Umberto Biccari

Curriculum Vitae (updated July 2025)

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Google Scholar Research Gate
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International Ph.D. Summa Cum Laude in mathematics from the University of Basque Country, in the field of control theory for dynamical systems. Researcher at DeustoTech, University of Deusto, affiliated to the Chair of Computational Mathematics. Certified research and project management experience in applied and computational mathematics and technology, covering areas such as machine learning, artificial intelligence, control theory, optimal control, optimization, and Partial Differential Equations. Teaching experience as a lecturer at the University of Deusto and through several specialized PhD-level courses in control theory and related topics. Experienced in computational software for optimization and scientific computing, as well as programming languages typically employed in applied mathematics and artificial intelligence. Good communication and management skills developed through a working experience in different projects and with different responsibilities, in multidisciplinary teams with members of several nationalities. Italian mother-tongue, proficient in English and Spanish, with a good understanding of French.

Personal information

Date of birth: September 29th, 1988 **Birthplace:** Florence, Italy **Nationality:** Italian

Work experience

Actual position

Researcher, University of Deusto, Bilbao, Spain — *Dec. 2024–present*

Previous positions

AI Researcher, Sherpa.ai, Bilbao, Spain — *Oct. 2022–Nov. 2024*
Associated researcher, Fundación Deusto, Bilbao, Spain — *Mar. 2017–Sep. 2022*
Lecturer, Engineering faculty, University of Deusto, Bilbao, Spain — *Sep. 2023–Feb. 2025*
Lecturer, Engineering faculty, University of Deusto, Bilbao, Spain — *Sep. 2019–Feb. 2022*
Postdoctoral researcher, Basque Center for Applied Mathematics, Bilbao, Spain — *Jan. 2017–Feb. 2017*

Education

International PhD Summa Cum Laude in Mathematics

University of the Basque Country, Bilbao, Spain & Basque Center for Applied Mathematics — *Sep. 2013–Dec. 2016*

Internship

Basque Center for Applied Mathematics, Bilbao, Spain — *Mar. 2013–Aug. 2013*

Master degree in Mathematics

University of Florence, Italy — *Oct. 2010–Jul. 2012*

Bachelor degree in Mathematics

University of Florence, Italy — *Oct. 2007–Jul. 2010*

PhD thesis

Title. On the controllability of Partial Differential Equations involving non-local terms and singular potentials
Institution. University of the Basque Country & Basque Center for Applied Mathematics, Bilbao, Spain
Advisor. Prof. Enrique Zuazua
Summary. In this thesis, we investigate the controllability properties of Partial Differential Equations (PDEs) that model various phenomena across multiple fields of applied sciences, including elasticity theory, ecology, anomalous transport and diffusion, material science, filtration in porous media, and quantum mechanics. The first part of the thesis focuses on the analysis of nonlocal PDEs involving the fractional Laplace operator. In the second part, we shift our attention to PDEs with singular potentials of Hardy type.
Link. Download PDF

Master thesis

Title. A free boundary problem for the $CaCO_3$ neutralization of acid waters
Institution. University of Florence, Italy
Advisor. Prof. Riccardo Ricci and Prof. Angiolo Farina
Summary. In this thesis, we analyze a parabolic free boundary model arising from the neutralization of acidic waters through filtration via calcium carbonate. After formulating the model based on physical principles, we compute an approximate yet reliable solution, examining its properties and asymptotic behavior. This analysis is further extended to cylindrical and spherical geometries, both of which are relevant for describing the underlying physical phenomena.

Bachelor thesis

Title. About the existence of periodic solutions for the generalized Liénard Equation
Institution. University of Florence, Italy
Advisor. Prof. Gabriele Villari
Summary. This thesis focuses on the qualitative analysis of a generalized Liénard-type equation, a well-known model for oscillating circuits. In particular, we establish results that ensure the existence of periodic solutions.

Personal skills

Languages

Italian: mother tongue
English: level C1, certificate of *Cambridge Assessment English* (2018)
Spanish: level C1, certificate of *Escuela oficial de idiomas de Bilbao* (2016)
French: level B2, certificate of *Institut Français de Florence* (2006)

	Written comprehension	Writing	Listening	Speaking
Italian	Mother tongue	Mother tongue	Mother tongue	Mother tongue
English	Professional	Professional	Professional	Professional
Spanish	Professional	Professional	Professional	Professional
French	Professional	Medium level	Medium level	Medium level

Computer skills

Operating systems: Ubuntu, Windows
Computational software: `IpOpt`, `CasADi`, `FreeFEM`
Programming languages: Matlab, Python, Bash (basic), HTML
Text editing: LaTeX, Microsoft Office

Certificates

Ikertramos call 2019: positive evaluation of Unibasq for the research activity in the 6 years period 2013-2018.
Profesor de universidad privada: positive evaluation of Aneca for the role of professor of private university.
Contratado doctor: positive evaluation of Aneca for the role of tenured professor.
Ayudante doctor: positive evaluation of Aneca for the role of assistant professor.

Publications

Papers published

1. U. Biccari and E. Zuazua, *Gaussian Beam ansatz for finite difference wave equations*, Found. Comput. Math., Vol. 25 (2025), pp. 1-54 (link)

2. H. Antil, U. Biccari, R. Ponce, M. Warma and S. Zamorano, *Controllability properties from the exterior under positivity constraints for a 1-D fractional heat equation*, Evol. Equ. Control Theo., Vol. 13.3 (2024), pp. 893-924 (link)

3. U. Biccari, Y. Song, X. Yuan and E. Zuazua, *A two-stage numerical approach for the sparse initial source identification of a diffusion-advection equation*, Inv. Problems, Vol. 39.9 (2023), p. 095003 (link)

4. U. Biccari and E. Zuazua, *Multilevel control by duality*, Syst. Control Letters, Vol. 175 (2023), p. 105502 (link)

5. A. Rahmoune and U. Biccari, *Multiplicity of solutions for fractional $q(.)$-Laplacian equations*, J. Elliptic Parabol. Equ., Vol. 9.2 (2023), pp. 1101-1129 (link)

6. U. Biccari and E. Zuazua, *Multilevel Selective Harmonic Modulation by duality*, IFAC-PapersOnLine, Vol. 55.16 (2022), pp. 56-61 (link)

7. U. Biccari, C. Esteve-Yagüe and D. J. Oroya-Villalta, *Multilevel Selective Harmonic Modulation via Optimal Control*, Appl. Math. Optim., Vol. 86.3 (2022), p. 43 (link)

8. U. Biccari, V. Hernández-Santamaría and J. Vancostenoble, *Existence and cost of boundary controls for a degenerate/singular parabolic equation*, Math. Control Relat. F., Vol. 12.2 (2022), pp. 495-530 (link)

9. U. Biccari, *Internal control for a non-local Schrödinger equation involving the fractional Laplace operator*, Evol. Eq. Control. Theo., Vol. 11.1 (2022), pp. 301-324 (link)

10. U. Biccari, A. Marica and E. Zuazua, *Propagation of one and two-dimensional discrete waves under finite difference approximation*, Found. Comput. Math., Vol. 20 (2020), pp. 1401-1438 (link)

11. U. Biccari and E. Zuazua, *A stochastic approach to the synchronization of coupled oscillators*, Front. Energy Res., Vol. 8 (2020), p. 115 (link)

12. U. Biccari, M. Warma and E. Zuazua, *Controllability of the one-dimensional fractional heat equation under positivity constraints*, Commun. Pure Appl. Anal., Vol. 19.4 (2020), pp. 1949-1978 (link)

13. U. Biccari and M. Warma, *Null-controllability properties of a fractional wave equation with a memory term*, Evol. Eq. Control The., Vol. 9.2 (2020), pp. 399-430 (link)

14. U. Biccari and V. Hernández-Santamaría, *Controllability of a one-dimensional fractional heat equation: theoretical and numerical aspects*, IMA J. Math. Control Inf., Vol. 36.4 (2019), pp. 1199-1235 (link)

15. U. Biccari and V. Hernández-Santamaría, *Null Controllability of linear and semilinear nonlocal heat equations with an additive integral kernel*, SIAM J. Control Optim., Vol. 57.4 (2019), pp. 2924-2938 (link)

16. U. Biccari and S. Micu, *Null-controllability properties of the wave equation with a second order memory term*, J. Differential Equations, Vol. 267.2 (2019), pp. 1376-1422 (link)

17. U. Biccari, D. Ko and E. Zuazua, *Dynamics and control for multi-agent networked systems: a finite difference approach*, Math. Models Methods Appl. Sci., Vol. 29.4 (2019), pp. 755-790 (link)

18. U. Biccari, *Boundary controllability for a one-dimensional heat equation with a singular inverse-square potential*, Math. Control Relat. F., Vol. 9.1 (2019), pp. 191-219 (link)

19. U. Biccari and V. Hernández-Santamaría, *The Poisson equation from non-local to local*, Electron. J. Differential Equations, Vol. 2018.145 (2018), pp. 1-13 (link)

20. U. Biccari, M. Warma and E. Zuazua, *Local elliptic regularity for the Dirichlet fractional Laplacian*, Adv. Nonlinear Stud., Vol. 17.2 (2017), pp. 387-409 (link)

21. U. Biccari, M. Warma and E. Zuazua, *Addendum: Local elliptic regularity for the Dirichlet fractional Laplacian*, Adv. Nonlinear Stud., Vol. 17.4 (2017), pp. 837-839 (link)

22. U. Biccari and E. Zuazua, *Null controllability for a heat equation with a singular inverse-square potential involving the distance to the boundary function*, J. Differential Equations, Vol. 261.5 (2016), pp. 2809 - 2853 (link)

Book chapters

1. U. Biccari, M. Warma and E. Zuazua, *Control and numerical approximation of fractional diffusion equations.* Handbook of Numerical Analysis, Vol. 23 (2022), pp. 1-58 (link)

2. U. Biccari, M. Warma and E. Zuazua, *Local regularity for fractional heat equations.* In *Recent Advances in PDEs: Analysis, Numerics and Control.* SEMA SIMAI Springer Series, Volume 17 (2018), Springer International Publishing (link)

Papers submitted

1. U. Biccari, *Spiking Neural Networks: a theoretical framework for Universal Approximation and training* (link)

2. K. Lyu, U. Biccari and J. Wang, *Robust stabilization of hyperbolic PDE-ODE systems via Neural Operator-approximated gain kernels* (link)

3. R. Morales and U. Biccari, *A Multi-Objective Optimization framework for Decentralized Learning with coordination constraints* (link)

4. U. Biccari, M. Warma and E. Zuazua, *Boundary observation and control for fractional heat and wave equations* (link)

5. A. Ramoune and U. Biccari, *Blow-up results for a logarithmic pseudo-parabolic $p(.)$-Laplacian type equation* (link)

Citation scores

Scopus: h-index 12, 314 citations
Google Scholar: h-index 16, 611 citations
Research Gate: h-index 15, RG Score 686.8, 634 citations

Teaching

Academic courses

Calculus
Bachelor degree in Computer Engineering, University of Deusto, Bilbao, Spain (6 ECTS) *Sep. 2024–Feb. 2025*

Algebra
Bachelor degree in Industrial Engineering, University of Deusto, Bilbao, Spain (6 ECTS) *Sep. 2023–Feb. 2024*

Algebra
Bachelor degree in Computer Engineering, University of Deusto, Bilbao, Spain (6 ECTS) *Sep. 2021–Feb. 2022*

Mathematics
Bachelor degree in Business Administration, University of Deusto, Bilbao, Spain (6 ECTS) *Sep. 2020–Feb. 2021*

Mathematics
Bachelor degree in Business Administration, University of Deusto, Bilbao, Spain (6 ECTS) *Sep. 2019–Feb. 2020*

Non-academic courses

Title. Numerical methods for fractional equation control and optimization
Date. Aug. 1 - 12, 2022
Institution. University of Shangai, China
Summary. Intensive course of 24 hours held addressed to master and Ph.D. students in applied mathematics. The course covered several topics related with the modeling, analysis, numerical simulation and control of fractional differential equations.

Title. Control problems for non-local PDE
Date. Jun. 24 - 28, 2019
Institution. University of Naples, Italy

Summary. Intensive course of 10 hours held within the semester on *Shape optimization, control and inverse problems for partial differential equations*, organized by the University of Naples, Italy, with the collaboration of INDAM. The course was addressed to Ph.D. students in applied mathematics.

Title. Mathematical methods for control theory
Date. Sep. 2018 - Apr. 2019 & Sep. 2017 - Apr. 2018
Institution. Fundación Deusto, Bilbao, Spain
Summary. The scope of the course was to provide the mathematical and computational fundamentals for control theory. The course was addressed to master and Ph.D. students in applied mathematics and engineering, with a total duration of 57 hours per academic year.

Participation in research projects

ERC Advanced Grant 101096251 CoDeFeL
Control for Deep and Federated Learning
Funding agency: *European Research Council* *Researcher*
Funding: *1.313.658,30€*
Duration: *2024-2028*

PID2023-146872OB-I00 DyCMaMod
Dynamics and Control for Machine learning and Modeling
Funding agency: *Spanish Government* *Researcher*
Funding: *161.250€*
Duration: *2024-2027*

TED2021-131390B-I00 DasEl
Data science for Electrical networks
Funding agency: *Spanish Government* *PI*
Funding: *194.200€*
Duration: *2022-2025*

PID2020-112617GB-C22 KiLearn
Kinetic equations and Learning control
Funding agency: *Spanish Government* *Researcher*
Funding: *30.600€*
Duration: *2021-2025*

ElkarTek 2020 CONVADP
New technologies to improve power density in electronic converters
Funding agency: *Basque Government, Spain* *Local PI*
Funding: *87.184,80€*
Duration: *2020-2021*

FA9550-15-1-0027
Nonlocal PDEs: analysis, control and beyond
Funding agency: *Air Force Office of Scientific Research (U.S.)* *Researcher*
Funding: *456.494$*
Duration: *2018-2021*

MTM2017-82996-C2-1-R CoSNet
Control and Stability of hybrid ac/dc Networks
Funding agency: *Spanish Government* *Researcher*
Funding: *34.500€*
Duration: *2018-2020*

ElkarTek 2018 Road2DC
New tools to design and control hybrid ac/dc networks
Funding agency: *Basque Government, Spain* *Researcher*
Funding: *109.272,75€*
Duration: *2018-2019*

ERC Advanced Grant 694126 DyCon

Dynamic Control
Funding agency: *European Research Council* *Researcher*
Funding: *2.065.125€*
Duration: *2016-2021*

MTM2014-52347-C2-1-R
Methods for platforms of numerical simulations and control of environmental fluxes
Funding agency: *Spanish Government* *Researcher*
Funding: *71.269€*
Duration: *2015-2018*

FA9550-15-1-0027
Dynamics, Control and Numerics for Fractional Partial Differential Equations
Funding agency: *Air Force Office of Scientific Research (U.S.)* *Researcher*
Funding: *450.438$*
Duration: *2014-2017*

MTM2011-24766
Partial Differential Equations: analysis, control, numerics and applications
Funding agency: *Spanish Government* *PhD student*
Funding: *308.308€*
Duration: *2012-2014*

ERC Advanced Grant 246775 NumeriWaves
New analytical and numerical methods in wave propagation
Funding agency: *European Research Council* *PhD student*
Funding: *1.663.000€*
Duration: *2010-2015*

Visiting research appointments

Friedrich-Alexander Universität Erlangen Nürenberg, Germany
Invited by Prof. Enrique Zuazua *Jun. 2022*

University of Naples, Italy
Invited by Prof. Giuseppe Floridia *Jun. 2019*

Friedrich-Alexander Universität Erlangen Nürenberg, Germany
Invited by Prof. Günter Leugering *Mar. 2019*

University of Puerto Rico-Rio Piedras, U.S.
Invited by Prof. Mahamadi Warma *Nov.-Dec. 2018*

University of Craiova, Romania
Invited by Prof. Sorin Micu *Jul. 2018*

Universidad Autónoma de Madrid, Spain
Invited by Prof. Ireneo Peral *Mar. 2017*

University of Puerto Rico-Rio Piedras, U.S.
Invited by Prof. Mahamadi Warma *Feb.-Mar. 2016*

University of Paul Sabatier, Toulouse, France
Invited by Prof. Sylvain Ervedoza *May 2014*

University of Paul Sabatier, Toulouse, France
Invited by Prof. Sylvain Ervedoza *Mar. 2014*

Talks

Control and Machine Learning
Workshop "Control, inverse problems and Machine Learning — *Dec. 3, 2024*
Almagro, Ciudad Real, Spain

Multilevel control
Conference "Partial differential equations, optimal design and numerics" — *Aug. 29, 2022*
Benasque, Spain

Multilevel Selective Harmonic Modulation by duality
IFAC workshop "Control applications of optimization" — *Jul. 22, 2022*
Gif-sur-Yvette, France

Multilevel control
Biennial conference of the "Spanish society of applied mathematics" — *Jul. 20, 2022*
Zaragoza, Spain

Multilevel control
Workshop "Analysis, control & inverse problems for diffusive systems with applications to natural and social sciences" — *Jul. 18, 2022*
Bari, Italy

Multilevel control
Conference "Inverse problems modeling and simulation" — *May 24, 2022*
Malta

Multilevel Selective Harmonic Modulation via Optimal Control
INdAM conference "Analysis and numerics of design, control and inverse problems" — *Jul. 2, 2021*
Rome, Italy

Stochastic optimization methods for the simultaneous control of parameter-dependent systems
Friedrich-Alexander Universität Erlangen-Nürenberg, Germany — *Jun. 12, 2020*

Controllability of fractional heat equations under positivity constraints
Conference of young researchers of the "Spanish royal mathematical society" — *Jan. 28, 2020*
Castellón, Spain

Controllability of a 1d fractional heat equation under positivity constraints
Conference "Partial differential equations, optimal design and numerics" — *Aug. 21, 2019*
Benasque, Spain

Dynamics and control for multi-agent networked systems: a finite difference approach
Universidad de Cantabria, Santander, Spain — *Apr. 3, 2019*

Dynamics and control for multi-agent networked systems: a finite difference approach
Friedrich-Alexander Universität Erlangen-Nürenberg, Germany — *Mar. 14, 2019*

Controllability of a one-dimensional fractional heat equation: theoretical and numerical aspects
Conference "Dynamics, control and numerics for fractional PDE" — *Dec. 5, 2018*
San Juan, Puerto Rico, U.S.

Propagation of one and two-dimensional discrete waves under finite difference approximation
French-Romanian conference in applied mathematics — *Aug. 30, 2018*
Bordeaux, France

Propagation of one and two-dimensional discrete waves under finite difference approximation
University of Craiova, Romania — *Jul. 6, 2018*

Controllability of Partial Differential Equations with integral kernels
Conference "Microlocal and numerical analysis, knietic equations and control" — *Mar. 1, 2018*
Madrid, Spain

A Finite Element approximation of the one-dimensional fractional Poisson equation with applications to numerical control
Conference "Partial differential equations, optimal design and numerics" *Aug. 29, 2017*
Benasque, Spain

Control of partial differential equations involving the fractional Laplacian
Conference "Partial differential equations, optimal design and numerics" *Aug. 25, 2017*
Benasque, Spain

Null controllability for a heat equation with a singular inverse-square potential involving the distance to the boundary function
Universidad Autónoma de Madrid *Mar. 8, 2017*
Benasque, Spain

Boundary controllability for a one-dimensional heat equation with two singular inverse-square potentials
Conference "Recent developments on approximation methods for controlled evolution equations" *Nov. 3, 2015*
Mathematisches Forschunginstitut of Oberwolfach, Germany

Boundary controllability for a one-dimensional heat equation with two singular inverse-square potentials
Conference "Partial differential equations, optimal design and numerics" *Sep. 1, 2015*
Benasque, Spain

Internal control for non-local Schrödinger and wave equations involving the fractional Laplace operator
Conference "Fractional calculus, probability and non-local operators: applications and recent developments" *Nov. 14, 2014*
Bilbao, Spain

Internal control of evolution problems involving the fractional Laplace operator
CIMI - Centre International de Mathématiques et d'Informatique *May. 20, 2014*
Bilbao, Spain

Internal control a fractional Schrödinger equation via the Hilbert Uniqueness Method
Conference "Fractional calculus, probability and non-local operators: applications and recent developments" *Nov. 8, 2013*
Bilbao, Spain

Additional academic activities and merits

Editorial responsibilities

Associate editor
Advances in Continuous and Discrete Models

Reviewer fro JCR indexed journals
- IEEE Transactions on automatic control
- Systems and Control Letters
- Journal de Mathématiques Pures et Appliquées
- SIAM Journal on Control and Optimization
- Applied Mathematics and Optimization
- ESAIM: Control, Optimization and Calculus of Variations
- ...

Organization of conferences

Control, inverse problems and beyond
Thematic session within the conference "Partial differential equations, optimal design and numerics" *Aug. 25, 2022*
Benasque, Spain

Nonlocal PDE and control
Thematic session within the conference "Partial differential equations, optimal design and numerics" *Aug. 21, 2019*
Benasque, Spain

Control of PDE
Symposium within the "International conference on elliptic and parabolic problems" *May. 20-24, 2019*
Gaeta, Italy

Dissemination activity

Models involving memory terms and hybrid PDE/ODE systems

Dissemination video on the control of differential equations with memory effects
link