Lorenzo De Marinis

Curriculum Vitae

Via G. Moruzzi 1
Pisa, Italy 56124
✉ lorenzo.demarinis[AT]santannapisa.it
↪ *LinkedIn*

Research

Present Mar 2023	**Assistant Professor - Photonic Quantum and Neuromorphic Computing**, *Scuola Superiore Sant'Anna*, Pisa, Italy. Assistant professor (RTD-A) under the national quantum science and technology institute, next-gen EU project. Main research concerning photonic integrated circuits for quantum random number generators, quantum computing devices and analog neuromorphic computing.
Feb 2023 Oct 2022	**Research Fellow - Photonic Quantum and Neuromorphic Computing**, *Scuola Superiore Sant'Anna*, Pisa, Italy. The research fellowship (assegno di ricerca) aims at advancing the state-of-the-art in quantum and neuromorphic computing through photonic integration technologies. Main research on quantum random number generators, photonic quantum and neuromorphic integrated circuits. PI: Prof. Giampiero Contestabile
Apr 2022 Nov 2021	**Visiting Researcher - Machine Learning Methods for Optical Communications**, *WinPhos Lab - Aristotle University of Thessaloniki*, Thessaloniki, Greece. Theoretical and experimental research on machine learning methods for optical communications. After a state-of-the-art investigation, a neural network end-to-end model has been developed with PyTorch, embedding the optical link. Laboratory tests were carried out to validate the numerical results. PI: Prof. Nikos Pleros
Sep 2019 May 2019	**Post-Graduate Research Scholarship - Photonic Integrated Circuits for Neuromorphic Computing**, *Scuola Superiore Sant'Anna*, Pisa, Italy. System engineering and design of photonic integrated circuits for neuromorphic computing. PI: Prof. Piero Castoldi

Education

Sept 2022 Oct 2019	**PhD in Emerging Digital Technologies**, *Scuola Superiore Sant'Anna*, Pisa, Italy. *Achieved Cum Laude* - PhD Thesis "Integrated Photonic Neuromorphic Computing". Main activity on the conceptualization, design and testing of photonic integrated circuits for neuromorphic computing. Developed expertise in various fields: photonic integrated circuits, photonic-electronic codesign, machine and deep learning theory, semiconductor lasers, low-precision and analog computing. Supervisor: Prof. Giampiero Contestabile - Tutor: Prof. Nicola Andriolli.
Feb 2019 Oct 2016	**Master of Science in Electronic Engineering**, *University of Pisa*, Pisa. 110/110 *Cum Laude*. Master thesis "Towards Array of Nanolasers in Porous Silicon Technology", this work was a first approach on photonics from a practical point of view, with insights on photonic crystals, lasers and silicon processing. Supervisor: Prof. Giuseppe Barillaro
Oct 2016 Sep 2012	**Bachelor of Science in Electronic Engineering**, *University of Pisa*, Pisa. 110/110. Bachelor thesis "Many level logics", the work focused on the state-of-the-art of multiple level and fuzzy logics in electronics and other non-conventional apporoaches (e.g., photonic and quantistic). Supervisor: Prof. Andrea Nannini

Expertise

Lorenzo De Marinis has worked on **photonic neuromorphic computing** since the end of his MS. His main research activity concerns the conceptualization, design, and testing of novel photonic integrated circuits (PIC) with various technologies (SOI, InP, LNOI, SiN). With a background in electronic engineering, he also manages the **electro-optic codesign of photonic systems** and sub-systems.

During his Ph.D., he developed a background in analog neuromorphic processors, machine learning, AI for optical communications, deployment of deep learning models in resource-constrained scenarios, and AI for in-networking applications. Currently, he is working as an assistant professor developing PICs for quantum random number generation, quantum computing and neuromorphic processing, under the Italian National Quantum Science and Technology Institute.

Positions as Project Reviewer

2024   **European Innovation Council and SMEs Executive Agency**, *EIC Accelerator Expert Reviewer*, **Role**: Project Reviewer for the 2024 EIC Accelerator call.

Participation in International and National Projects

2023 - 2025   **NextGen EU, NQSTI**, *"National Quantum Science and Technology Institute"*, **Role**: Researcher.
Involved in spoke 6, 7, 8 and 9, for the national quantum science and technology institute as an assistant professor at Scuola Superiore Sant'Anna. Main research concerning the development of photonic circuits for quantum computing (spoke 6), integration and deployment in systems focusing on QRNG for QKD (spoke 7), Technology transfer strategies (spoke 8), and education & outreach (spoke 9).

2022 - 2023   **Italian Ministry for Foreign Affairs - INPATIENT**, *"Integrated Photonic Artificial Neural Networks"*, **Role**: Researcher.
Indo-Italian bilateral project between Scuola Sant'Anna and the Indian Institute of Technology Patna. Coordination between the research units in both institutions for practical development of software for neuromorphic photonic chips

2021 - 2023   **Italian Ministry of University and Research - QP**, *"Quantum Pathfinder"*, **Role:** researcher.
The QP project is a PRO3 funding, a national triennal project dedicated to the few excellence universities in Italy. QP aims at the development of key enabling technologies in quantum science. Developed QRNG chips for fiber-based QKD optical links.

2022 - 2024   **EU Project ACTPHAST 4R - PEMAN**, *"Photonic Electronic Multiply-Accumulate Neurons"*, **Role**: photonic integration technology research engineer.
Simulation, design and validation of an InP photonic integrated chip for neuromorphic applications

2021 - 2023   **EU Project ACTPHAST 4R**, *"An integrated coherent combiner for free space communications"*, **Role**: photonic integration technology research engineer.
Simulation, design and validation of a Thick SOI photonic integrated chip for free space communications

Awards

Nov 2023   **IEEE Young Professional Travel Grant**, *IEEE Photonics Conference - ICP 2023*, Orlando, FL, USA - Awarded by the IEEE Photonics Society, given on the basis of CV, statement of interest, and volunteer activity in the photonics community.

Nov 2022   **Best Student Paper Award**, *Asia Communications and Photonics Conference - ACP 2022*, Shenzhen, China - Optica Student Paper Prize for the paper entitled "Improving Noise Resilience in End-To-End Deep Learning Optical Fiber Transmission".

June 2022   **Best Oral Presentation**, *Italian conference on Optics and Photonics 2022*, Trento, Italy - Optica Best oral presentation award in the section of Emerging Technologies for the invited talk entitled "Leveraging Lithium Niobate on Insulator Technology for Photonic Analog Computing".

Invited Talks

Jul 2024   "Photonic Technologies for Analog Neuromorphic Processors", at the 2024 IEEE Photonics in Switching and Computing (PSC) conference, Bridgetownd, Barbados.

Nov 2023   "Neuromorphic Photonics for Digital Signal Processing", at the 2023 IEEE Photonics Conference (IPC), Oralndo, FL, USA.

June 2022   "Leveraging on Lithium Niobate on Insulator Technology for Photonic Analog Computing" at the Italian conference on Optics and Photonics (ICOP), 2022.

Feb 2021   "Photonic Neuromorphic Computing: an overview of optics for AI" at the Mini-Symposium "Introduction to photonic reservoir computing" organized by the POST-DIGITAL EU Project.

Dec 2019   "Photonic Neuromorphic Computing: Towards all-optical Neural Networks" at the ERC workshop "Photonic Reservoir Computing and Information Processing in Complex Networks", Trento.

Teaching

–   **Course Lecturer** (titolare di corso) "Analog Neuromorphic Processors" for MS students in Information Engineering of Scuola Superiore Sant'Anna (SSSA), Pisa - A.Y. 23/24

- **Course Lecturer** "Fundamentals of Quantum Computing" for PhD students in the Emerging Digital Technologies program of Scuola Superiore Sant'Anna (SSSA), Pisa - Scheduled A.Y. 23/24
- Lessons on "Neuromorphic photonic accelerators for AI" under the course "Symbolic and Evolutionary Artificial Intelligence" - MS in AI and Data Engineering, University of Pisa
- Tutoring of Ph.D. students within the course in Emerging Digital Technologies, SSSA, Pisa
- Tutoring of several MS students for their Thesis, from Scuola Sant'Anna and University of Pisa

Courses & Summer Schools

Jan 2023   **PQIP2023 Photonic Quantum Information Processing - 12th Optoelectronics and Photonics Winter School**, *University of Trento*, Trento, Italy.
The school initially introduced the general concepts about Quantum Information science, with particular attention to implementations in photonic computing and machine learning. The school offered a series of lectures to prepare the on both software (programming languages and algorithms) and hardware implementations (photon sources, detectors and integrated photonic architectures) of nowadays quantum science. Finally, a number of lectures covered application-oriented aspects, such as Q-random number generators, Q-Key Distribution and Q-imaging.

June 2021   **NMP2021 Neuromorphic Photonics - 11th Optoelectronics and Photonics Summer School**, *University of Trento*, Trento, Italy.
The school introduced the general concepts about biological brain neurons and neuroscience, with particular attention to their implementation in machine learning and complex networks. Then, the lectures focused on different neuromorphic photonic platforms (from lasers and diffraction systems to integrated photonics chips) and on applications as photonic accelerators, optical device optimization and telecommunications.

Jul 2019   **ePIXfab Silicon Photonics Summer School**, *Scuola Superiore Sant'Anna*, Pisa, Italy.
The summer school is designed to equally benefit the beginners and experts from an industrial or academic background in the field of silicon photonics. After covering the basics of silicon photonics, the school dives into the latest trends, hot-topics and recent/upcoming technological developments in the field of silicon photonics. Industrial and academic speakers will show the latest research results for various applications of silicon photonics.

MITx Course: Photonic Integrated Circuits I, *MITx - online learning iniziative of the MIT*, Cambridge (USA).
Six-week MITx course that gives the bases through the design of a photonic integrated circuit chip with a case study on the implementation of a transceiver from components design to layout with DRC check that can be submitted to AIM Photonics's state-of-the-art 300mm wafer foundry. To earn the course certification a project on a 2x2 reconfiurable linear optical processor was submitted with a design report.

Selected Publications

Journal

L. De Marinis, N. Andriolli, and G. Contestabile, "Analysis of Integration Technologies for High-Speed Analog Neuromorphic Photonics." in J. Sel. Top. in Quant. Electron., 2023

L. De Marinis, A. Catania, A. Castoldi, G. Contestabile, P. Bruschi, M. Piotto and N. Andriolli, "A codesigned integrated photonic electronic neuron" in IEEE J. Quantum Electron., 2022

L. De Marinis, M. Cococcioni, P. Castoldi and N. Andriolli, "Photonic Neural Networks: A Survey" in IEEE Access, vol. 7, pp. 175827-175841, 2019, doi: 10.1109/ACCESS.2019.2957245.

Proceedings

Invited   **L. De Marinis**, I. Roumpos, N. Andriolli, M. Moralis-Pegios, N. Pleros, and G. Contestabile "Neuromorphic Photonics for Digital Signal Processing", at the 2023 IEEE Photonics Conference (IPC), Oralndo, FL, USA.

Student Award   **L. De Marinis**, G. Roumpos, G. Mourgias-Alexandris, M. Kirtas, N. Passalis, A. Tefas, G. Contestabile, K. Vyrsokinos, N. Pleros and M. Moralis-Pegios, "Improving Noise Resilience in End-To-End Deep Learning Optical Fiber Transmission" In APC, 2022

Invited **L. De Marinis**, E. Paolini, G. Contestabile and N. Andriolli, "Leveraging Lithium Niobate on Insulator Technology for Photonic Analog Computing" in Italian Conference on Optics and Photonics, pp. 1-4. IEEE, 2022

Invited **L. De Marinis** and N. Andriolli, "Photonic Integrated Neural Network Accelerators" in Photonics in Switching and Computing conference, 2021

Languages

Italian	**Native speaker**
English	**Professional working proficiency - C1**

Miscellaneous

Volunteer Experience	Volunteer experience since the age of 18. Approaching, Support and Meal serving for homeless people in Pisa downtown. More than 10 years experience in the Italian Scout association, from first entry up to group leader. Former member of "Libera", an Italian anti-Mafia association promoting legality, equality and citizens rights.
Mountain	Ski mountaineer, rock climber, and mountain biker. Aspiring instructor of ski mountaineering for the Italian Alpine Club

References

Prof. Giampiero Contestabile, *Associate Professor*, Scuola Superiore Sant'Anna, Pisa, Italy.
g.contestabile@santannapisa.it

Prof. Nikos Pleros, *Associate Professor*, Aristotle University of Thessaloniki, Greece.
npleros@csd.auth.gr

Prof. Nicola Andriolli, *Associate Professor*, University of Pisa, Pisa, Italy.
nicola.andriolli@unipi.it

Prof. Piero Castoldi, *Full Professor*, Scuola Superiore Sant'Anna, Pisa, Italy.
p.castoldi@santannapisa.it

March 14, 2024

APPENDIX A - List of All Publications

Journal

J10   I. Roumpos, **L. De Marinis**, M. Kirtas, N. Passalis, A. Tefas, G. Contestabile, N. Pleros, M. Moralis-Pegios, and K. Vyrsokinos 2023. "High-performance end-to-end deep learning IM/DD link using optics-informed neural networks." Optics Express, 31(12), pp.20068-20079.

J9   **L. De Marinis**, N. Andriolli, and G. Contestabile, "Analysis of Integration Technologies for High-Speed Analog Neuromorphic Photonics." in J. Sel. Top. in Quant. Electron., 2023

J8   E. Paolini, **L. De Marinis**, L. Maggiani, M. Cococcioni, and N. Andriolli, "CHARLES: A C++ fixed-point library for Photonic-Aware Neural Networks." in Neural Networks, 2023

J7   L.Z. Khan, J. Pedro, N. Costa, **L. De Marinis**, A. Napoli and N. Sambo, "Data Augmentation to Improve Performance of Neural Networks for Failure Management in Optical Networks" In J. Opt. Commun. Netw. 15.1 (2023): 57-67

J6   F. Cugini, D. Scano, A. Giorgetti, A. Sgambelluri, **L. De Marinis**, P. Castoldi, and F. Paolucci,
Invited   "Telemetry and AI-based security P4 applications for optical networks" In J. Opt. Commun. Netw., 2023, 15, A1-A10

J5   P. Bisconti, D. Orsitto, F. Fedorczyk, F. Brau, M. Capasso, **L. De Marinis**, H. Eken, F. Merenda, M. Forti, M. Pacini and C. Schettini, "Maximizing team synergy in AI-related interdisciplinary groups: an interdisciplinary-by-design iterative methodology" in AI & SOCIETY, 2022, 1-10

J4   **L. De Marinis**, A. Catania, A. Castoldi, G. Contestabile, P. Bruschi, M. Piotto and N. Andriolli, "A codesigned integrated photonic electronic neuron" in IEEE J. of Quantum Electron., 2022

J3   E. Paolini, **L. De Marinis**, M. Cococcioni, L. Valcarenghi, L. Maggiani and N. Andriolli, "Photonic-aware neural networks" in Neural Comput. & Applic., 2022, 1-13

J2   **L. De Marinis**, M. Cococcioni, O. Liboiron-Ladouceur, G. Contestabile, P. Castoldi and N.
Invited   Andriolli, "Photonic Integrated Reconfigurable Linear Processors as Neural Network Accelerators" in MDPI Appl. Sci., 2021; 11(13):6232.

J1   **L. De Marinis**, M. Cococcioni, P. Castoldi and N. Andriolli, "Photonic Neural Networks: A Survey" in IEEE Access, vol. 7, pp. 175827-175841, 2019, doi: 10.1109/ACCESS.2019.2957245.

Volume

V2   G. Pratti, A. Putzer and **L. De Marinis**, "Advancing Legal and Practical Recognition of the Non-Human Right to Energy" in Routledge Handbook of Energy Transitions, T&F, 2022

V1   **L. De Marinis** and F. Merenda "Intelligenza Artificiale: una sfida alla separazione dei saperi scientifici" in AREL la RIVISTA, vol. 1/2021, pp. 155-157, 2021

Proceedings

P21   E. Paolini, **L. De Marinis**, G. Contestabile, S. Gupta, L. Maggiani, and N, Andriolli. "Validation of Photonic Neural Networks in Health Scenarios." In 2023 International Conference on Photonics in Switching and Computing (PSC), pp. 1-3. IEEE, 2023.

P20   P.S. Kincaid, **L. De Marinis**, A. Montanaro, A. Santamato, N. Andriolli, and G. Contestabile. "Source Device Independent Quantum Random Number Generator with Integrated InP Photonics." In 2023 International Conference on Photonics in Switching and Computing (PSC), pp. 1-3. IEEE, 2023.

P19   **L. De Marinis**, P.S. Kincaid, G. Contestabile, S. Gupta, and N, Andriolli. "Graphene-Based Photonic-Electronic Multiply-Accumulate Neurons." In 2023 International Conference on Photonics in Switching and Computing (PSC), pp. 1-3. IEEE, 2023.

P18   N. Sambo, L. Zar Khan, J. Pedro, N. Costa, **L. De Marinis**, and A. Napoli. "The potential of data augmentation for failure management in optical networks." In Photonic Networks and Devices, pp. NeM3B-1. Optica Publishing Group, 2023.

P17 **L. De Marinis**, N. Andriolli, S. Gupta, and G. Contestabile. "Impact of Photonic Integration Platforms on the Performance of Neuromorphic Accelerators." In 2023 Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO/Europe-EQEC), pp. 1-1. IEEE, 2023.

P16 I. Roumpos, **L. De Marinis**, G. Mourgias-Alexandris, M. Kirtas, N. Passalis, A. Tefas, G. Contestabile, K. Vyrsokinos, N. Pleros, and M. Moralis-Pegios. "Physics-inspired End-to-End Deep Learning for High-Performance Optical Fiber Transmission Links." In CLEO: Science and Innovations, pp. SF1F-6. Optica Publishing Group, 2023.

P15 L. Barsellotti, **L. De Marinis**, F. Cugini, and F. Paolucci "FTG-Net: Hierarchical Flow-to-Traffic Graph Neural Network for DDoS Attack Detection." In 2023 IEEE 24th International Conference on High Performance Switching and Routing (HPSR) (pp. 173-178). 2023 IEEE.

P14 **L. De Marinis**, G. Roumpos, G. Mourgias-Alexandris, M. Kirtas, N. Passalis, A. Tefas, G.
Student Contestabile, K. Vyrsokinos, N. Pleros and M. Moralis-Pegios, "Improving Noise Resilience in
Award End-To-End Deep Learning Optical Fiber Transmission" In Asia Communications and Photonics Conference, 2022

P13 E. Paolini, F. Civerchia, **L. De Marinis**, L. Valcarenghi, L. Maggiani and N. Andriolli, "Photonic-aware Neural Networks for Packet Classification in Beyond 5G Networks" In 2022 International Conference on Network of the Future (NoF) (pp. 1-5). IEEE (pp. 1-5). IEEE

P12 **L. De Marinis**, E. Paolini, G. Contestabile and N. Andriolli, "Leveraging Lithium Niobate
Invited on Insulator Technology for Photonic Analog Computing" in Italian Conference on Optics and Photonics, pp. 1-4. IEEE, 2022

P11 E. Paolini, **L. De Marinis**, M. Cococcioni, L. Valcarenghi, L. Maggiani, and N. Andriolli "Photonic-Aware Neural Network: a fixed-point emulation of photonic hardware." In 27th OptoElectronics and Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC), pp. 01-03. IEEE, 2022

P10 E. Paolini, **L. De Marinis**, L. Maggiani, and N. Andriolli. "Accelerating Pooling Layers in Photonic Convolutional Neural Networks." In 27th OptoElectronics and Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC), pp. 1-3. IEEE, 2022.

P9 **L. De Marinis**, G. Contestabile and N. Andriolli, "A Lithium Niobate on Insulator Based Photonic Neural Network" In 27th OptoElectronics and Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC), pp. 1-3. IEEE, 2022.

P8 E. Paolini, F. Civerchia, **L. De Marinis**, L. Valcarenghi, L. Maggiani, and N. Andriolli. "Photonic-aware Neural Networks for Packet Classification in URLLC scenarios." In IEEE 23rd International Conference on High Performance Switching and Routing (HPSR), pp. 218-223. IEEE, 2022.

P7 **L. De Marinis** and N. Andriolli, "Photonic Integrated Neural Network Accelerators" in Photonics
Invited in Switching and Computing conference, 2021, W3B.1

P6 **L. De Marinis**, M. Sorel, C. Klitis, G. Contestabile and N. Andriolli, "Silicon Photonic Filter-
Stdnt. Award based Dot Product Engine for Convolutional Neural Networks" in Advanced Photonics Congress,
Finalist 2021, SpM5C.3

P5 **L. De Marinis**, G. Contestabile, P. Castoldi and N. Andriolli,"A Silicon Nitride Reconfigurable Linear Optical Processor" in Optical Fiber Communication Conference, 2021, Tu1C.6

P4 F. Paolucci, **L. De Marinis**, P. Castoldi and F. Cugini, "Demonstration of P4 Neural Network Switch" in Optical Fiber Communication Conference, 2021,OFC Demo Zone

P3 **L. De Marinis**, A. Catania, P. Castoldi, P. Bruschi, M. Piotto and N. Andriolli, "A Codesigned Photonic Electronic MAC Neuron with ADC-Embedded Nonlinearity" Conference on Lasers and Electro-Optics, 2021, AW3E.4.

P2 **L. De Marinis**, F. Nesti, M. Cococcioni and N. Andriolli "A Photonic Accelerator for Feature Map Generation in Convolutional Neural Networks" in Photonics in Switching and Computing conference, 2020, PsTh1F.3

P1 **L. De Marinis**, O. Liboiron-Ladouceur and N. Andriolli "Characterization and ENOB Analysis of a Reconfigurable Linear Optical Processor" in Photonics in Switching and Computing conference, 2020, PsW1F.4

APPENDIX B - List of All Talks

T13
Invited "Neuromorphic Photonics for Digital Signal Processing", at the 2023 IEEE Photonics Conference (IPC), Oralndo FL, USA.

T12 "Impact of Photonic Integration Platforms on the Performance of Neuromorphic Accelerators." at the "Analog optical processing: back in town for neuromorphic applications?" Workshop at the Photonics in Switching and Computing (PSC) conference, 2023.

T11 "Impact of Photonic Integration Platforms on the Performance of Neuromorphic Accelerators." In 2023 Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO/Europe-EQEC), 2023

T10 "Improving Noise Resilience in End-To-End Deep Learning Optical Fiber Transmission" In Asia Communications and Photonics Conference, 2022

T9
Invited "Leveraging Lithium Niobate on Insulator Technology for Photonic Analog Computing" n Italian Conference on Optics and Photonics, IEEE, 2022

T8 "A Lithium Niobate on Insulator Based Photonic Neural Network" In 27th OptoElectronics and Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC), 2022.

T7 "Silicon Photonic Filter-based Dot Product Engine forConvolutional Neural Networks" in Advanced Photonics Congress, 2021

T6 "Silicon Nitride Reconfigurable Linear Optical Processor" in Optical Fiber Communication Conference, 2021

T5 "A CodesignedPhotonic Electronic MAC Neuron with ADC-Embedded Nonlinearity" Conference on Lasers and Electro-Optics (CLEO), 2021

T4
Invited "Photonic Neuromorphic Computing: an overview of optics for AI" at the Mini-Symposium "Introduction to photonic reservoir computing" organized by the POST-DIGITAL EU Project coordinated by Aston Institute of Photonic Technologies., 2021

T3 "Photonic Accelerator for Feature Map Generation in Convolutional Neural Networks" in Photonics in Switching and Computing conference, 2020

T2 "Characterization and ENOB Analysis of a Reconfigurable Linear Optical Processor" in Photonics in Switching and Computing conference, 2020

T1
Invited "Photonic Neuromorphic Computing: Towards all-optical Neural Networks" at the ERC workshop "Photonic Reservoir Computing and Information Processing in Complex Networks", Trento 2019