

EDUCATION

- Apr. 2024 - **Ph.D. in Computational Mathematics, Learning, and Data Science**, *Università di Pavia*
 Mar. 2027 (expected) (UniPV), Pavia, Italy
 ○ **Research topic:** Mathematically certified deep learning algorithms for inverse problems governed by PDEs. Application to the personalized treatment plans in oncology.
 ○ *Fellowship:* Marie Skłodowska-Curie Doctoral fellow within the IN-DEEP European Doctoral Network.
 ○ *Supervisors:* Dr. Alessandro Reali, University of Pavia (UniPV, Italy), Dr. Giancarlo Sangalli, University of Pavia (UniPV, Italy), Dr. Claudio Canuto, Polytechnic Institute of Turin (POLITO, Italy).
- Sep. 2021 - **M.Sc. in Computational Science and Engineering**, *École Polytechnique Fédérale de Lausanne*
 Feb. 2024 (EPFL), Lausanne, Switzerland
 ○ **Grade-Point Average (GPA): 5.96/6.00.**
 ○ **M.Sc. Thesis:** “*Preconditioned Low-Rank Riemannian Optimization for Multiterm Linear Matrix Equations*”, under the supervision of Professor D. Kressner and Professor L. Robol.
- Sep. 2018 - **B.Sc. in Mathematics (curriculum: Computational oriented to Computer Science)**,
 Jul. 2021 *Università di Pisa*, Pisa, Italy
 ○ **Final Grade: 110/110 cum Laude**
 ○ **B.Sc. Thesis:** “*Low-rank numerical methods for the Sylvester equation (original title: Metodi numerici low-rank per l’equazione di Sylvester)*”, under the supervision of Professor D.A. Bini.
- 2013-2018 **Diploma di Liceo Scientifico**, *Liceo Scientifico “U.Dini”*, Pisa, Italy, final grade **100/100 cum Laude**

RESEARCH EXPERIENCES

- Oct. 2026 - **Research stay**, *Tecnia Research & Innovation*, Bilbao, Spain
 Jan. 2027 (planned) **Role:** Conducting research activities under the supervision of Dr. J. Del Ser. Working on explainable AI and differentiable machine learning frameworks for interpretable tumor growth modeling, enabling patient-specific prediction, parameter estimation, and uncertainty quantification.
- 20-24 Sep. 2026 **Research stay**, *SISSA mathLab, Scuola Internazionale Superiore di Studi Avanzati*, Trieste, Italy
Role: Conducting research activities under the supervision of Dr. F. Pichi. Working on the Riemannian structure of the neural network manifold.
- Sep. 2026 - **Research stay**, *Università di Firenze, Department of Mathematics and Computer Science “U. Dini”*, Firenze, Italy
 Oct. 2026 (ongoing) **Role:** Conducting research activities under the supervision of Prof. C. Giannelli. Working on the integration of neural networks and isogeometric analysis for forward and inverse problems governed by PDEs.
- 09-19 May 2026 **Research stay**, *Institut Camille Jordan, Université Claude Bernard Lyon 1*, Villeurbanne, France
Role: Conducting research activities under the supervision of Prof. C. Marcati. Working on scalable natural gradient methods and tensor train approaches for the Gross-Pitaevskii equation.
- Sep. 2025 - **Research stay**, *Politecnico di Torino (POLITO), DISMA*, Torino, Italy
 Nov. 2025 **Role:** Conducting research activities under the supervision of Prof. S. Berrone and Prof. C. Canuto. Working on loss functions based on a posteriori error estimators for the training of neural networks approximating solutions of PDEs.

- Feb. 2024 - **Invited “Master’s valorisation” internship**, EPFL MNS, Chair of Numerical Modelling and Simulation, Lausanne, Switzerland
Mar. 2024 **Role:** Conducting research activities under the supervision of Prof. A. Buffa and Y. Voet. Working on Model Order Reduction for time-dependent PDEs, with applications to isogeometric discretizations.
- Jul. 2023 - **Research activity under the supervision of Dr. F. Henríquez**, École Polytechnique Fédérale de Lausanne (EPFL), Department of Mathematics, Lausanne, Switzerland
Sep. 2023 **Role:** Extended a prior Semester Project titled “Multi-Fidelity Surrogate Modeling for Large-Scale Bayesian Inverse Problems using Artificial Neural Networks”, with a focus on its application to inverse acoustic scattering by random domains.

INDUSTRY EXPERIENCES

- Sep. 2022 - **Internship: Reinforcement Learning for the race strategy application in Formula 1**, Alfa Romeo F1 Team Orlen (Sauber Motorsport AG), Hinwil, Switzerland
Feb. 2023 **Role:** Responsible for enhancing an AI agent for Live Race Strategy in F1 Grand Prix:
 - Developed the simulation environment.
 - Studied the convergence of Reinforcement Learning (RL) algorithms in a highly stochastic setting.
 - Implemented F1-specific versions of state-of-the-art RL algorithms such as DQN, PPO and SAC.
 - Led the migration of the code from TensorFlow to PyTorch.
- Feb. 2018 - **Consulting activities**, Roboris Srl, Pisa, Italy
Dec. 2023 **Role:** Consulting activities at Roboris Srl, as a freelancer.
- Jun. 2016 - **Young Apprenticeship: Introduction to C++ programming**, Roboris Srl, Pisa, Italy
Jul. 2016

PUBLICATIONS AND PREPRINTS

- [1] Bioli I., & Mendibe Abarategi M. (2026). Self-Scaled Broyden Family of Quasi-Newton Methods in JAX. *Technical Note, arXiv Preprint*. <https://doi.org/10.48550/arXiv.2603.10599>.
- [2] Bioli I., Marcati C., & Rakhuba M. (2026). Riemannian optimization on low-rank tensor train manifolds for the Gross–Pitaevskii equation. *arXiv Preprint*. <https://doi.org/10.48550/arXiv.2609.37103>.
- [3] Bioli I., Marcati C., & Sangalli G. (2025). Accelerating Natural Gradient Descent for PINNs with Randomized Numerical Linear Algebra. *arXiv Preprint*. <https://doi.org/10.48550/arXiv.2505.11638>. (*To appear in Computer Methods in Applied Mechanics and Engineering*).
- [4] Bioli I., & Voet Y. (2025). A theoretical study on the effect of mass lumping on the discrete frequencies in immersogeometric analysis. *Journal of Scientific Computing*, 104, 103. <https://doi.org/10.1007/s10915-025-02990-2>.
- [5] Bioli I., Kressner D., & Robol L. (2025). Preconditioned low-rank Riemannian optimization for symmetric positive definite linear matrix equations. *SIAM Journal on Scientific Computing*, 47(2), A1091-A1116. <https://doi.org/10.1137/24M1680429>.

AWARDS AND SCHOLARSHIPS

- 2026 **SIAM Travel Award**, Awarded by SIAM to attend the SIAM Conference on Mathematics of Data Science (MDS26), Salt Lake City, Utah, USA.
- Oct. 2024 **EPFL - Best Master Average Grade 2024**, Awarded to the EPFL student with the highest average grade across all Master’s programs.
- Oct. 2024 **Prix Douchet 2024 - EPFL Mathematics Section**, Awarded to the student in the Mathematics section with the highest average grade during Master’s studies.

- Apr. 2024 - **Fellowship: Marie Skłodowska-Curie Doctoral Fellow within the IN-DEEP European**
 Mar. 2027 **Doctoral Network**
- 2019-2021 **Reduction of University fees by merit - Università di Pisa**
- Mar. 2026 **Full Fee Waiver - Pathfinder Innovation Bootcamp**, *Awarded by Fondazione Miticoro to attend the Pathfinder Innovation Bootcamp (Milan, Italy, 3-6 March 2026).*

TRAINING AND PROFESSIONAL DEVELOPMENT

Soft Skills and Professional Development:

- Mar. 2026 **Pathfinder Innovation Bootcamp**, *Fondazione Miticoro*, Milan, Italy, 32h
 Innovation, deep-tech, venture capital, corporate innovation, career development.
- Nov. - Dec. 2024 **EU Programming and Horizon Europe Proposal Design**, *Transversal Course*, *Università di Pavia*, Pavia, Italy, 12h, 3 CFU
 EU research policy, Horizon Europe proposal writing, European Innovation Council.
- Jul. 2024 **Soft Skills for Research**, *Transversal Course*, *Università di Pavia*, Pavia, Italy, 22h, 3 CFU
 Academic writing, presentations, time management, career planning.

Scientific Training:

- Jul. 2026 **Third IN-DEEP Week – Scientific Training**, *University of Nottingham*, Nottingham, UK
 Neural network approximation of PDEs, learning for high-dimensional control, PDE-constrained optimization, reinforcement learning.
- Sep. 2025 **Second IN-DEEP Week – Scientific Training**, *Politecnico di Torino*, Torino, Italy, 12h, 3 CFU
 Mathematical foundations of Deep Learning PDE solvers and High Performance Computing.
- May 2025 **IN-DEEP Workshop: Quality datasets for deep PDE solvers**, *Università di Pavia*, Pavia, Italy, 12h, 3 CFU
 Geometric Deep Learning, CAD for Industrial Applications, Supervised/Unsupervised Learning in Deep PDE Solvers.
- Apr. - Jul. 2025 **Advanced Numerical Methods for Scientific Computing**, *Doctoral Course*, *Università di Pavia*, Pavia, Italy, 24h, 7 CFU
 Optimization methods, variational problems, neural network training for PDEs, Riemannian optimization.
- Mar. 2025 **Advanced Scientific Programming in Python**, *Transversal Course*, *Università di Pavia*, Pavia, Italy, 20h, 5 CFU
 Advanced Python concepts for scientific computing.
- Jan. 2025 **Advanced Numerical Methods for Machine & Deep Learning**, *Winter School*, *Università di Ferrara*, Ferrara, Italy, 28h, 7 CFU
 Stochastic optimization, randomized numerical linear algebra, regularization, uncertainty quantification.
- Oct. 2024 **First IN-DEEP Week – Scientific Training**, *BCAM*, *Bilbao*, Spain, 16h, 4 CFU
 Fundamentals of neural networks, architecture design, optimization strategies, TensorFlow.
- Jul. 2024 **Isogeometric Analysis: Theory, Applications, and New Trends**, *Summer School*, *Como*, Italy, 28h, 6 CFU
 IGA foundations, spline basis functions, structure-preserving discretizations, engineering applications.
- Jun. 2024 **From Cells to Tissues: Models, Analysis and Applications**, *Summer School*, *Como*, Italy, 24h, 6 CFU
 Mathematical models in cell and tissue mechanobiology, PDEs with free boundaries.
- Apr. - Jun. 2024 **Functional Analysis and Differential Equations**, *Master Course*, *Università di Pavia*, Pavia, Italy, 56h, 7 CFU
 Functional analysis, distributions, Sobolev spaces, elliptic PDEs.

SEMINARS, TALKS AND POSTERS

- Nov. 2026 (planned) **SIAM Conference on Mathematics of Data Science (MDS26), Minisymposium “Model-Based Geometry-Aware Preconditioning for Scientific Machine Learning”, Salt Lake City, Utah, USA.** Title: *Scalable Natural Gradient Descent and Geometry-Aware Preconditioning for Neural PDE Solvers*
- Oct. 2026 (planned) **Seminari di Analisi Numerica del DISMA, Politecnico di Torino, Torino, Italy.** Title: *Irreducible shallow tanh neural networks are a manifold*
- Oct. 2026 (planned) **Seminar, Dipartimento di Matematica e Informatica “U. Dini”, Università di Firenze, Firenze, Italy.** Title: *IsoGeometric Analysis Quasi-Interpolated Neural Networks for forward and inverse PDE problems*
- Sep. 2026 **AJS – Analysis Junior Seminars, SISSA, Trieste, Italy.** Title: *Are neural networks a manifold? A work-in-progress answer for shallow tanh networks*
- Jul. 2026 **WCCM-ECCOMAS 2026, Munich, Germany.** Title: *Scalable Natural Gradient Descent for Neural PDE Solvers: Low-Rank Preconditioning and Efficient Implementations*
- Jul. 2026 **Third IN-DEEP Week, University of Nottingham, Nottingham, UK.** Title: *Non-degenerate tanh Shallow Neural Networks are a Manifold (?)*
- Jun. 2026 **GIMC SIMAI Young 2026, Università di Pisa, Pisa, Italy.** Title: *Randomized Low-Rank Natural Gradient Methods for Scalable Neural PDE Learning*
- May 2026 **HOFEIM 2026 - High-Order Finite Element and Isogeometric Methods - Poster Session, Università di Siena, Siena, Italy.** Title: *IGA-Interpolated Neural Networks (IGAINNs) for the Solution of PDE-Governed Problems*
- Jan. 2026 **4th Workshop of UMI Group “Mathematics for Artificial Intelligence and Machine Learning”, Sapienza University of Rome, Roma, Italy.** Title: *On Optimization Challenges in Neural Network Based Approaches to PDEs*
- Nov. 2025 **Seminari di Analisi Numerica del DISMA, Politecnico di Torino, Torino, Italy.** Title: *Optimization Challenges (and Possible Remedies) in Neural Network Solvers for PDEs*
- Sep. 2025 **Second IN-DEEP Week, Politecnico di Torino, Torino, Italy.** Title: *Update on DC2 project status: Mathematically certified deep learning algorithms for inverse problems governed by PDEs*
- Sep. 2025 **The Thirteenth International Conference on IsoGeometric Analysis (IGA 2025), Eindhoven, The Netherlands.** Title: *A theoretical study on the effect of mass lumping on the discrete frequencies in immersogeometric analysis*
- Sep. 2025 **2nd Workshop on Machine Learning in Infinite Dimensions - Poster Session, ETH Zürich, Zürich, Switzerland.** Title: *Accelerating Natural Gradient Descent with Randomized Nyström Preconditioning.*
- Sep. 2025 **SIMAI 2025, SISSA, Trieste, Italy.** Title: *Accelerating Natural Gradient Descent for PINNs with Randomized Numerical Linear Algebra*
- Jun. 2025 **DD29 - 29th International Conference on Domain Decomposition Methods, Politecnico di Milano, Milano, Italy.** Title: *Preconditioning PINNs: A Randomized Approach to Natural Gradient Descent*
- May 2025 **Spring Workshop “CompMat” - Poster Session, Università di Pavia, Pavia, Italy.** Title: *Accelerating Natural Gradient Descent for PINNs with Randomized Preconditioning*
- Mar. 2025 **Annual Meeting of EMS activity group on Scientific Machine Learning - Poster Session, Milan, Italy.** Title: *Accelerating PINNs Training with Efficient Randomized Preconditioners*

- Jan. 2025 **Advanced Numerical Methods for Machine & Deep Learning - Poster Session, Ferrara, Italy.** Title: *Preconditioned Low-Rank Riemannian Optimization for Symmetric Positive Definite Linear Matrix Equations*
- Jan. 2025 **Due Giorni di Algebra Lineare Numerica e Applicazioni @ UNIPI, Pisa, Italy.** Title: *Preconditioned Low-Rank Riemannian Optimization for Symmetric Positive Definite Linear Matrix Equations*
- Dec. 2024 **PAV-IA Seminars, Pavia, Italy.** Title: *Bridging the gap between FEM and PINNs*
- May 2024 **Lions-Magenes days 2024 - Poster Session, Pavia, Italy.** Title: *Preconditioned Low-Rank Riemannian Optimization for Multiterm Linear Matrix Equations*
- May 2024 **SIAM Conference on Applied Linear Algebra (LA24) - Poster Session, Paris, France.** Title: *Preconditioned Low-Rank Riemannian Optimization for Multiterm Linear Matrix Equations*
- Apr. 2024 **Caffè Beltrami, Università di Pavia, Pavia, Italy.** Title: *Introduzione all'ottimizzazione Riemanniana*
- Apr. 2024 **PYSANUM: Pisan Young Seminars in Applied and NUMerical Mathematics, Università di Pisa, Pisa, Italy.** Title: *Un'introduzione all'ottimizzazione Riemanniana con applicazioni ad equazioni matriciali*
- Apr. 2024 **NumPI Seminars - Numerical Analysis Group, Università di Pisa, Pisa, Italy.** Title: *Preconditioned Low-Rank Riemannian Optimization for Multiterm Linear Matrix Equations*
- Feb. 2024 **PINN-PAD: Physics Informed Neural Networks in PADova, Università di Padova, Padova, Italy.** Title: *Multi-Fidelity Neural Network Surrogate Modeling for Large-Scale Bayesian Inverse Problems with Applications to Inverse Acoustic Scattering by Random Domains*
- Jul. 2023 **Internal Seminar, Università di Pavia, Department of Mathematics, Pavia, Italy.** Title: *Multi-Fidelity Surrogate Modeling for Large-Scale Bayesian Inverse Problems using Artificial Neural Networks*

Co-author of research works presented at:

- Feb. 2024 **SIAM Conference on Uncertainty Quantification (UQ24), Trieste, Italy. Presenter: F. Henríquez.** Title: *Parametric Shape Holomorphy of Boundary Integral Operators: Application to Operator Learning and Multi-fidelity Bayesian Inversion*
- Jan. 2024 **WONAPDE 2024: Seventh Chilean Workshop on Numerical Analysis of Partial Differential Equations, Universidad de Concepción, Concepción, Chile. Presenter: F. Henríquez.** Title: *Parametric Shape Holomorphy of Boundary Integral Operators: Applications to Operator Learning and Multifidelity Bayesian Inversion*

ORGANIZATION OF CONFERENCES AND SEMINARS

- 14-18 Sep. 2026 **Minisymposium: “Preconditioning in and for Scientific Machine Learning”, The Sixth Edition of the Young Applied Mathematicians Conference (YAMC 2026), Minisymposium Co-Organizer, Turin, Italy**
- 03-05 Jun. 2026 **Minisymposium: “MS02 - Advances in Neural Network Approximation and Surrogate Modeling for Scientific Machine Learning”, GIMC SIMAI Young 2026, Minisymposium Co-Organizer, Pisa, Italy**
- 03-05 Jun. 2026 **Minisymposium: “MS04 - High-Order Numerical Methods for Complex Mechanics and Higher-Order PDEs”, GIMC SIMAI Young 2026, Minisymposium Co-Organizer, Pisa, Italy**

- 22-26 Sep. 2025 **Minisymposium: “Recent Advances in Scientific Machine Learning: From Theory to Applications”**, *The Fifth Edition of the Young Applied Mathematicians Conference (YAMC 2025)*, *Minisymposium Co-Organizer*, Padua, Italy
- 7 May 2025 **Lombardy Young Numerical Analysts (LYNUM VI)**, *Conference Co-Organizer*, Pavia, Italy
- 10-14 Mar. 2025 **Advanced Scientific Programming in Python**, *Seminar Co-Organizer*, Pavia, Italy
- 10-11 Feb. 2025 **Joint GNCS-SIAM Chapters Meeting for Young Researchers in Numerical Analysis and Applied Mathematics**, *Conference Co-Organizer*, Pavia, Italy
- 2024 - ongoing **PAV-IA: Beyond informal AI talks**, *Seminars Cycle Co-Organizer*, Pavia, Italy

TEACHING

- Feb. 2026 - **Teacher Assistant for the course “Finite Elements”**, *University of Pavia*, Pavia, Italy
 Jun. 2026 **Role:** Prepare text and code for exercise sessions; deliver hands-on exercise sessions in Julia.
- Feb. 2025 - **Teacher Assistant for the course “Finite Elements”**, *University of Pavia*, Pavia, Italy
 Jun. 2025 **Role:** Prepare text and code for exercise sessions; deliver hands-on exercise sessions in Julia.
- Nov. 2024 - **Lecturer for the course “Introduction to Julia Programming for Data Science and Scientific Computing”**, *University of Pavia*, Pavia, Italy
 Jan. 2025 **Role:** Organise course structure and lesson plans; deliver lectures and lead hands-on exercise sessions.
- Feb. 2023 - **Student Assistant for the class “Numerical approximation of partial differential equations”**, *École Polytechnique Fédérale de Lausanne (EPFL)*, Lausanne, Switzerland
 Jul. 2023 **Role:** Support and organization for the exercise sessions; Supervision of course projects.
- Jul. 2022 - **Student Assistant for the class “Artificial Neural Networks and Reinforcement Learning”**, *École Polytechnique Fédérale de Lausanne (EPFL)*, Lausanne, Switzerland
 Jul. 2023 **Role:** Developing a series of new computational exercises for the 2023 edition of the class “Artificial Neural Networks and Reinforcement Learning”. Support and organization for the exercise sessions.
- Sep. 2022 - **Student Assistant for the class “Machine Learning”**, *École Polytechnique Fédérale de Lausanne (EPFL)*, Lausanne, Switzerland
 Feb. 2023 **Role:** Code and infrastructure improvements; Projects grading.

AFFILIATIONS

- 2026- **Member** of the *Y-SIMAI (Young SIMAI) Committee*
- 2026- **Member** of the *Società Italiana di Matematica Applicata e Industriale (SIMAI)*
- 2025- **Member** of the *INDAM GNCS - Gruppo Nazionale per il Calcolo Scientifico*
- 2024-2025 **President** of the *Università Di Pavia SIAM Student Chapter*
- 2024- **Founder and Member** of the *Università Di Pavia SIAM Student Chapter*
- 2024- **Member** of the *Unione Matematica Italiana (UMI)*
- 2022-2024 **Member** of the *SIAM Student Chapter at EPFL*
- 2022- **Member** of the *Society for Industrial and Applied Mathematics (SIAM)*

RELEVANT ACADEMIC PROJECTS

- Feb. - Jun. 2023 **Multi-Fidelity Surrogate Modeling for Large-Scale Bayesian Inverse Problems using Artificial Neural Networks**
 Semester Project under the supervision of Professor J.S. Hesthaven and Dr. F. Henríquez
 ○ **Topics:** Bayesian Inverse Problems, Markov Chain Monte Carlo, Scientific Machine Learning, Data-driven
 ○ **Code:** Python, Pytorch, L^AT_EX

- Feb. - Jun. 2022 **Rigorous data-driven computation of spectral properties of Koopman operators for dynamical systems** 
 Semester Project under the supervision of Professor D. Kressner and Dr. A. Cortinovis
 ○ **Topics:** Computational Linear Algebra, Dynamical Systems, Koopman Operator, Data-driven techniques
 ○ **Code:** MATLAB, $\LaTeX$
- Apr. - Jun. 2022 **Training an agent to play Tic-Tac-Toe** 
 Artificial Neural Networks, course project
 ○ **Topics:** Reinforcement Learning, Q-Learning, Deep Q-Learning (DQN)
 ○ **Code:** Python, Keras, $\LaTeX$
- Nov. - Dec. 2021 **U-Net for segmenting fascicles in vagus nerve histologies** 
 Machine Learning, course project
 ○ **Topics:** Computer Vision, Biomedical Image Segmentation, Convolutional Neural Networks, U-Net
 ○ **Code:** Python, Keras, scikit-image, $\LaTeX$
- Dec. 2021 **Numerical methods for eigenvalues computation** 
 Scientific Computing, course project
 ○ **Topics:** Programming Concepts in Scientific Computing, Numerical Linear Algebra
 ○ **Code:** C++, Eigen Library
- Oct. 2021 **Higgs Boson Challenge** 
 Machine Learning, course project
 ○ **Topics:** Machine Learning, Binary Classification
 ○ **Code:** Python, Numpy, $\LaTeX$

PROGRAMMING AND COMPUTER SKILLS

Programming Languages

- Python (*Advanced*) *Experience with Deep Learning libraries: Jax, PyTorch, TensorFlow*
- MATLAB (*Advanced*)
- Julia (*Advanced*) *Experience with Deep Learning and Linear Algebra libraries: Lux.jl, CUDA.jl, Krylov.jl*
- C, C++ (*Intermediate*)

Version Control: Git, GitHub, GitLab

Scientific Writing and Presentations

- $\LaTeX$, Beamer
- Microsoft Word, Microsoft Powerpoint

LANGUAGES

Italian	Native	
English	Proficient (C2 CEFR)	<i>Cambridge English: Advanced (CAE) passed at Grade A in Jun. 2021</i>
Spanish	Intermediate	