Vincenzo Barbuto

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Education

2022 – · · · · **Ph.D. Information and Communication Technologies**, University of Calabria.
Thesis title: *Intelligence at the IoT Edge: Enabling Smartness in Cyber-Physical Systems* | Supervisor: Prof. Giancarlo Fortino, Prof. Claudio Savaglio

2020 – 2022 **M.Sc. Computer Engineering for the Internet of Things**, University of Calabria.
Final score: 110/110 cum laude | Thesis title: *Creating Digital Twins with General Purpose Sensing: Architecture and Initial Experiments* | Supervisors: Prof. Giancarlo Fortino, Prof. Roberto Minerva, Prof. Claudio Savaglio

2021–2022 **M.Sc. in Data Science and Network Intelligence**, Télécom SudParis, Institut Polytechnique de Paris
GPA: 18,34/20 | Final report: *Creating Digital Twins with General-Purpose Sensing: Architecture and Initial Experiments* | Supervisor: Prof. Roberto Minerva

2017 – 2020 **B.Sc. Computer Engineering**, University of Calabria.
Final Score: 105/110. | Thesis: *UnicalSharing: progettazione di una web app per la condivisione nell'Università ed implementazione lato client* (*UnicalSharing: Design and Implementation of a Client-Side Web Application for University Resource Sharing*). | Supervisor: Prof. Francesco Scarcello.

Employment History

2022 (Feb – Jul) **Research Trainee,** DICE Lab, Évry, France.
Conducted research on Edge AI–enabled Digital Twin architectures for intelligent traffic monitoring. Designed and experimentally validated a distributed system achieving 90% bandwidth savings over cloud-centric solutions, with inference latency reduced by a factor of 2–10 on edge devices.

2020 – 2021 **Software Engineer**, Calió Informatica S.r.l., Rende, Italy
Worked on the development and optimization of enterprise software for document and warehouse management. Improved an invoicing platform handling over five million invoices per year by implementing browser caching, multithreading, and parallelism in C#. Enhanced database efficiency through SQL bulk operations to speed up insertion and update processes in the company's CMS.

Teaching Activity

Engaged in academic tutoring and professional training roles within computer science education and edge intelligence. Activities included assisting in undergraduate teaching, supervising laboratory work, and delivering specialized industry training on Edge AI and real-time analytics.

2025 (Apr – Sep) **Teaching Tutor**, University of Calabria
Supported teaching activities for the *Computer Science Fundamentals* course in the Electronic Engineering program. Guided laboratory sessions on C programming, assisted students in mastering core programming concepts, and provided exam preparation support.

Teaching Activity (continued)

2025 (Jun – Jul) **Industry Training Instructor**, Kineticon S.r.l. (Remote)
Designed and delivered a corporate training course on *Edge Analytics and Online Learning*. Covered topics such as model training, optimization, and deployment of Edge AI solutions using TensorFlow Lite for on-device inference, as well as online learning techniques with River, including drift detection and adaptive analytics for IoT/edge scenarios.

2023 (Mar – Sep) **Teaching Tutor**, University of Calabria
Supported teaching activities for the *Computer Science Fundamentals* course in the Electronic Engineering program. Guided laboratory sessions on C programming, assisted students in mastering core programming concepts, and provided exam preparation support.

Research Activity

My research activity focuses on the design and engineering of distributed, intelligent, and adaptive cyber-physical systems (CPS), with particular reference to the integration of Edge Intelligence (EI) and Digital Twin (DT) technologies within the Internet of Things (IoT) and Smart IoT Domains. The main research contributions address the definition of methodologies, frameworks, and tools for developing deterministic, interoperable, and self-adaptive systems that operate reliably across the edge–cloud continuum. The conducted studies and experiments span several emerging application areas, including smart mobility, traffic pre-emption, and healthcare IoT, and are organized along the following three thematic lines:

R1 **Engineering Methodologies for Edge-AI-Based CPS**

Development of engineering methodologies and design frameworks for building Edge-AI-enabled CPS. The proposed approaches leverage the Lingua Franca coordination language, the CAL theorem (Consistency–Availability–Latency), and MAPE-K loops to ensure time-deterministic execution, formal coordination, and self-adaptation in distributed environments [6, 3, 8].

R2 **Modeling and Simulation of Edge-Intelligent Systems**

Design of simulation and validation tools for assessing the consistency, performance, and adaptability of distributed AI workflows across the computing continuum. This includes the modeling of feedback-driven control cycles and runtime model-switching policies, evaluated through federated and hybrid-simulation setups for CPS and IoT scenarios [1, 5].

R3 **Opportunistic and Generative Digital Twin Services**

Definition of novel paradigms such as the Opportunistic Digital Twin (ODT) and the Generative Digital Twin (GDT) to enable context-aware, data-driven, and self-evolving services. These models exploit *synthetic sensing*, contextual AI, and *opportunistic computing* to dynamically adapt service placement and resource orchestration across heterogeneous edge and cloud infrastructures [1, 7, 2, 4].

Research and Study Periods Abroad

2024–2025 **University of California, Berkeley (California, USA)**
Visiting Scholar at the Department of Electrical Engineering and Computer Sciences (EECS), University of California, Berkeley, conducting research on distributed coordination and Edge Intelligence under the supervision of Prof. Edward A. Lee.

2021–2022 **Télécom SudParis, Institut Polytechnique de Paris (Évry, France)**
Exchange student within the dual degree program jointly established between Télécom SudParis and the University of Calabria, focusing on Data Science and Network Intelligence.

Research Collaborations

The main scientific collaborations established over time, also reflected in joint publications and shared research outcomes, are briefly summarized below:

2024 **Prof. Edward A. Lee** and his research group at the University of California, Berkeley (USA)

2022 **Prof. Noël Crespi** and **Prof. Roberto Minerva**, Télécom SudParis, Institut Polytechnique de Paris (France)

Research Project Participation

2024 – · · · · **Lingua Franca**. lf-lang.org lf-lang
Active contributor to the open-source Lingua Franca project, coordinated by the University of California, Berkeley, in collaboration with international academic and industrial partners. The project aims to provide a deterministic coordination language for the design and execution of distributed Cyber-Physical Systems (CPS). Contributions include the development of an **Edge AI library**[1] enabling the integration of lightweight machine learning models into Lingua Franca programs; the **enhancement of the Visual Studio Code interface**[2] through the implementation of the Package Explorer and extended library management support; and the **testing and evaluation of distributed coordination mechanisms** to assess performance, synchronization, and reliability in federated CPS deployments [5].

2022 – 2024 **MLSysOps**. mlsysops.eu mlsysops-eu
Contributed to the design and preliminary implementation of a **multi-agent system** aimed at supporting the automation and optimization of machine learning workflows across distributed infrastructures. The activity focused on the **engineering of classes, attributes, and inter-agent interactions** through UML-based modeling, emphasizing modularity, scalability, and interoperability. Participated in the **system architecture definition** and the early **prototype development phase**, assisting in translating conceptual models into implementable components and supporting the alignment between software design and system-level requirements.

Scientific Events and Research Presentations

2025 **Presented** the paper *"Service Continuity in Healthcare Internet of Things (HIoT): An Architectural Solution"* at the **IEEE International Conference on Distributed Computing in Smart Systems and the Internet of Things (DCOSS-IoT 2025)**.

Presented the paper *"Edge AI in the Computing Continuum: Consistency and Availability at Early Design Stages"* at the **IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW 2025)**.

Attended and **presented a poster** titled *"Edge AI in the Computing Continuum: Consistency and Availability at Early Design Stages"* at the **IEEE@Unical Workshop 2025**.

[1] lf-lang/edgeai-python
[2] lf-lang/vscode-lingua-franca

Scientific Events and Research Presentations (continued)

2024
- **Attended** the **Bay Area Robotics Syposium (BARS)**, hosted by the University of California, Berkeley.
- **Speaker** at the webinar *"Digital Twins in Action: From IoT Continuum to UAV Control Theory"*, held as part of the activities of the **IEEE Student Branch, University of Calabria**.
- **Attended** the **Year 6 Google-BAIR Commons Annual Workshop**, hosted by Berkeley Artificial Intelligence Research (BAIR) Lab.

2023
- **Presented** the paper on *"Towards an edge intelligence-based traffic monitoring system"* at the **IEEE International Conference on Systems, Man, and Cybernetics (SMC 2023)**
- **Attended** the main sessions of the **International Conference on Embedded Wireless Systems and Networks (EWSN 2023)**

Research Publications

Journal Articles

1. **V. Barbuto**, C. Savaglio, and E. A. L. G. Fortino, "Engineering opportunistic digital twins with lingua franca," 2025, Under review in *Future Generation Computer Systems (FGCS)*.
2. C. Savaglio, **V. Barbuto**, F. Mangione, and G. Fortino, "Generative digital twins: A novel approach in the iot edge-cloud continuum," *IEEE Internet of Things Magazine*, 2024.
3. **V. Barbuto**, C. Savaglio, M. Chen, and G. Fortino, "Disclosing edge intelligence: A systematic meta-survey," *Big Data and Cognitive Computing*, vol. 7, no. 1, p. 44, 2023.
4. C. Savaglio, **V. Barbuto**, F. M. Awan, R. Minerva, N. Crespi, and G. Fortino, "Opportunistic digital twin: An edge intelligence enabler for smart city," *ACM Transactions on Sensor Networks*, 2023.

Conference Proceedings

5. **V. Barbuto**, C. Savaglio, G. Fortino, and E. A. Lee, "Edge ai in the computing continuum: Consistency and availability at early design stages," in *2025 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*, IEEE, 2025, pp. 1120–1127.
6. **V. Barbuto**, G. Tavella, P. Mazzei, F. Pupo, C. Savaglio, and G. Fortino, "Service continuity in healthcare internet of things (hiot): An architectural solution," in *2025 21st International Conference on Distributed Computing in Smart Systems and the Internet of Things (DCOSS-IoT)*, IEEE, 2025, pp. 01–06.
7. F. Mangione, **V. Barbuto**, C. Savaglio, and G. Fortino, "A generative ai-driven architecture for intelligent transportation systems," in *2024 IEEE 10th World Forum on Internet of Things (WF-IoT)*, IEEE, 2024, pp. 1–6.
8. **V. Barbuto**, C. Savaglio, R. Minerva, N. Crespi, and G. Fortino, "Towards an edge intelligence-based traffic monitoring system," in *2023 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, IEEE, 2023, pp. 3434–3439.

Skills

Languages — Strong reading, writing, and speaking skills in **English**; basic knowledge of **Spanish** and beginner level in **French**.

Misc. — Academic research, teaching, training, software engineer

Miscellaneous Experience

Awards and Achievements

2021, 2022 — **Most Deserving Student**, University of Calabria.
Most dedicated and highest-achieving student among the Internet of Things (IoT) students within the Department of Computer, Modeling, Electronic, and System Engineering, University of Calabria for the academic year 2020-21 and 2021-22

2021 — **Honors Track**, University of Calabria.
Outstanding undergraduate student in the Department of Computer, Modeling, Electronic, and System Engineering (DIMES), University of Calabria for the academic year 2020-21

Roles

2025 – · · · · — **Chair**, IEEE Student Branch, University of Calabria.

2023 – 2024 — **Vice Chair**, IEEE Student Branch, University of Calabria.

Public Engagement

2023, 2025 — **Participant** at SuperScienceMe, Researchers' Night, University of Calabria, Italy. Presented an interactive activity on emotion recognition through computer vision.

Bibliometric Indicators

The bibliometric indicators of the scientific output (updated on November 3, 2025) are summarized in **Table 1**, based on data from the four main reference databases: **Google Scholar**, **Scopus**, **Web of Science**, and **ResearchGate**.

Table 1. Bibliometric indicators of the scientific output.

Database	H-index	Citations	Sources
Google Scholar	4	102	7
Scopus	3	56	6
Web of Science	1	25	1
ResearchGate	4	101	7

Rende, November 3, 2025 **Signature:** Vincenzo Barbuto

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