

Antonio Álvarez-López

Curriculum Vitae

✉ (+34) 622692163
✉ antonio.alvarezl@uam.es
↗ Web page
Google Scholar
GitHub
ORCID: 0009-0004-1302-6389



Education

- Oct 2022–Present **PhD in Mathematics**, Universidad Autónoma de Madrid (UAM), Spain.
(Expected June 2026)
Controllability of Neural ODEs and Flow-Based Generative Models.
Advisor: Enrique Zuazua Iriondo. Co-advisor: Rafael Orive Illera.
- 2021–2022 **Master's degree in Advanced Mathematics**, Universidad Complutense de Madrid, Spain.
Thesis: Parker's Problem in Magnetohydrodynamics and transition maps for force-free fields.
Advisor: Alberto Enciso. GPA: 8.65/10.
- 2016–2021 **Bachelor's double degree in Mathematics and Physics**, Universidade de Santiago de Compostela (USC), Spain, Academic year 2019–2020 in Universidad de Granada.
GPA: 9.3/10. Highest Honors in 19 out of 59 courses.

Research stays

- Aug–Nov 2025 **National University of Singapore**, (Singapore). Host: Qianxiao Li.
- May–July 2025 **Sorbonne Université, Laboratoire Jacques-Louis Lions**, (Paris, France). Host: Borjan Geshkovski.
- 2022–2026 **Friedrich-Alexander-Universität**, (Erlangen, Germany, 2 months per year). Host: Enrique Zuazua.
- Jan 2024 **Sichuan University, School of Mathematics**, (Chengdu, China). Host: Qi Lü.
- Aug–Sept 2023 **Massachusetts Institute of Technology, Department of Mathematics**, (Cambridge, USA). Host: Philippe Rigollet and Borjan Geshkovski.
- Feb–March 2023 **Imperial College London, Department of Mathematics**, (London, UK). Host: Domènec Ruiz-Balet.

Scholarships

- 2025–2026 **FPU Mobility Supplement**, Ministerio de Universidades, Ranked #1 in Spain.
- 2022–2026 **FPU Predoctoral Fellowship**, Ministerio de Universidades, Ranked #6 in Spain.
- June–July 2021 **Machine Learning Research Intern**, Advisor: Paulo F. Lamas. Subject: Pattern recognition in cardiovascular diseases using machine learning, CiTIUS, Santiago de Compostela.
- July–Sept 2020 **Severo Ochoa-ICMAT Research Intern**, Advisor: Alberto Enciso. Subject: Mathematical problems in fluid mechanics, ICMAT, Madrid.

Research Interests

- (i) Mathematical foundations of AI: I approach learning problems in flow-based models (neural ODEs, transformers) through the lens of control, to approximate dynamical systems and probability distributions.
- (ii) Translating that understanding into principled tools: I have developed data-driven models and decision-making methods for time-series in digital health, combining neural ODEs with kernel methods.

Scientific production

Published articles

Interplay between depth and width for interpolation in neural ODEs, with Arselane Hadj Slimane and Enrique Zuazua, Neural Networks, Vol. 180, 106640, 2024.

<https://doi.org/10.1016/j.neunet.2024.106640>.

Cluster-based classification with neural ODEs via control, with Rafael Orive-Illera and Enrique Zuazua, Journal of Machine Learning, Vol. 4(2), 128–156, 2025.

<https://doi.org/10.4208/jml.241114>.

Constructive approximate transport maps with normalizing flows, with Borjan Geshkovski and Domènec Ruiz-Balet, Applied Mathematics and Optimization, Vol. 92, 33, 2025.

<https://doi.org/10.1007/s00245-025-10299-7>.

Preprints (submitted)

Perceptrons and localization of attention's mean-field landscape, with *Borjan Geshkovski and Domènec Ruiz-Balet*.
<https://www.arxiv.org/abs/2601.21366>

Continuous Temporal Learning of Probability Distributions via Neural ODEs with Applications in Continuous Glucose Monitoring Data, with *Marcos Matabuena*.
<https://arxiv.org/abs/2505.08698>

Convergence, design and training of continuous-time dropout as a random batch method, with *Martín Hernández*.
<https://arxiv.org/abs/2510.13134>

Invited seminars

- Sept 29, 2025 Entropy-driven control of the continuity equation for normalizing flows. *Machine Learning and Scientific Computing Seminar*. **National University of Singapore**.
- Sept 16, 2025 Entropy-driven control of the continuity equation for normalizing flows. *Nonlinear PDE seminar*. Department of Mathematics. **Texas A&M University**.
- July 9, 2025 New deep learning models and perspectives for continuous-time glucose monitoring. *DeustoCCM Seminar*. **University of Deusto, DeustoTech**.
- 2024–2025 Presentations in lecture seminars: *Learning Rate — Machine Learning Series*, 4 sessions. **FAU-DCN**.
- April 1, 2024 Controllability of neural differential equations. *Seminario Fontán de Matemáticas*. **USC**.
- Feb 22, 2024 Stable Architectures for Deep Neural Networks. *Mathematics for Deep Learning* (reading group). **Univs. of Bath, Cambridge, and University College London**.
- Jan 25, 2024 Efficient classification and interpolation with neural ODEs. *Mathematics Seminar*. School of Mathematics. **Sichuan University**.
- March 1, 2023 On the separability of two finite sets of random points using hyperplanes. *Mini-workshop between Technische Universität München (Applied Numerical Analysis group) and FAU-DCN*.
- Feb 28, 2023 Break the curse of dimensionality with Barron Spaces. *Applied PDEs Seminar*. **Imperial College London**.
- Nov 14, 2022 Break the curse of dimensionality with Barron Spaces. **FAU-DCN**.
- April 4, 2021 Formation of singularities in the incompressible Euler fluid equations. *Seminarios de Iniciación a la Investigación*. Instituto de Matemáticas. **USC**.

Participation in scientific events

- Dec 2025 **Conference**, *International Conference on Statistics and Data Science*, Universidad de Sevilla, Spain.
Contributed talk: Continuous-time learning of probability distributions via neural ODEs with applications in continuous glucose monitoring data (**Student Travel Award**).
- June 2025 **Workshop**, *Mean Field Games, Optimal Transport, and Machine Learning*, NYU - Paris, France.
- April 2025 **Workshop**, *Machine Learning and PDEs*, FAU, Erlangen, Germany.
- Nov 2024 **Seminar**, *Control and Machine Learning*, Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany.
- Oct 2024 **Conference**, *Conference on Control, Inversion and Numerics for PDEs*, Fudan University, Shanghai, China.
Presented poster: Controllability of Neural ODEs for Classification.
- Sept 2024 **Conference**, *Mathematical Aspects of Learning Theory – 20 years later*, Centre de Recerca Matemàtica, Barcelona, Spain.
Presented poster: Simultaneous Control of Neural ODEs for Data Classification.
- Aug 2024 **Conference**, *X Partial differential equations, optimal design and numerics*, Centro de Ciencias de Benasque Pedro Pascual, Huesca, Spain.
Two invited talks (Aug 26–27): Cluster-based classification with neural ODEs via control. Interplay between depth and width for interpolation in neural ODEs.
- July 2024 **Summer School**, *C.I.M.E. Session on “PDEs, Control and Deep Learning”*, Cetraro, Italy.
- July 2024 **Conference**, *Fourth Symposium on Machine Learning and Dynamical Systems*, Fields Institute, Canada.
Presented poster: Simultaneous Control of Neural ODEs for Data Classification.
- June 2024 **Conference**, *21 French-German-Spanish Conference on Optimization*, Universidad de Oviedo, Spain.
Invited talk (June 21): Controllability of neural ODEs for data classification.
- June 2024 **Conference**, *Trends in Mathematical Sciences*, FAU, Erlangen, Germany.
Presented poster: Optimized Classification with Neural ODEs.
- March 2024 **Workshop**, *Dynamics, Data and Deep Learning Workshop*, Engineers' House, Bristol, UK.
Presented poster: Optimized Classification with Neural ODEs (**Best Poster Award**).

- Dec 2023 **Workshop**, *Mathematical Opportunities in Digital Twins*, George Mason University, Fairfax, Virginia.
Presented poster: Optimized Classification with Neural ODEs.
- Nov 2023 **Conference**, *V BYMAT Conference*, ICMAT, Madrid, Spain.
Invited talk (Nov 14): Neural ODEs and data classification.
- July 2023 **Summer School**, *XV International ICMAT Summer School on Geometry, Dynamics and Field Theory*, ICMAT, Madrid, Spain.
- Feb 2023 **Workshop**, *Exploring foundation models*, The Alan Turing Institute, London, United Kingdom.

Teaching (assistant)

- Jan–May 2025 **Calculus II**, *Degree in Data Science and Engineering*, UAM.
- Jan–May 2025 **Probability and Statistical Inference**, *Degree in Computer Science*, UAM.
- Feb–May 2024 **Numerical Calculus**, *Double degree in Mathematics and Computer Science*, UAM.
- Feb–May 2023 **Data Analysis**, *Degree in Biology*, UAM.

Organization

- 2024–2025 **Machine Learning Seminars. Junior colloquia. Lecture group**, ICMAT, UAM, FAU-DCN.

Awards

- 2025 **Student Travel Award**, *2025 IMS International Conference on Statistics and Data Science (ICSDS)*.
For my paper <https://arxiv.org/abs/2505.08698>
- 2024 **Best Poster Award**, *Workshop Dynamics, Data and Deep Learning, Bristol*.
- 2021 **Research Fellowship “JAE Intro SOMdM 2021”**, *ICMAT, Madrid*.
Awarded to 7 students nationwide.
- 2018 **Academic Excellence Award**, Best qualifications of Galician University System.
- 2016 **USC's A Ponte Award**, Top students in the University Entrance Exam.
- 2016 **Mathematics Olympiad Awards**, (Regional) Honorable Mention.
- 2016 **Physics Olympiad Awards**, (Regional) Third Place.
- 2014 **National Award for Academic Achievement**, *Spanish Lower Secondary Education*.
Awarded to 25 students nationwide.

Others

- Languages **Spanish (Native), Galician (Native), English (C2), French (B2), German (Basic)**.
- Programming **Python, Matlab, R, Fortran**