Romina Soledad Molina, Ph.D.

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Personal Information

Citizenship: Argentine / Italian

Birth Place: San Luis, Argentina

Birth Date: November 20, 1984

Education

Università degli Studi di Trieste and Universidad Nacional de San Luis — **Italy / Argentina**
PhD in Industrial and Information Engineering (italy) / Computer Science (Argentina) — *2019–2023*
Thesis: *"SoC-based FPGA architecture for image analysis and other highly demanding applications"*

Universidad Nacional de San Luis — **Argentina**
Master in Computer Science — *2014–2017*
Thesis: *"Recuperación de Imágenes sobre Plataformas de Sistemas de Cómputo de Alta Productividad"*
(Image Retrieval on High Productivity Computing Systems Platforms)

Universidad Nacional de San Luis — **Argentina**
Bachelor in Electronic Engineering — *2003–2010*

Affiliations

2019–Present: The Abdus Salam International Centre for Theoretical Physics (ICTP), Italy.

2019–2023: Università degli Studi di Trieste (UNITS), Italy.

2020–2024: Associazione Società Italiana di Elettronica (SIE), Italy.

2020–2023: Istituto Nazionale di Fisica Nucleare (INFN), Italy.

2021–2022: Consiglio Nazionale delle Ricerche (CNR) -ISTI, Pisa, Italy.

2012–2023: Universidad Nacional de San Luis (UNSL), Argentina.

Professional Experience

Current Position: Postdoctoral researcher on Machine Learning for Advanced Scientific Instrumentation, ICTP – MLab – STI, Trieste, Italy.

- Research, development, and implementation of machine learning algorithms for advanced scientific instrumentation, targeting different devices, such as FPGA/SoC, microcontrollers, CPU, and GPU.
- AI-driven research projects in interdisciplinary fields.

Universidad Nacional de San Luis — **Argentina**
Researcher and Lecturer — *2012–2019*

- Assistant professor: digital signal processing and digital control (Electronic Engineer degree).
- Lecturer in post-graduate courses (master and Ph.D. levels).
- Research in artificial vision and control systems.
- Supervised thesis projects focusing on machine learning and image processing.

Fedetek S.R.L. — **Argentina**
Graphic designer and software developer — *2003–2012*

Research/Visiting Periods in Other Centers

2024: University of Novi Sad, Serbia — Horizon 2020 research and innovation staff exchange grant.

2024: Thapar Institute of Engineering and Technology, India – Bilateral project Italy-India.

2023: International Atomic Energy Agency (IAEA) – NSIL, Vienna, Austria.

2022: NECSTLab: Advanced projects in computing systems - DEIB, Politecnico di Milano, Italy.

2021: ISTI – CNR, Pisa, Italy

2021–2023: Scientific contractual agreement, AI and HPC research on SoC-FPGA devices, ICTP, Trieste, Italy.

2020–2021: Visiting Scientist, Multidisciplinary laboratory (MLab), ICTP, Trieste, Italy.

2019–2020: Visiting Scientist, Multidisciplinary laboratory (MLab), ICTP, Trieste, Italy.

2018: Research period at Universidad de Castilla-La Mancha, Ciudad Real, Spain.

2015: Research period at Universidad de Castilla-La Mancha, Ciudad Real, Spain.

Research Experience in Specific Projects

2024–Present: REMARKABLE: Rural Environmental Monitoring via ultra wide-ARea networKs And distriButed federated Learning – Horizon 2020 research and innovation staff exchange.

2022–2024: Manageable AI for Scene Understanding Tasks from Low-Light Noisy Images, Italy and India.

2017–2018: HAMLET: Hardware Acceleration of Machine Learning Tasks, Italy and Argentina.

2015–2016: Similarity Search in the Big Data Era, Argentina.

2012–2019: Artificial vision and digital control, Argentina.

Selected scholarships/grant

2024: Receiver of "Subsidio profesor visitante", Fundación Williams, Argentina [Presented by Luciana De Micco. Granted 2024, Executed 2025].

2024: IAEA scholarship, Muon Tomography Workshop, France.

2019–2023: PhD scholarship, POR FVG – Fondo Sociale Europeo, Italy.

2017: ICTP scholarship, FPGA for Nuclear Instrumentation, Trieste, Italy.

Teaching and Supervision

2012–2019: Assistant professor: Digital Signal Processing and Digital Control, Electronic Engineer, Universidad Nacional de San Luis

- Responsible for practical exercises, simulations, and laboratories in digital signal processing and digital control.

2017-Present: Lecturer in postgraduate courses

- From algorithm to hardware: machine learning in embedded systems (2025) - Universidad de Mar del Plata, Argentina.
- Procesamiento digital de señales en sistemas embebidos (2018/2019) – UNSL, Argentina.
- Diseño avanzado de sistemas embebidos en lógica programable: Zynq APSoC, Vivado-HLS y SDSoC (2018) – UNSL, Argentina.
- Análisis de procesamiento paralelo y distribuido sobre datos masivos (2018) – UNSL, Argentina.
- Programación avanzada de Sistemas Embebidos en RTOS y Linux Embebido (2017) – UNSL, Argentina.

2019-2025: Lecturer and laboratory instructor in ICTP workshops and schools

- Joint ICTP-IAEA School on Detector Signal Processing and Machine Learning for Scientific Instrumentation and Reconfigurable Computing — (smr 4110). Trieste, Italy. October/November 2025 [To be held].
- 1st Mesoamerican Workshop on Reconfigurable X-ray and Scientific Instrumentation for Cultural Heritage — (smr 4078). Antigua, Guatemala. June 2025 [To be held].
- Workshop on Fully-Programmable Systems-on-Chip for Scientific Applications — (smr 3983). Doha, Qatar.

October 2024.

- Joint ICTP-IAEA School on Systems-on-Chip Based on FPGA for Scientific Instrumentation and Reconfigurable Computing — (smr 3891). Trieste, Italy. November/December 2023.
- Joint ICTP-IAEA School on FPGA-based SoC and its Applications to Nuclear and Scientific Instrumentation — smr 3765. Trieste, Italy. November/December 2022.
- Joint ICTP, SAIFR and UNESP School on Systems-on-Chip, Embedded Microcontrollers and their Applications in Research and Industry — smr 3557. On-line. October 2021.
- Joint ICTP-IAEA School on FPGA-based SoC and its Applications for Nuclear and Related Instrumentation — smr 3562. Trieste, Italy. January/February 2021.
- ICTP School and Conference on Fully-Programmable Systems-On-Chip for Scientific Instrumentation — smr 3332. Guwahati, India. November 2019.
- ICTP Advanced Workshop on Modern FPGA Based Technology for Scientific Computing. Trieste, Italy. May 2019.
- ICTP Advanced Workshop on FPGA-based Systems-On-Chip for Scientific Instrumentation and Reconfigurable Computing. Trieste, Italy. November/December 2018.

2018-2025: Invited Lectures and Presentations

- Summer School: IoT for Eco-Friendly Tourism, Valencia, Spain (2025).
  Topic: Machine learning and model compression for FPGA-based Edge IoT devices.
- Workshop: Seismology and Artificial Intelligence, Frankfurt Institute for Advanced Studies, Frankfurt, Germany (2023).
  Topic: Seismic event detection at Copahue volcano using digital signal processing and machine learning: towards edge implementation.
- DEIB – NECSTLab, Politecnico di Milano, Milan, Italy (2022).
  Topic: SoC-FPGA architectures for machine learning applications.
- Workshop: CAHEP2020 – Central American Meeting on High Energy Physics, Cosmology, and High Energy Astrophysics, Guatemala (November 2020).
  Topic: "FPGA para la aceleración de algoritmos de Machine Learning."
- Universidad de Castilla-La Mancha (UCLM), Spain (2018).
  Seminar: "Digital Signal Processing" — Master's in Computer Engineering (Ingeniería Informática).

2014-2023 - **Supervision**: Supervised multiple thesis projects in image processing and AI, focused on interdisciplinary fields, resulting in high-impact publications.

- Selected thesis
  - *Machine learning techniques for moth classification in precision agriculture*. Student: Valentina Carrer. Supervisor: Giovanni Ramponi – Co-supervisor: Romina Molina. Year: 2022. [Master in Computer and Electronic Engineering (Laurea magistrale, UniTS, Trieste, Italy).]
  - *Herramienta basada en procesamiento digital de señales y aprendizaje automático para la clasificación de trazas sísmicas volcánicas*. Student: Yair Mauad Sosa. Supervisor: Romina Molina. Co-supervisor: Alejandro Nuñez Manquez. Year: 2023 [Bachelor Electronic Engineer with Digital System Orientation (UNSL, San Luis, Argentina).]
  - *Detección de plagas en cultivos frutales a través de procesamiento de imagen y aprendizaje automático mediante trampas IoT*. Student: Agustina Suarez. Supervisor: Romina Molina. Co-supervisor: Ricardo Petrino. Year: 2021. [Bachelor Electronic Engineer with Digital System Orientation (UNSL, San Luis, Argentina).]
  - *Equipo de medición de velocidades de semillas en descargas de silos con visión*. Student: Valeria Gonzalez. Supervisor: Ing. Romina Molina – Co-supervisor: Jésica Benito. Year: 2019. [Bachelor Electronic Engineer with Digital System Orientation (UNSL, San Luis, Argentina).]

Awards and Recognitions

2022: Industry Impact Award, ECIR2022, Norway.

List of Publications

Book Chapters:

- Gil Costa, **Molina, R. S.**, et al., *Hardware Acceleration of CBIR System with FPGA-Based Platform*, IGI, 2016.

Journal Papers:

- **Molina, R. S.**, et al., *Performance Estimation Methodology for High-Level Synthesis Hardware Designs*, Submitted ACM.
- Ballina, M. G., Crespo, M.L., Carrato, S., **Molina, R. S.**, et al., *A method for accurate and precise pulse arrival time estimation: A case study on high-energy particle detectors*, IEEE Transactions on Nuclear Science. 2025. doi: 10.1109/TNS.2025.3557623..
- Morales, I., **Molina, R. S.**, et al., *Embedded real-time high event rate gamma/neutron discrimination based on machine learning with SiPM CLYC detectors*, IEEE Transactions on Nuclear Science. 2024.
- Sosa, Y. M., **Molina, R. S.**, et al., *Seismic Event Detection in the Copahue Volcano Based on Machine Learning: Towards an On-the-Edge Implementation*, MDPI Electronics. 2024.
- **Molina, R. S.**, et al., *An End-to-End Workflow to Efficiently Compress and Deploy DNN Classifiers On SoC/FPGA*, IEEE Embedded Systems Letters. 2023.
- **Molina, R. S.**, et al., *High-Level Synthesis Hardware Design for FPGA-based Accelerators: Models, Methodologies, and Frameworks*, IEEE Access. 2022.
- Cicuttin, A., Morales, I. R., Crespo, M. L., Carrato, S., García, L. G., **Molina, R. S.**, et al., *A Simplified Correlation Index for Fast Real-Time Pulse Shape Recognition*, MDPI Sensors. 2022.
- **Molina, R. S.**, et al., *Efficient traversal of decision tree ensembles with FPGAs*, Journal of Parallel and Distributed Computing, Elsevier. 2021.
- Garcia, L. G., **Molina, R. S.**, et al., *Muon–Electron Pulse Shape Discrimination for Water Cherenkov Detectors Based on FPGA/SoC*, MDPI Electronics. 2021.
- Marsi, S., Bhattacharya, J., **Molina, R. S.**, et al., *A Non-Linear Convolution Network for Image Processing*, MDPI Electronics. 2021.
- Guzzi, F., De Bortoli, L., **Molina, R. S.**, et al., *Distillation of an End-to-End Oracle for Face Verification and Recognition Sensors*, MDPI Sensors. 2021.
- **Molina, R. S.**, et al., *Heterogeneous SoC-based acceleration of MPEG-7 compliance image retrieval process*, Journal of Real-Time Image Processing. 2018.

Conference Papers:

- **Molina, R. S.**, et al., *Efficient Split Learning LSTM Models for FPGA-based Edge IoT Devices*, IEEE International Conference on Machine Learning for Communication and Networking. 2025. arXiv preprint arXiv:2502.08692.
- Ballina, M., **Molina, R. S.,** et al., *HyperFPGA: Enhancing Education With Remote Laboratory Access for Heterogeneous Computing on MPSoC-FPGA Technologies*, IEEE EDUCON. 2025. [Accepted]
- García Ordóñez, L. G., Crespo, M. L., Cicuttin, A., Morales, I., **Molina, R. S.,** et al., *MA-XRF Scanner: Implementation of Image Reconstruction Algorithms Based on Single Photon Detection for Cultural Heritage Studies*, EXRS2024 conference. 2024.
- **Molina, R. S.**, et al., *ML-based classifier for precision agriculture on embedded systems*, International Conference on Applications in Electronics Pervading Industry, Environment and Society. 2022.
- Florian Samayoa, W., Valinoti, B., **Molina, R. S.**, et al., *Diagnostic analytics for pixelated particle detectors: A case study*, International Conference on Applications in Electronics Pervading Industry, Environment and Society. 2022.
- Gil-Costa, V., Loor, F., **Molina, R. S.**, et al., *Energy-Efficient Ranking on FPGAs through Ensemble Model Compression*, 12th Italian Information Retrieval Workshop. 2022.
- **Molina, R. S.**, et al., *Compression of NN-Based Pulse-Shape Discriminators in Front-End Electronics for Particle Detection*, International Conference on Applications in Electronics Pervading Industry, Environment and Society. 2022.
- Gil-Costa, V., Loor, F., **Molina, R. S., et al.**, *Ensemble Model Compression for Fast and Energy-Efficient Ranking on FPGAs*, European Conference on Information Retrieval, Springer. 2022.

- Suárez, A., **Molina, R. S.**, et al., *Pest detection and classification to reduce pesticide use in fruit crops based on deep neural networks and image processing*, IEEE XIX Workshop on Information Processing and Control (RPIC). 2021.
- García Ordóñez, L. G., **Molina, R. S.**, et al., *Pulse shape Discrimination for Online Data Acquisition in Water Cherenkov Detectors Based on FPGA/SoC*, 37th International Cosmic Ray Conference. 2021.
- **Molina, R. S.**, et al., *Implementation of Particle Image Velocimetry for Silo Discharge and Food Industry Seeds*, Applications in Electronics Pervading Industry, Environment and Society. Lecture Notes in Electrical Engineering. 2021.
- Guillermo, G. L., Crespo, M. L., Carrato, S., Cicuttin, A., Oswaldo, F. W., **Molina, R. S.**, et al., *High Voltage Isolated Bidirectional Network Interface for SoC-FPGA Based Devices: A Case Study: Application to Micro-pattern Gaseous Detectors*, Applications in Electronics Pervading Industry, Environment and Society. Lecture Notes in Electrical Engineering. 2021.
- **Molina, R. S.**, et al., *Implementation of Search Process for a Content-Based Image Retrieval Application on System on Chip*, X Southern Conference on Programmable Logic. 2019.
- Ariza, C. R., **Molina, R. S.**, et al., *Eye Tracker Acceleration in Reconfigurable Hybrid Systems*, IEEE Biennial Congress of Argentina (ARGENCON). 2018.
- Luis Britos, Maria E. Di Gennaro, Veronica Gil Costa, Fernando Kasián, Jair Lobos, Verónica Ludueña, **Molina, R. S.**, et al., *Búsquedas en Grandes Volúmenes de Datos*, WICC 2016 - XVII Workshop de Investigadores en Ciencias de la Computación. 2016.
- **Molina, R. S.**, et al., *Conversión de RGB a YCbCr en SystemGenerator y HLS*, XXI Congreso Argentino de Ciencias de la Computación CACIC. 2015.
- **Molina, R. S.**, et al., *Hybrid Classification of Resistors through Image Processing*, 22nd Euromicro International Conference on Parallel, Distributed, and Network-Based Processing. 2014.

COMPASS (CERN) Collaboration papers:

- Alexeev, G. D., Alexeev, M. G., Alice, C., Amoroso, A., Andrieux, V., Anosov, V., et al., *Collins and Sivers transverse-spin asymmetries in inclusive muonproduction of $\rho 0$ mesons.* Physics Letters B. 2023.
- Bradamante, F., Bressan, A., Cicuttin, A., Crespo, M. L., Chatterjee, C., et al., *Long term experience with perfluorobutane in COMPASS RICH.* Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment. 2023.
- Alexeev, G. D., Alexeev, M. G., Amoroso, A., Andrieux, V., et al., *Double J/ψ production in pion-nucleon scattering at COMPASS.* Physics Letters B. 2023.

Academic Training and Events

- Joint IAEA-ICTP Workshop on Artificial Intelligence and Machine Learning in Advancing Nuclear Engineering. Abdus Salam International Centre for Theoretical Physics (ICTP). Trieste, Italy. 2025.
- Joint IAEA–French Alternative Energies and Atomic Energy Commission Workshop on Muon Tomography: From Basic Principles to Practical Usage and Applications, Gif-sur-Yvette, France, Jun 2024.
- Workshop Seismology and Artificial Intelligence, Frankfurt Institute for Advanced Studies, Frankfurt, Germany. 2023.
- ApplePies2022: Applications in Electronics Pervading Industry, Environment and Society. Genova, Italy. 2022.
- 44th European Conference on Information Retrieval (ECIR). Stavanger, Norway. 2022.
- ApplePies2021: Applications in Electronics Pervading Industry, Environment and Society. 2021. Hybrid mode.
- SIE2021: 52nd Annual Meeting of the Associazione Società Italiana di Elettronica (SIE), Trieste, Italy. 2021.
- International Graduate School for PhD students in Electronics. Trieste, Italy. 2021.
- ApplePies2020: Applications in Electronics Pervading Industry, Environment and Society. 2020. On-line.
- 17th International Workshops on Hadron Structure and Spectroscopy (IWHSS 2020), Trieste, Italy. 2020. On-line.
- Second International Conference on Advances in Electrical, Electronic and System Engineering (ICAEESE 2019), Guwahati, India. 2019.
- X Southern Programmable Logic Conference, Buenos Aires, Argentina. 2019.
- Joint ICTP-IAEA School on Zynq-7000 SoC and its Applications for Nuclear and Related Instrumentation,

Abdus Salam International Centre for Theoretical Physics (ICTP). Trieste, Italy. 2017.
- VII Congreso de Microelectrónica Aplicada, San Luis. Argentina. 2016.
- 4th Embedded system school, San Luis, Argentina. 2015.
- Simposio Argentino de Sistemas Embebidos (SASE), Buenos Aires, Argentina. 2014.
- 9th Escuela Argentina de Micro-Nanoelectrónica, Tecnología y Aplicaciones (EAMTA), UTN, Mendoza, Argentina. 2014.
- 8th Congreso Argentino de Micro-Nanoelectrónica, Tecnología y Aplicaciones (CAMTA), UTN, Mendoza, Argentina. 2014.
- RPIC 2013 – XV Reunión de trabajo en Procesamiento de la Información y Control, Bariloche, Río Negro, Argentina. 2013.
- Simposio Argentino de Sistemas Embebidos (SASE), Buenos Aires, Argentina. 2013.

Conference Role and Organization

Conference Organization:
- SPL 2023 (XI Southern Programmable Logic Conference), San Luis, Argentina.
- SPL 2019 (X Southern Programmable Logic Conference), Buenos Aires, Argentina.
- VII Congreso de Microelectrónica Aplicada, San Luis, Argentina (2016).

Conference Roles:
- SPL2023 – Technical committee.
- LAWCC 2023 - XV Congreso de la Mujer Latinoamericana en la Computación – Program committee.
- SPL2019 – Executive committee - Publicity chair.

Outreach Activities:
- Scientific presentation "Apprendimento Automatico Applicato (Applied Machine Learning)" for the Liceo Cotta (Verona), ICTP, Trieste, Italy. 2024.
- ESOF 2020, ICTP booth, Trieste, Italy.
- Trieste Next 2019, 2021, and 2023, ICTP booth, Trieste, Italy.

Certifications & Courses (most recent)

- Supervised Machine Learning: Regression and Classification. 2025. Coursera. [Ongoing]
- Bootcamp Avanzado MLOps — Machine Learning Operation Hands-on. 2025. Udemy.
- Entrepreneurship for Engineers. 2025. edX.
- Linear Algebra for Machine Learning and Data Science. 2023. Coursera.
- Developing FPGA-accelerated cloud applications with SD Accel: Practice. 2020. Coursera.

Technical Skills

Programming: Python, C/C++, MATLAB, VHDL.

GUI design: Qt, PyQt.

AI Frameworks: TensorFlow, Keras, PyTorch, Scikit-learn.

Hardware: FPGA, SoC, Embedded Systems, Microcontrollers.

Tools: Vivado, SDSoC, OpenCV, High-Level Synthesis (HLS), Visual Code.

Agile development tools: Jira, GitHub.