Daniel Jiménez-González, Xavier Martorell, Nacho Navarro and Roberto Giorgi, in: *De-CPS '15, Proceedings of the 2nd Workshop Challenges and New Approaches for Dependable and Cyber-Physical System Engineering*. Published in: *Ada User Journal*. Dec 2015, Vol. 36 Issue 4, p259-263.

2016

- [19] "A Software Stack for Next-Generation Automotive Systems on Many-Core Heterogeneous Platforms", Paolo Burgio, Marko Bertogna; Ignacio Sañudo Olmedo; Paolo Gai; Andrea Marongiu; Michal Sojka, in *2016 Euromicro Conference on Digital System Design (DSD)*, pp.55-59, 2016.
- [20] "Enabling predictable parallelism in single-GPU systems with persistent CUDA threads", Paolo Burgio, 28th Euromicro Conference on Real-Time Systems (ECRTS16), Toulouse (FR), July 2016.
- [21] "Embedded platforms for next-generation autonomous driving systems", Keynote @ International Design & Test Symposium (IDT) 2016

2017

- [22] "A software stack for next-generation automotive systems on many-core heterogeneous platforms", Paolo Burgio, Marko Bertogna, Nicola Capodieci, Roberto Cavicchioli, Mickal Sojka, Houdek, Andrea Marongiu, Paolo Gai, Claudio Scordino, Bruno Morelli, in *Journal of Microprocessors and Microsystems (MICPRO)*, Elsevier, 2017
- [23] "Adaptive Coordination in Autonomous Driving: Motivations and Perspectives", Marko Bertogna; Paolo Burgio, Giacomo Cabri and Nicola Capodieci in *The International Conference on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE) 2017*
- [24] "HGT: an open-source framework for simulating parallel real-time tasks", Ignacio Sañudo Olmedo, Paolo Burgio and Marko Bertogna, in *International Workshop on Analysis Tools and Methodologies for Embedded and Real-time Systems (WATERS) 2017*

- [25] "An emulation framework for closed source components in multi-core automotive platforms" Ignacio Sañudo Olmedo, Paolo Burgio and Marko Bertogna, in *Forum on specification & Design Languages (FDL) 2017 - Special Session on Design and test of Automotive Embedded System*

2018

- [26] "Convolutional Neural Networks on embedded automotive platforms: a qualitative comparison", Paolo Burgio, Gianluca Brilli, Antonio Marra, Marko Bertogna, in *Workshop on "New Platforms for Future Cars" @Design, Automation and Testing in Europa (DATE), 2018*
- [27] Chapter 4 in "High-performance and time-predictable embedded computing", Editors: Luis Miguel Pinho, Eduardo Quinones, Marko Bertogna, Andrea Marongiu, Vincent Nelis, Paolo Gai and Juan Sancho (Editors), River Publishers, 2018
- [28] "Artificial Neural Networks: The Missing Link Between Curiosity and Accuracy", Giorgia Franchini, Paolo Burgio and Luca Zanni, in ISDA 2018.

2019

- [29] "System Performance Modelling of Heterogeneous HW Platforms: An Automated Driving Case Study", Falk Wurst, Dakshina Dasari, Arne Hamann, Dirk Ziegenbein, Ignacio Sañudo, Nicola Capodiecì, Marko Bertogna, Paolo Burgio, in *22nd Euromicro Conference on Digital Systems Design (DSD), 2019*.
- [30] "PRYSTINE - Technical Progress After Year 1", Norbert Druml, Omar Veledar, Georg Macher, Georg Stettinger, Selim Solmaz, Jakob Reckenzaun, Sergio E. Diaz, Mauricio Marcano, Jorge Villagra, Rutger Beekelaar, Johannes Jany-Luig, Marta Maria Corredoira, Paolo Burgio, Christian Ballato, Björn Debaillie, Lars van Meurs, Andrei Sergeevich Terechko, Fabio Tango, Anna Ryabokon, Andrei Anghel, Oguz Icoğlu, Sumeet S. Kumar, George Dimitrakopoulos, in *22nd Euromicro Conference on Digital Systems Design (DSD), 2019*.
- [31] "An open source research framework for IoT-capable smart traffic lights", Gianluca Brilli, Paolo Burgio, in Goodtechs 2019.
- [32] "F1/10: An Open-Source Autonomous Cyber-Physical Platform", Matthew O'Kelly, Varundev Sukhil, Houssam Abbas, Jack Harkins, Chris Kao, Yash Vardhan Pant, Rahul Mangharam, Dipshil Agarwal, Madhur Behl, Paolo Burgio, Marko Bertogna, CoRR abs/1901.08567, 2019.

2020

- [33] "Graphic Interfaces in ADAS: from requirements to implementation", Alessio Masola, Cristian Gabbi, Andrea Castellano, Nicola Capodiecì, Paolo Burgio, in Goodtechs 2020.
- [34] "Human-Automation Interaction Through Shared and Traded Control Applications", Mauricio Marcano, Sergio E. Diaz, Joshué Pérez, Andrea Castellano, Elisa Landini, Fabio Tango, Paolo Burgio, in IHSI 2020.
- [35] "An Automatic Scenario Generator for Validation of Automated Valet Parking Systems.", Andrea Tagliavini, Donato Ferraro, Tomasz Kloda, Paolo Burgio, in VEHITS 2020
- [36] "Real-Time clustering and LiDAR-camera fusion on embedded platforms for self-driving cars" Micaela Verucchi, Luca Bartoli, Fabio Bagni, Francesco Gatti, Paolo Burgio, Marko Bertogna, in IRC 2020.
- [37] Chapter 11 in book: "Heterogeneous Computing Architectures – Challenges and vision", Editors: Olivier Terzo, Karim Djemame, Alberto Scionti, Clara Pezuela, CRC Press, Taylor & Francis Group, 2020

2021

- [38] "Shared and traded control for Human-Automation Interaction: a haptic steering controller and a visual interface", Mauricio Marcano, Sergio E. Diaz, Joshué Pérez, Andrea Castellano, Elisa Landini, Fabio Tango, Paolo Burgio, in **Int. Journal of Human-Intelligent Systems Integration (HISI)** – Invited extension of [33].

- [39] "SPHERE: A Multi-SoC Architecture for Next-Generation Cyber-Physical Systems Based on Heterogeneous Platforms.", Alessandro Biondi, Daniel Casini, Giorgiomaria Cicero, Niccolò Borgioli, Giorgio Buttazzo, Gaetano Patti, Luca Leonardi, Lucia Lo Bello, Marco Solieri, Paolo Burgio, Ignacio Sanudo Olmedo, Angelo Ruocco, Luca Palazzi, Marko Bertogna, Alessandro Cilardo, Nicola Mazzocca, Antonino Mazzeo: **Intl. Journal IEEE Access**
- [40] "A Full-Featured, Enhanced Cost Function to Mitigate Motion Sickness in Semi- and Fully-autonomous Vehicles", Isa Moazen, Paolo Burgio, in VEHITS 2021.
- [41] "Performance modeling of Heterogeneous HW Platforms", Falk Rehma, Dakshina Dasaria, Arne Hamanna, Michael Presslera, Dirk Ziegenbein, Jorg Seittera, Ignacio Sanudo, Nicola Capodiecici, Paolo Burgio, Marko Bertogna, MICPRO Journal 2021

2022

- [42] "Real-Time Requirements for ADAS Platforms Featuring Shared Memory Hierarchies", Nicola Capodiecici, Paolo Burgio, Roberto Cavicchioli, Ignacio Sanudo Olmedo, Marco Solieri, Marko Bertogna, **Autonomous Systems Design issue of IEEE Journal of Design & Test**
- [43] "An FPGA Overlay for Efficient Real-Time Localization in 1/10th Scale Autonomous Vehicles", Andrea Bernardi, Gianluca Brilli, Alessandro Capotondi, Andrea Marongiu, Paolo Burgio, in: Design, Automation and Testing in Europe (DATE) 2022
- [44] "Understanding and Mitigating Memory Interference in FPGA-based HeSoCs", Gianluca Brilli, Alessandro Capotondi, Paolo Burgio, Andrea Marongiu, in: Design, Automation and Testing in Europe (DATE) 2022
- [45] "Sentient Spaces: Intelligent Totem Use Case in the ECSEL FRACTAL Project ", Federica Caruso, Tania Di Mascio, Daniele Frigioni, Luigi Pomante, Giacomo Valente, Stefano Delucchi, Paolo Burgio, Manuel Di Frangia, Luca Paganin, Chiara Garibotto and Damiano Vallocchia, in: Euromicro Conference on Digital Systems Design (DSD) 2022, Maspalomas, Spain, 2022 pp. 741-747. doi: 10.1109/DSD57027.2022.00104
- [46] "Motion Sickness Minimization Alerting System Using The Next Curvature Topology", I. Moazen, P. Burgio and A. Castellano, 2022 IEEE International Conference on Mechatronics and Automation (ICMA), Guilin, Guangxi, China, 2022, pp. 635-640, doi: 10.1109/ICMA54519.2022.9856280.

2023

- [47] "Fine-Grained QoS Control via Tightly-Coupled Bandwidth Monitoring and Regulation for FPGA-based Heterogeneous SoCs", Gianluca Brilli, Giacomo Valente, Alessandro Capotondi, Paolo Burgio, Tania De Mascio, Paolo Valente, Andrea Marongiu, in: Design Automation Conference (DAC), 2023 2023: 1-6, doi: 10.1109/DAC56929.2023.10247840
- [48] "Time-sensitive autonomous architectures", Donato Ferraro, Luca Palazzi, Federico Gavioli, Michele Guzzinati, Andrea Bernardi, Paolo Burgio and Marco Solieri, in Real-Time Syst (2023), doi: doi.org/10.1007/s11241-023-09404-2
- [49] "The Advantage of Using Traffic Rules for Motion Prediction in Intersections (TRMPI)", I. Moazen and P. Burgio, 2023 IEEE International Conference on Mechatronics and Automation (ICMA), Harbin, Heilongjiang, China, 2023, pp. 537-542, doi: 10.1109/ICMA57826.2023.10215975.
- [50] "Optimized Local Path Planner Implementation for GPU-Accelerated Embedded Systems", Muzzini, N. Capodiecici, F. Ramanzin and P. Burgio, in IEEE Embedded Systems Letters, doi: 10.1109/LES.2023.3298733.