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Decreto Rettore Università di Roma "La Sapienza" n 2267/2021 del 09.08.2021

Daniele De Sensi Curriculum Vitae

Date 29.09.2021

Part I – General Information

Full Name	Daniele De Sensi
Citizenship	Italian
Spoken Languages	Italian, English

Part II – Education

Type	Year	Institution	Notes (Degree, Experience,...)
University graduation	Sep. 2007- Oct. 2010	University of Pisa	Bachelor Degree in Computer Science (110/110 <i>cum laude</i>) Thesis: <i>Realization of a Muskel Over FastFlow Version</i>
Post-graduate studies	Oct. 2010- Feb. 2013	University of Pisa and Scuola Superiore Sant'Anna	Master Degree in Computer Science and Networking (110/110 <i>cum laude</i>) Thesis: <i>DPI Over Commodity Hardware: Implementation of a Scalable Framework Using FastFlow</i>
PhD	Sep. 2014- Apr. 2018	University of Pisa	PhD in Computer Science (Excellent, <i>cum laude</i>) Thesis: <i>Self-Adaptive Solutions for Managing Performance and Power Consumption of Parallel Applications</i>
Licensure	Apr. 2021 – Apr. 2030	Ministro dell'istruzione, università e ricerca (MIUR)	National Scientific Qualification (Abilitazione Scientifica Nazionale) as Associate Professor, for the scientific sector 01/B1 (Computer Science)

Part III – Appointments

IIIA – Academic Appointments

Start	End	Institution	Position
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Mar. 2020	Mar. 2022	ETH Zurich	ETH Postdoctoral Fellow. I won a 2-year fellowship (more info at: https://ethz.ch/en/research/research-promotion/eth-fellowships.html) for doing research on traffic control techniques (routing, congestion control, Quality of Service management) for next-generation High Performance Computing (HPC) interconnection networks.
Sep. 2018	Dec. 2018	ETH Zurich	Visiting PostDoc
Nov. 2017	Feb. 2020	University of Pisa	Assegnista di Ricerca (PostDoc)
Oct. 2016	Apr. 2017	Queen's University Belfast	Visiting PhD Student

IIIB – Other Appointments

Start	End	Institution	Position
Jan. 2019	Jan. 2020	CounterFlowAI	External Consultant
Jun. 2018	Jan. 2020	QXIP	External Consultant
May 2013	Sep. 2014	List S.p.A.	Software Architect

Part IV – Teaching experience

Year	Institution	Lecture/Course
2021	ETH Zurich	Teaching Assistant for the <i>Parallel Programming</i> course
2020	ETH Zurich	Teaching Assistant for the <i>Computer Systems</i> course
2020	University of Pisa	Guest Lecturer for a lecture on " <i>Performance- and Power-Aware Computing using the Nornir Framework</i> " for the " <i>Parallel and Distributed Systems: Paradigms and Models</i> " course
2019	University of Pisa	Co-Teacher for the <i>Algoritmica e Laboratorio (Algorithm)</i> course
2018	University of Pisa	Teaching Assistant for the <i>Programmazione e Laboratorio I (Programming)</i> course
2016	University of Pisa	Teaching Assistant for the <i>Programmazione e Laboratorio I (Programming)</i> course
2021	HiPEAC Conference	Tutorial on " <i>IPerFEct – Identifying heterogeneous multi-processing configurations for Performance and Energy consumption Trade-Offs</i> "

2020	AutoDaSP Workshop	Tutorial on “Adding autonomic and power-aware capabilities to parallel streaming applications with the Nornir framework”
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Part V - Society memberships, Awards and Honors

Year	Title
2021	Nominated by ETH Zurich to participate to GYSS 2022 (https://www.nrf.gov.sg/gyss/home), a global event gathering young scientists and researchers (PhD students and post-docs) from all over the world. The event includes talks by globally recognized scientific leaders, including more than 20 recipients of the Nobel Prize, Fields Medal, Millennium Technology Prize, and Turing Award.
2018	Finalist of the 2018 edition of the IEEE HPEC Graph Challenge, with the paper “Discovering k-Trusses in Large-Scale Network”
2018	Member of the winning team of Reply Code Challenge (1st of 1207 teams)

Part VI - Funding Information

Year	Title	Program	Grant value
2020-2022	Principal Investigator (Individual project) for the project “TORRENT: Traffic cOntrol foR Emerging INterconnects”	ETH Fellowships. The fundings have been granted by ETH Zurich after a competitive evaluation of project proposals and an interview with the ETH Research Commission.	230800 CHF
2014-2017	PhD Scholarship	Pegaso program, by Regione Toscana	36000 EUR
2012	Scholarship	Granted by List S.p.A. and University of Pisa	6000 EUR

Part VII – Research Activities

Keywords	Brief Description
High-Performance Computing (HPC)	In this area, I worked on the analysis and optimization of interconnection networks for HPC systems, with a particular focus on routing algorithms. My most relevant publications on this topic are “Mitigating Network Noise on Dragonfly Networks through Application-Aware Routing” and “An In-Depth Analysis of the Slingshot Interconnect”. I also worked on the application level, by designing and implementing high-performing solutions for large-scale graph processing and network monitoring. My most relevant publications on this topic are “D2K: Scalable Community Detection in Massive Networks via Small-Diameter k-Plexes” and “Deep Packet Inspection on Commodity Hardware using FastFlow”.
High Level Parallel Programming	Building efficient parallel applications for new computing systems is a difficult task, which requires a significant effort to the application programmers. To this regard, I validated some high-level parallel programming techniques (parallel design patterns), providing benchmarks to compare and optimize the support of these programming abstractions.

My most relevant publications on this topic include: *“Bringing Parallel Patterns Out of the Corner: The P3ARSEC Benchmark Suite”* and *“A Power-Aware, Self-Adaptive Macro Data Flow Framework”*.

Power-Aware Computing

Power consumption is becoming a relevant issue in computing systems, due to its economic and environmental impact, but also because an uncontrolled growth in the power consumption may limit the development of new computing systems on a larger scale. I consider scenarios where the user wishes to express specific requirements on the power consumption and/or performance of his/her application. The main goal of my work is the design of algorithms that, without any previous information about the application, can dynamically and automatically change the number of resources allocated to the application, to provide the service level required by the user. My most relevant publications on this topic are: *“Simplifying self-adaptive and power-aware computing with Nornir”*, *“A Reconfiguration Algorithm for Power-Aware Parallel Applications”*, *“Predicting performance and power consumption of parallel applications”*, and *“Power LognRoll: Power-Efficient Localized Rollback for MPI Applications Using Message Logging Protocols”*.

In-Network Computing

Recently, I am investigating how to improve the performance of distributed applications, by offloading part of the computation to network devices (in my case, to network switches). The main idea is to program network switches so that they can not only forward the packets, but also apply some custom processing on them. In particular, in the work *“Flare: Flexible In-Network Allreduce”* I focused on the *allreduce*, an operation widely used both in scientific computing and in the distributed training of deep neural networks. I designed a novel architecture for network switches and a set of algorithms to use this architecture at its best, showing significant improvements compared to the state of the art.

Part VIII – Summary of Scientific Achievements

Product type	Number	Data Base	Start	End
Papers [international]	31	Scopus	2012	2021

Two additional papers (*“Flare: Flexible In-Network Allreduce”* and *“Power Log’n’Roll: Power-Efficient Localized Rollback for MPI Applications Using Message Logging Protocols”*) are published but not yet indexed by Scopus.

Reference database: Scopus

Total Impact factor	30.368
Average Impact Factor per Product	2.336
Total Citations	244
Average Citations per Product	7.87
Hirsch (H) index	10
Normalized H index* (if seniority considered from the first published paper)	1.11
Normalized H index* (if seniority considered from the end of	2.5

the PhD)

*H index divided by the academic seniority.

Part IX– Selected Publications

List of the publications selected for the evaluation. For each publication report title, authors, reference data, journal IF (if applicable), citations, press/media release (if any).

- 1. *Predicting Performance and Power Consumption of Parallel Applications***
Daniele De Sensi
Proceedings of 24th Intl. Conf. on Parallel, Distributed and Network-Based Processing (PDP), 2016
Citations: 21
DOI: 10.1109/PDP.2016.41
- 2. *Flare: Flexible In-Network Allreduce***
Daniele De Sensi, Salvatore Di Girolamo, Saleh Ashkboos, Shigang Li, Torsten Hoefler
Proceedings of Supercomputing Conference (SC), 2021
Citations: 0
DOI: 10.1145/3458817.3476178
- 3. *Mitigating Network Noise on Dragonfly Networks through Application-Aware Routing***
Daniele De Sensi, Salvatore Di Girolamo, Torsten Hoefler
Proceedings of Supercomputing Conference (SC), 2019
Citations: 11
DOI: 10.1145/3295500.3356196
- 4. *Simplifying Self-Adaptive and Power-Aware Computing with Nornir***
Daniele De Sensi, Tiziano De Matteis, Marco Danelutto
Future Generation Computer System, 2018
Impact Factor: 5.768
Citations: 15
DOI: 10.1016/j.future.2018.05.012
- 5. *Mammut: High-level management of system knobs and sensors***
Daniele De Sensi, Massimo Torquati, Marco Danelutto
SoftwareX, Vol. 6, pp. 150-154, 2017
Impact Factor: 1.959
Citations: 15
DOI: 10.1016/j.softx.2017.06.005
- 6. *Bringing Parallel Patterns out of the Corner: the P³ARSEC Benchmark Suite***
Daniele De Sensi, Tiziano De Matteis, Massimo Torquati, Gabriele Mencagli, Marco Danelutto
ACM Transactions on Architecture and Code Optimization, 2017
Impact Factor: 1.131
Citations: 20
DOI: 10.1145/3132710
- 7. *An In-Depth Analysis of the Slingshot Interconnect***
Daniele De Sensi, Salvatore Di Girolamo, Kim H. McMahon, Duncan Roweth, Torsten Hoefler
Proceedings of Supercomputing Conference (SC), 2020
Citations: 6

DOI: 10.5555/3433701.3433747

8. A Reconfiguration Algorithm for Power-Aware Parallel Applications

Daniele De Sensi, Massimo Torquati, Marco Danelutto
ACM Transactions on Architecture and Code Optimization, 2016

Impact Factor: 1.636

Citations: 40

DOI: 10.1145/3004054

9. A Power-Aware, Self-Adaptive Macro Data Flow Framework

Marco Danelutto, Daniele De Sensi, Massimo Torquati
Parallel Processing Letters, 2016

Citations: 11

DOI: 10.1142/S0129626417400047

10. GASSER: an Auto-Tunable System for General Sliding-Window Streaming Operators on GPUs

Tiziano De Matteis, Gabriele Mencagli, Daniele De Sensi, Massimo Torquati, Marco Danelutto
IEEE Access, 2019

Impact Factor: 3.745

Citations: 5

DOI: 10.1109/ACCESS.2019.2910312

11. D2K: Scalable Community Detection in Massive Networks via Small-Diameter k -Plexes

Alessio Conte, Tiziano De Matteis, Daniele De Sensi, Roberto Grossi, Andrea Marino, Luca Versari
Mining, 2018

Citations: 17

DOI: 10.1145/3219819.3220093

12. Power-Aware Pipelining with Automatic Concurrency Control

Massimo Torquati, Daniele De Sensi, Gabriele Mencagli, Marco Aldinucci, Marco Danelutto
Concurrency and Computation: Practice and Experience, 2018

Impact Factor: 1.167

Citations: 6

DOI: 10.1002/cpe.4652

Part X – Participation to Program Committee and Editorial Boards

- I have been a local chair for the *Euro-Par 2018* conference
- I have been a technical program committee member for the following conferences/workshops:
 - *SC 2021*
 - *CSASE 2021*
 - *HPCEd 2020*
 - *HiPC 2020-21*
 - *INFOCOMP 2020-21*
 - *CCIOT 2019-21*
 - *International Conference on Big Data and Internet of Things 2020*
 - *PPAM 2019 (Special Session on Tools for Energy Efficient Computing)*
 - *International Conference on Big Data and Internet of Things 2019*
 - *ADVCOMP 2019*
 - *PDP 2019 (Special Session on Parallel Numerical Methods and Libraries for Heterogeneous Multi/Many-cores)*
 - *Auto-DaSP 2017-21 (in conjunction with the Euro-Par conference)*

- *International Workshop on Advancements in Parallel Programming Models and Frameworks for the Multi-/Many-core Era 2017*
- I have been a member of the artefact evaluation committee for the following conferences:
 - SC 2021
 - ASPLOS 2021
 - PPOPP 2021
 - Euro-Par 2018
- I organized tutorials for the following conferences:
 - HiPEAC 2021
 - AutoDaSP 2019
- I have been a guest editor for the journal: MDPI Energies -- Special Issue on *Performance–Power Tradeoffs in Parallel Applications*
- I have been invited as a reviewer for the following journals:
 - IEEE Transactions on Emerging Topics in Computing, Impact Factor: 7.691
 - Future Generation Computer Systems, Impact Factor: 7.187
 - IEEE Transactions on Cloud Computing, Impact Factor: 5.938
 - Journal of Systems Architecture, Impact Factor: 3.777
 - Journal of Parallel and Distributed Computing, Impact Factor: 3.734
 - PLOS ONE, Impact Factor: 3.240
 - MDPI Applied Sciences, Impact Factor: 2.679
 - Journal of Supercomputing, Impact Factor: 2.474
 - SoftwareX, Impact Factor: 1.959
 - Cluster Computing, Impact Factor: 1.809
 - Concurrency and Computation: Practice and Experience, Impact Factor: 0.56
 - ACM Transactions on Parallel Computing
 - MDPI Computers
- I served as a sub-reviewer for the following conferences and workshops: Cluster 2020, EuroSys 2020, SPIRE 2019, SAC 2019, UCC 2018, Cluster 2018, SAC 2018, ISPA2017, AICCSA 2017, ICCAD 2017, ICA3PP 2017, RePara 2015

Part XI –Supervision Activity

I co-supervised the following students:

- Federico Umani, for the Master thesis in Computer Science, University of Pisa
- Clemens Klopstein, for the Bachelor thesis in Computer Science, ETH Zurich
- Loic Holbein, for the Bachelor thesis in Computer Science, ETH Zurich
- Tobias Rahn, for the Bachelor thesis in Computer Science, ETH Zurich
- Patrick Grunz, for the Master thesis in Computer Science, ETH Zurich
- Tommaso Bonato, for the Master thesis in Computer Science, ETH Zurich
- Severin Kistler, for the Master thesis in Computer Science, ETH Zurich
- Nils Blach, for an intership in the *Scalable Parallel Computing Laboratory*, ETH Zurich
- Demétrios Coutinho, I have been a member of the qualification jury for his PhD studies
- Demétrios Coutinho, I have been a member of his PhD jury

Part XII – National and International Collaborations

Academic Collaborations:

- ETH Zurich, Switzerland: I have been a visiting PostDoc in 2018, and currently a Postdoctoral Fellow from March 2020, in the *Scalable Parallel Computing Laboratory*, led by Prof. Torsten Hoefler. So far, we published three scientific papers (and other three papers are currently submitted), alongside with other scientific activities.
- Queen’s University Belfast, United Kingdom: I have been a visiting PhD student in 2017. So far, we published three scientific papers.

- Pontifical Catholic University of Rio Grande do Sul, Brazil: We published three scientific papers.
- Laboratory of Advanced Research on Cloud Computing, Brazil: We published one scientific paper.
- University of Bristol, United Kingdom: We published one scientific paper.
- Instituto Federal do Rio Grande do Norte, Brazil: We published one scientific paper.
- Universidade Federal de Pampa, Brazil: We published one scientific paper.
- Universidade Federal do Rio Grande do Norte, Brazil: We published one scientific paper.
- National Institute of Informatics, Japan: We published two scientific papers.
- Virginia Tech, Stati Uniti: We published one scientific paper.
- Università di Torino, Italy: We published two scientific papers.
- Università di Firenze, Italy: We published one scientific paper.

Industrial Collaborations:

- Cray HPE, United Kingdom: We published one scientific paper. The collaboration is still ongoing and we are planning to submit another paper.
- Google Research, Switzerland: We published one scientific paper.
- ATS Advanced Technology Solutions S.p.A, Italy: We published one scientific paper.

Part XIII – Research Evaluation Panels

I have been a member of the panel for the evaluation of the *ETH Career Seed Grants*.

Part XIV – Developed Software

- **Peafowl** (<https://github.com/DanieleDeSensi/Peafowl>)
Peafowl was one of the output of my master thesis. It is a flexible and extensible Deep Packet Inspection (DPI) framework which can be used to identify the application protocols carried by the packets traveling over the network and to extract and process data and metadata carried by those protocols. Peafowl also exploits the parallelism of current multicore machines to process in real time data traveling on modern networks.
Peafowl has been adopted by:
 - The *QXIP* company (<http://qxip.net/>) in their VoIP Capture products
 - The *CounterFlowAI* company (<https://www.counterflow.ai/>) in their network security solutions
 - Other network monitoring tools such as *extfilter* (<https://github.com/max197616/extfilter>).
- **Nornir** (<http://danieledesensi.github.io/nornir/>)
Nornir is a runtime support, providing the possibility to specify requirements in terms of performance and/or power consumption on parallel applications. These requirements will be enforced by selecting an appropriate amount of resources to allocate to the application. Nornir was one of the software output of my Ph.D. thesis.
- **Mammut** (<http://danieledesensi.github.io/mammut/>)
Mammut provides an high-level object oriented abstraction of architectural features normally exposed by means of *sysfs* files or CPU registries. It allows the user to easily interacts with control knobs and sensors available on the computing system. By using Mammut is possible, for example, to shut down some cores, scale their frequency and to read sensors like power consumption and others. Mammut was one of the software output of my Ph.D. thesis, and it has been also used in the WP4 of the *RePhrase* EU H2020 Project.
- **P³ARSEC** (<https://github.com/ParaGroup/p3arsec>)
P³ARSEC is an implementation of the well-known PARSEC benchmark suite by using parallel patterns. We improved the performance of several applications while reducing, at the same time, the code complexity with respect to the original versions. P³ARSEC is a useful tool for

benchmarking parallel patterns-based techniques and frameworks. P³ARSEC was one of the software output of my Ph.D. thesis.

- **awr** (<https://github.com/DanieleDeSensi/awr>)
awr is a library which can be used on Cray Aries supercomputers to optimize the routing algorithm based on application characteristics.
- **ffProbe** (<https://github.com/DanieleDeSensi/ffProbe>)
ffProbe is a new pipelined parallel implementation of a NetFlow probe built on top of FastFlow, a parallel programming framework for multicore platforms based on non-blocking lock-free/fence-free synchronization mechanisms.
- Additionally, I partially contributed to the development of the following software:
 - The **FastFlow** parallel programming framework (<http://calvados.di.unipi.it/>)
 - The **parallel_enum** framework for finding communities in large scale networks (https://github.com/veluca93/parallel_enum).

Part XV – Participation to research projects

During my career, I worked on the following research projects:

- **TORRENT: Traffic cOntrol foR Emerging INterconnects** (Mar. 2020 – Mar. 2022)
Role: Individual Project
Description: The TORRENT project has been funded by ETH Zurich under the ETH Fellowship program, after the evaluation of project proposals and interviewing the candidates.
- **DECLware: Declarative methodologies for designing and deploying applications** (Jul. 2018 – Jul. 2020)
Role: Participant
Description: The DECLware project has been a basic research project funded by the University of Pisa, whose main purpose was to research declarative models to capture, model and manage different aspects related to parallelism exploitation, modularity and security in data-intensive applications in a coordinated way.
- **Refactoring Parallel Heterogeneous Resource-Aware Applications- a Software Engineering Approach (RePhrase)** (Nov. 2017 – Mar. 2018)
Role: Collaborator
Description: The 3-years H2020 RePhrase project targets the design of software engineering techniques to help software developers in dealing with the increasing complexity of heterogeneous computing architectures. I contributed to the design and development of high-level parallel patterns and to their optimization from an energy perspective. Moreover, the Mammut library I developed has been used in WP4 for monitoring CPU power consumption.
- **Through The Fog** (Oct. 2015 – Oct. 2016)
Role: Participant
Description: The *Through the Fog* project has been a basic research project funded by the University of Pisa, whose main purpose was to foster collaboration among different research groups of the Computer Science department in exploring the emerging *Fog computing* paradigm from different angles.