

# Alessandra Fais | CV

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## SUMMARY

I'm currently pursuing my Ph.D. at the Information Engineering Department of the University of Pisa, Italy. I received both my Bachelor's and Master's degrees from the Computer Science Department of the same university. I have co-authored six peer-reviewed papers related to my research interests, and published at international conferences and journals. My research focuses on data stream processing applications in the networking domain, high-performance packet processing on multicores and SmartNICs, software data plane acceleration, parallel and distributed computing.

## EXPERIENCE

*Relevant topics taught at University courses:* Software Defined Networking, Network Function Virtualization, Multi-Access Edge Computing (MEC), Cloud and Edge computing, Service Oriented Architectures, virtualization approaches, RedHat OpenStack, VirtualBox, Docker, Kubernetes.

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| <b>Program Committee member</b><br><i>ACM SIGCOMM 2022 Conference, Posters and Demos Session</i>   | <b>Amsterdam, Netherlands</b><br>Jun. 2022          |
| <b>Teaching Assistant, Course "Wireless Network Design" (2021/2022)</b><br><i>Laboratory Part on virtualization, course cod. 1041I, Università di Pisa</i> | <b>Pisa, Italy</b><br>Feb. 2022 – Jun. 2022         |
| ◦ TEACHING MATERIAL: <a href="https://github.com/alefais/virtualization-lab-unipi">https://github.com/alefais/virtualization-lab-unipi</a>                 |   |
| <b>External Lecturer, Course "Basics of JavaScript"</b><br><i>Project IFTS "I.T.E.M. in Elba" – C.E.S.C.O.T. Formazione srl</i>                            | <b>Portoferraio, Italy</b><br>Nov. 2021 – Jan. 2022 |
| <b>External Lecturer, Course "Programming Languages"</b><br><i>Project IFTS "Digital Media Designer" - Istituto Modartech</i>                              | <b>Pontedera, Italy</b><br>Jun. 2021 – Jul. 2021    |
| <b>Teaching Assistant, Course "Wireless Networks" (2020/2021)</b><br><i>Laboratory Part on virtualization, course cod. 918II, Università di Pisa</i>       | <b>Pisa, Italy</b><br>Feb. 2021 – Jun. 2021         |
| <b>Teaching Assistant, Course "Wireless Networks" (2019/2020)</b><br><i>Laboratory Part on virtualization, course cod. 918II, Università di Pisa</i>       | <b>Pisa, Italy</b><br>Feb. 2020 – Jun. 2020         |

## PUBLICATIONS

### Journal Papers

- [J1] A. Fais, G. Lettieri, G. Procissi, S. Giordano, F. Oppedisano. **Data Stream Processing for Packet-Level Analytics**. 2021, MDPI Sensors, Vol. 21, Issue 5, Pages 1735. DOI: 10.3390/s21051735.
- [J2] G. Mencagli, M. Torquati, A. Cardaci, A. Fais, L. Rinaldi, M. Danelutto. **WindFlow: High-Speed Continuous Stream Processing with Parallel Building Blocks**. 2021, IEEE Transactions on Parallel and Distributed Systems (TPDS), Vol. 32, Issue 11, Pages 2748–2763. DOI: 10.1109/TPDS.2021.3073970.
- [J3] N. Bonelli, F. Del Vigna, A. Fais, G. Lettieri, G. Procissi. **Programming Socket-Independent Network Functions with Nethuns**. 2022, ACM SIGCOMM Computer Communication Review (CCR), Vol. 52, Issue 2, Pages 35–48. DOI: 10.1145/3544912.3544917.
- [J4] G. Mencagli, M. Torquati, A. Fais, D. Griebler, M. Danelutto. **General-Purpose Data Stream Processing on Heterogeneous Architectures with WindFlow**. 2022, ELSEVIER Journal of Systems and Software, Vol. XX, Issue XX, Pages XX–XX. DOI: XX. (under review, submitted Jun. 27, 2022)

## Conference and Workshop Papers.....

[C1] **A. Fais, G. Procissi, S. Giordano, F. Oppedisano. Data Stream Processing in Software Defined Networks: Perspectives and Challenges.** In Proceedings of the 2020 IEEE 25th International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD). Pisa, Italy (Virtual Conference), September 14-16, 2020. DOI: 10.1109/CAMAD50429.2020.9209303.

[C2] **A. Fais, S. Giordano, G. Procissi. On the Design of Fast and Scalable Network Applications Through Data Stream Processing.** In Proceedings of the 2020 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN). Madrid, Spain (Virtual Conference), November 9-12, 2020. DOI: 10.1109/NFV-SDN50289.2020.9289855.

[C3] **A. Fais, G. Lettieri, G. Procissi, S. Giordano. Towards Scalable and Expressive Stream Packet Processing.** In Proceedings of the 2021 IEEE Conference on Global Communications (GLOBECOM), Next-Generation Networking and Internet (NGNI). Madrid, Spain, December 7-11, 2021. DOI: 10.1109/GLOBECOM46510.2021.9685436.

[C4] **A. Fais, G. Antichi, S. Giordano, G. Lettieri, G. Procissi. Mind the Cost of Telemetry Data Analysis.** ACM SIGCOMM 2022, Posters and Demos Session. Amsterdam, Netherlands, August 22-26, 2022. LINK TO CODE: <https://github.com/alefais/packet-streaming-bench-sigcomm22poster> (to appear)

## EDUCATION

### Università di Pisa

Pisa, Italy

Ph.D. in Information Engineering – Telecommunications area

Nov. 2019 – Jan. 2023 (expected)

SUPERVISORS: Prof. S. Giordano, Prof. G. Procissi

RESEARCH: My research mainly focuses on Data Stream Processing applications in the networking domain. The main aim is proving that this computational model is highly suitable for accelerating network applications performing near real-time processing of streams of packets by taking advantage of the full potential offered by latest breakthroughs in terms of hardware. The targeted systems are mainly scale-up servers equipped with multi-core CPUs and coprocessors, like GPUs and SmartNICs. Indeed, DaSP computation offloading to SmartNICs is part of the research investigation I'm carrying on during this last year of my PhD. The pursuit of high performance is always complemented by the desire to keep the proposed solutions as user-friendly as possible. To this end, high emphasis in my research project is given to the design of high-level abstractions, that hide the complexity related to both network programming and parallelism and are made directly available to programmers.

RELEVANT PHD COURSES:

- On Cyber-Physical Social Systems (CPSSs): challenges and new research directions
- 5G and V2X communications (Dr. D. Sabella - Intel Deutschland GmbH, Germany)
- Computing in Communication Networks for 5G and Tactile Internet (Dr. F. Fitzek - TU Dresden CeTI)
- 5G, Beyond 5G and 6G: the next frontier (Dr. E. Calvanese Strinati - CEA-LETI Grenoble, France)
- High-Performance Computing: architectures and systems
- Arm Architectures for High-Performance Real-Time (Dr. M. Andreozzi - Arm, UK)

### PRACE and Leopold-Franzens Universität Innsbruck

Innsbruck, Austria

Autumn School on GPU Programming with CUDA

Oct. 2021

### Università di Pisa, Dip. Ingegneria dell'Informazione (DII)

Pisa, Italy

Summer School on 5G technologies and research challenges

Jul. 2021 – Aug. 2021

### Scuola Superiore Sant'Anna and Università di Pisa

Pisa, Italy

Master's Degree in Computer Science and Networking

Sep. 2016 – Oct. 2019

FINAL GRADE: 110/110 *summa cum laude*

THESIS: Benchmarking Data Stream Processing Frameworks on Multicores

SUPERVISOR: Dr. G. Mencagli

ABSTRACT: The work shows a comparison in terms of performance (bandwidth and latency) between traditional Data Stream Processing (DaSP) systems and WindFlow (<https://paragroup.github.io/WindFlow/>), an efficient C++17 streaming library based on FastFlow's building blocks (<http://calvados.di.unipi.it/fastflow>). The goal is to quantify the benefit that may be achieved by using the C++ solution w.r.t. modern Java-based ones. A benchmark of four real-world DaSP applications have been designed and implementations are provided using Apache Storm, Apache Flink and WindFlow. Experiments show a significant throughput improvement and latency reduction by using the C++ solution w.r.t. the state-of-the-art frameworks on single multi-core machines. The results obtained are encouraging for future works which aim at designing innovative DaSP frameworks based on C++ and providing high-level abstractions like Storm and Flink, that may be able to overcome modern Java-based Stream Processing Engines on distributed scenarios too.

o THESIS MANUSCRIPT: <https://etd.adm.unipi.it/t/etd-09162019-220730/>

o LINKS TO PRODUCED SOFTWARE: [storm-applications](#), [flink-applications](#), [windflow-applications](#)

MASTER PROGRAM: Relevant courses cover parallelization methodologies, parallel programming models, architectures of high-performance computing systems, management and configuration of IP networks, Software Defined Networks, analysis of packet switching architectures, Service Oriented Architectures, cloud computing, microservices, virtualization techniques.

**Università di Pisa**

**Pisa, Italy**

*Bachelor's Degree in Computer Science, final grade 105/110*

*Sep. 2011 – Mar. 2016*

THESIS: Programming techniques for FPGA devices, SUPERVISOR: Prof. M. Danelutto

ABSTRACT: The thesis is a dissertation about FPGA programming methodologies (Hardware Description Languages, Chisel and OpenCL), with an overview of current technological trends.

## CONTRIBUTIONS TO OPEN SOURCE RESEARCH PROJECTS

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### **Nethuns**

*Nov. 2020 – Present*

A C software library which provides a unified API for fast and portable network programming on multicores. nethuns allows network programmers to perform operations over different underlying network I/O frameworks. Network applications implemented in terms of nethuns abstractions can run on different network APIs by being re-compiled with appropriate parameters, with no code modifications. The supported underlying capturing solutions are AF\_XDP and netmap for fast packet handling, along with the classic AF\_PACKET and libpcap.

The related publication is [J3]. PROJECT PAGE: <https://github.com/larthia/nethuns>.

### **WindFlow**

*Jun. 2019 – Present*

A C++17 software library for data stream processing on heterogeneous shared-memory architectures equipped with multi-core CPUs and NVIDIA GPUs. The library provides traditional stream processing operators like map, flatmap, filter, fold/reduce as well as sliding-window operators designed with complex parallel processing modes. The related publication is [J2]. PROJECT PAGE: <https://github.com/ParaGroup/WindFlow>.

## MAIN ACADEMIC PROJECTS

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A more complete list is available on my GitHub profile.

### **Parallel and Distributed Systems (paradigms and models) project**

*Sep. 2018 – Nov. 2018*

C++ and FastFlow implementation of the parallel scan Blelloch algorithm with a master-worker architecture schema and tests. [LINK TO CODE](#)

### **Networks and Technologies for Telecommunications – FPGA project**

*Jul. 2018*

Verilog implementation of Adders, Subtractors, and Multipliers and tests on both the Quartus University Program Waveform Simulator and on the DE2-115 series FPGA board. [LINK TO CODE](#)

### Packet Switching and Processing Architectures project

Mar. 2018 – May 2018

C++ monitoring application that captures traffic with Libpcap and identifies and analyses different flows.

[LINK TO CODE](#)

### Network Management project

Jul. 2014 – Aug. 2014

Lua script (chisel) that monitors system events with Sysdig to measure the performance of an application and the amount of resources required. [LINK TO CODE](#)

### Computer Networks project

May 2014 – Jun. 2014

Java implementation of a distributed chat system. [LINK TO CODE](#)

## SCHOLARSHIPS, GRANTS, AWARDS

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### Student Participation Grant, IEEE NFV-SDN 2020 (Doctoral Symposium)

Madrid, Spain

*Award funded by Intel*

Nov. 2020

### Ph.D. Scholarship

Pisa, Italy

*Scholarship funded by NetResults S.r.l.*

Nov. 2019

## SKILLS

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### Programming Languages:

- C, C++, Java
- basic knowledge of Bash scripting, GNU Make and CMake, Verilog, Python, C#, F#, OCaml, Scala, HTML5, JavaScript and jQuery

### Parallel Programming and Stream Processing Frameworks:

- FastFlow, WindFlow, Apache Storm, Apache Flink, Apache Spark Streaming

### Network Programming Tools:

- Libpcap, AF\_XDP, XDP, eBPF
- basic knowledge of Netmap, P4, ONOS, OpenFlow, Mininet

### Tools:

- Docker
- basic knowledge of OpenStack and Kubernetes

### Libraries:

- GDAL, GeoTools, Alglib (Descriptive Statistics package)

### Version Control and IDEs:

- git, JetBrains suite, Visual Studio Code

### Productivity:

- LaTeX, Office suite
- basic knowledge of gnuplot, R

## LANGUAGES

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- Italian: mother tongue
- English: C1+ level (C1+ CEFR certification)

Last updated on June 28, 2022.