Miguel Vaquero

Assistant Professor (Tenure Track) | IE University

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Work Experience

Jan 2021 – Present	(Tenure Track) Assistant Professor at IE University School of Science and Technology Assistant Professor of Applied Mathematics. Teaching: calculus, numerical methods, data analysis. Research: geometric mechanics, structure-preserving numerics, control and optimization, operations research.
Nov 2017 – Nov 2020	Postdoctoral Researcher, UC San Diego Mechanical and Aerospace Engineering Postdoctoral researcher with Jorge Cortés, working on control and optimization
Nov 2015 – May 2017	Postdoctoral Researcher (ERC Contract) Postdoctoral researcher with Daniel Peralta-Salas on his ERC project *Invariant manifolds in dynamical systems and PDE* at ICMAT (Severo Ochoa Distinction)
Apr 2011 – Sep 2011	Senior Researcher University of La Laguna, Tenerife, Spain. Pre-doctoral research appointment; contractual title: *Investigador Senior*. Research on geometric Hamilton–Jacobi theory through the Fundación Empresa Universidad de La Laguna.

Education

Oct 2011 – Sep 2015	Ph. D. FPI Scholarship at ICMAT — Severo Ochoa Distinction Advisor: Manuel de León Thesis: On the Geometry of the Hamilton-Jacobi Equation Defense: November 27th, 2015 | Qualification: Cum Laude Panel: J.C. Marrero, M.C. Muñoz-Lecanda, J.P. Ortega, T. Ratiu, W. Sarlet
2009 – 2010	Master of Science in Mathematics University of Santiago de Compostela, Spain Thesis: "Euler–Poincaré and Lie–Poisson reduction" Advisor: Prof. M. Salgado Only thesis with highest score (10.0 "Matrícula de Honor")
2004 – 2009	Bachelor's Degree (5-year) in Mathematics (w. Honors) University of Santiago de Compostela, Spain *"Premio extraordinario de la Universidad de Santiago de Compostela"* High School **"As Lagoas"**, Ourense — "Matrícula de Honor" (Honors)

Academic Accreditations

2026 Positive ANECA evaluation for *Profesor/a Contratado/a Doctor/a* (PCD)

2026 Positive ANECA evaluation for *Profesor/a de Universidad Privada* (PUP)

Honors, Awards, and Appointments

Since 2025 Editor, *Geometric Mechanics* — Scientific journal on geometric mechanics

Since 2021 20+ IE Teaching Excellence Awards (2021–present);
Most Engaged Professor Award (2023–24);
nominated again in 2024–25

2011 – 2015 FPI Scholarship — Competitive national grant for Ph.D.

2009 – 2010 Beca de la Xunta de Galicia — Competitive regional grant for Master's degree

2009 Premio Extraordinario de Fin de Carrera — Top academic achievement, USC

2008 – 2009 Beca de colaboración — Research grant, "Syzygies of Algebraic Curves"

2004 High School Honors — "Matrícula de Honor", HS "As Lagoas", Ourense

Journal Publications[1]

13 published articles in peer-reviewed journals.

1. G. Bianchin, M. Vaquero, J. Cortés, E. Dall'Anese: The Role of Network Connectivity in Distributed k-Agreement Protocols. *Automatica* **185**, 112753 (2026).
2. D. Peralta-Salas, M. Vaquero: Beltrami Fields with Morse Proportionality Factor. *J. Math. Anal. Appl.* **540** (2), 128632 (2024).
3. G. Bianchin, M. Vaquero, J. Cortés, E. Dall'Anese: k-Dimensional Agreement in Multiagent Systems. *IEEE Trans. Automat. Contr.* **69** (12), 8978–8985 (2024).
4. M. Vaquero, J. Cortés, D. Martín de Diego: Symmetry Preservation in Hamiltonian Systems: Simulation and Learning. *J. Nonlinear Sci.* **34** (6), 115 (2024).
5. G. Bianchin, M. Vaquero, J. Cortés, E. Dall'Anese: Online Stochastic Optimization for Unknown Linear Systems: Data-Driven Controller Synthesis and Analysis. *IEEE Trans. Automat. Contr.* **69** (7), 4411–4426 (2024).
6. M. Vaquero, P. Mestres, J. Cortés: Resource-Aware Discretization of Accelerated Optimization Flows: the Heavy-Ball Dynamics Case. *IEEE Trans. Automat. Contr.* **68** (4), 2109–2124 (2023).
7. M. de León, D. Martín de Diego, M. Vaquero: Hamilton-Jacobi theory, Symmetries and Coisotropic reduction. *J. Math. Pures Appl.* **107**, no. 5, 591–614 (2017).
8. S. Ferraro, M. de León, J.C. Marrero, D. Martín de Diego, M. Vaquero: On the geometry of the Hamilton-Jacobi equation and generating functions. *Arch. Ration. Mech. Anal.* **226**, 243–302 (2017).
9. C.M. Campos, M. de León, D. Martín de Diego, M. Vaquero: A Hamilton-Jacobi theory in Cauchy data spaces. *Rep. Math. Phys.* **76** (2015), no. 3, 359–387.

[1] My papers in mathematical journals use alphabetical order when listing authors, which is a common practice in mathematics (see the AMS statement on citation and impact).

10. M. de León, D. Martín de Diego, M. Vaquero: A Hamilton-Jacobi theory on Poisson manifolds. *J. Geom. Mech.* **6** (2014), no. 1, 121–140.
11. D. Iglesias-Ponte, J.C. Marrero, M. Vaquero: Poly-Poisson structures. *Lett. Math. Phys.* **103** (2013), no. 10, 1103–1133.
12. M. de León, J.C. Marrero, D. Martín de Diego, M. Vaquero: On the Hamilton-Jacobi theory for singular Lagrangian systems. *J. Math. Phys.* **54** (2013), no. 3, 032902, 32 pp.
13. M. de León, D. Martín de Diego, M. Vaquero: A Hamilton-Jacobi theory for singular Lagrangian systems in the Skinner and Rusk setting. *Int. J. Geom. Methods Mod. Phys.* **9** (2012), no. 8, 1250074, 24 pp.

Preprints and Submitted Manuscripts

1. M. Vaquero, J. Cortés: On the Regularization of Primal-Dual Dynamics in Time-Dependent Nonconvex Optimization. arXiv:2610.19916 (2026). To be submitted to *SIAM Journal on Control and Optimization*.
2. J. Hu, D. Martín de Diego, J.-P. Ortega, M. Vaquero: Learning Hamiltonians from Trajectory Data with Kernel Methods. arXiv:2610.17835 (2026). Submitted to *Foundations of Computational Mathematics*.
3. M. Caserta, A. García Romero, M. Vaquero: A Robust Chance Constrained Approach to Surgery Scheduling. arXiv:2608.03931 (2026). To be submitted to *Manufacturing & Service Operations Management*.
4. E. Celledoni, D. Martín de Diego, B. Owren, M. Vaquero: A Unified Discrete Gradient-SAV Framework for Structure-Preserving Integration. arXiv:2607.27795 (2026). To be submitted to *SIAM Journal on Scientific Computing*.
5. A. Cabrera, D. Martín de Diego, M. Vaquero: Approximating Symplectic Realizations: A General Framework for the Construction of Poisson Integrators. arXiv:2409.04342 (2024). Major revision at *Numerische Mathematik*.

Selected Manuscripts in Preparation

1. D. Martín de Diego, M. Vaquero: Barrier-safe Poisson integrators for collision avoidance via symplectic realizations. Manuscript in preparation, 2026.
2. D. Martín de Diego, M. Vaquero: Equivariant Conformal Contact Maps as Legendrian Bisections. Manuscript in preparation, 2026.
3. D.-J. Lee, M. Vaquero: Covariant development P-splines for intrinsic derivative estimation in manifold-valued longitudinal data. Manuscript in preparation, 2026.

Conference Proceedings

1. M. Vaquero, D. Martín de Diego, J. Cortés: Designing Poisson Integrators through Machine Learning. *IFAC-PapersOnLine* **58** (6), 31–35 (2024).
2. G. Bianchin, M. Vaquero, J. Cortés, E. Dall'Anese: Data-Driven Synthesis of Optimization-Based Controllers for Regulation of Unknown Linear Systems. *IEEE Conf. on Decision and Control*, Texas, USA, 2021.
3. M. Vaquero, J. Cortés: Convergence-Rate-Matching Discretization of Accelerated Optimization Flows through Opportunistic State-Triggered Control. *NeurIPS*, Vancouver, Canada, 2019.
4. M. Vaquero, J. Cortés: Distributed Augmentation-Regularization for Robust Online Convex Optimization. *IFAC NecSys*, Groningen, The Netherlands, 2018.

Contributions to Conferences

Talks

1. Minisymposium talk (30 min) at SciCADE 2026 (Edinburgh, July 2026). Title: *Using Symplectic Realizations for the Simulation and Learning of Hamiltonian Dynamical Systems*.
2. Short communication (30 min) at the VIII Iberoamerican meeting on Geometry, Dynamics and Field Theory, University of La Laguna (La Laguna, January 2026). Title: *Learning Hamiltonian Dynamics*.
3. Short communication (30 min) at the 2nd International Conference on Highly Flexible Slender Structures, Fraunhofer ITWM (Kaiserslautern, September 2025). Title: *Learning Dynamics and Symmetry*.
4. Talk (60 min), Workshop on Geometric Control and Mechanics (Thessaloniki, July 2024): *Primal-Dual Dynamics for Data-Driven Optimization*.
5. Short communication (30 min) at the De Leon Fest, ICMAT (Madrid, December 2023). Title: *Symmetry Preservation in Hamiltonian Systems: Simulation and Learning*.
6. Short communication (20 min) at the Southern California Control Workshop, UCLA (Los Angeles, December 2018). Title: *Regularization of Primal-Dual Dynamics for Time-Dependent Online Optimization*.
7. Short communication (30 min) at the V Iberoamerican meeting on Geometry, Mechanics and Control, University of La Laguna (Canary Islands, January 2017). Title: *Hamilton-Jacobi, symmetries and Poisson Manifolds*
8. Short communication (30 min) at the 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, ICMAT (Madrid, July 2014). Title: *On the Reduction of the Hamilton-Jacobi equation*
9. Short communication (15 min) at the VIII International Summer School on Geometry, Mechanics, and Control, Miraflores de la Sierra (Madrid, July 2014). Title: *On the Reduction of the Hamilton-Jacobi equation*
10. Short communication (30 min) at the VIII International Young Researchers Workshop on Geometry, Mechanics and Control, UPC (Barcelona, December 2013). Title: *Hamilton-Jacobi for generalized hamiltonian systems*
11. Short communication (15 min) at the VII International Summer School on Geometry, Mechanics, and Control, Miraflores de la Sierra (Madrid, July 2013). Title: *Stress–Energy–Momentum Tensor*
12. Short communication (30 min) at the VII International Young Researchers Workshop on Geometry, Mechanics and Control, ICMAT (Madrid, December 2012). Title: *Generating functions, Hamilton-Jacobi equation and cotangent groupoids*
13. Short communication (30 min) at the XXI Fall Workshop on Geometry and Physics, Universidad de Burgos (Burgos, September 2012). Title: *On the geometry of the Hamilton-Jacobi equation for generating functions*
14. Short communication (30 min) at the Focus Program on Geometry, Mechanics and Dynamics: The Legacy of Jerry Marsden, Fields Institute (Toronto, July 2012). Title: *Hamilton-Jacobi for Generalized Hamiltonian Systems*.
15. Short communication (30 min) at the 9th AIMS Conference on Dynamical Systems, Differential Equations and Applications (Orlando, July 2012). Title: *Hamilton-Jacobi for Singular Lagrangians*.
16. Invited Speaker at the XII Encuentro de Invierno de la red Geometría, Mecánica y Teoría de Control, Universidad de Zaragoza (Zaragoza, February 2012). Title: *The Hamilton-Jacobi theory*.
17. Short communication (15 min) at the V International Summer School on Geometry, Mechanics, and Control, Miraflores de la Sierra (Madrid, July 2011). Title: *On poly-Poisson manifolds*.

Posters

1. Poster at NeurIPS 2019 (Vancouver, December 2019). *Convergence-rate-matching discretization of accelerated optimization flows through opportunistic state-triggered control.*
2. Poster at Poisson 2014, UIUC (Champaign, August 2014). *On the geometry of the Hamilton-Jacobi equation.*
3. Poster at DeLeónFest, ICMAT (Madrid, December 2013). *Generating functions, Hamilton-Jacobi equation and cotangent groupoids.*
4. Poster at III Iberoamerican Meeting on Geometry Mechanics and Control (Salamanca, September 2013). *Generating functions, Hamilton-Jacobi equation and cotangent groupoids.*
5. Poster at XX Fall Workshop in Geometry and Physics, ICMAT (Madrid, September 2011). *On poly-Poisson manifolds.*
6. Poster at VI International Summer School on Geometry, Mechanics, and Control, ICMAT (June 2012). *A Hamilton-Jacobi theory for singular Lagrangian in the Skinner–Rusk setting.*
7. Poster at Poisson Geometry and Applications, Figueira da Foz (June 2011). *On poly-Dirac manifolds.*

Seminars Presented

1. Geometric Mechanics Group, ICMAT (2014): "Lagrangian intersection, Averaging and beyond" (Parts I–IV).
2. Young Researchers, UAM+ICMAT (2014): "An introduction to Classical Mechanics".
3. Mathematics Department, Universidad de La Laguna (2011): "On Poisson structures and their generalization" (Parts I–II).
4. Young Researchers, USC (2010): Reduction theory, Lie–Poisson and Euler–Poincaré reduction.

Work Abroad

2025 NTU, Singapore, 2 weeks — Visit J.P. Ortega: learning and dynamical systems

2015 UIUC, USA, 2 months — Visit R. Loja-Fernandes: Hamiltonian dynamics

2014 UCSD, San Diego, 30 days — Geometric integrators

2013 PIMS, Vancouver, 5 months — M.J. Gotay: geometric structures in Field Theory

2012 Fields Institute, Toronto, 3 weeks — Geometry, Mechanics and Dynamics

Institutional Service at IE University

- Bachelor in Applied Mathematics: degree design committee and approval memorandum.
- Computer Science and Artificial Intelligence (BCSAI): program redesign task force; reaccreditation support for BCSAI and Data and Business Analytics.
- Calculus coordination: course content and syllabi for two academic years.
- Faculty service: adjunct and full-time hiring panels; colleague mentoring on teaching.
- Exchange advising: course selection and credit equivalences for approximately 50 students per year.
- Cohort advising: BCSAI and Economics and Applied Mathematics, for three academic years.
- Final-year project assessment: more than 50 TFG defense panels.
- Outreach and orientation: an article, a video, talks, and open houses; co-organizer of the Orientation Day Data Workshop for three academic years.
- IE Research DataLab member since its inception; KAN4MET work-package co-lead.

Service to the Community

1. Reviewer, Mathematical Reviews (AMS)
2. Referee for *J. Geom. Mech.*, *Int. J. Geom. Methods Mod. Phys.*, *ICRA 2018*, *ACC 2019*, *CDC 2018*, *IFAC (NecSys 2018)*, *IEEE Trans. Autom. Control*, *ACC 2023*, *IEEE. Trans. Contr. Net. Sys.*, *Nonlinear Analysis: Hybrid Systems*, *Neural Networks*, *SIAM J. Appl. Dyn. Syst.*, *SIAM J. Sci. Comput*.
3. Outreach activity "Graffiti y Mates"
4. Volunteer, AIMS 2014 conference
5. Organizer, Geometric Mechanics Group Seminar (Spring 2014)
6. Organizer, *deLeonFest 2023*, ICMAT, Madrid, December 2023
7. Organizer, *Online Optimization Methods for Data-Driven Feedback Control*, ACC, San Diego, May 2023

Technical Skills

Python | R | Matlab | C/C++ | Fortran 90 | Mathematica | REDUCE | Gurobi | LaTeX

Participation in Research Projects

Research-team member. Dates below refer to grant periods; current Spanish national funding is listed as AEI/MICIU.

2025 – 2029 KAN4MET: Kolmogorov–Arnold Networks with Applications in Weather Forecasting
PID2024-155187OB-I00. Funding: AEI/MICIU.
PI: David Gómez-Ullate Oteiza.

2024 – 2027 Lagrangian and Hamiltonian Field Theories: Geometry, Discretization, Optimal Control
PCI2024-155047-2. Funding: AEI/MICIU–DFG.
PIs: D. Martín de Diego (Spain), S. Leyendecker (Germany).

2023 – 2027 Geometry of Dynamical Systems: From Theory to Applications
PID2022-137909NB-C21. Funding: AEI/MICIU.
PI: D. Martín de Diego.

2015 – 2019 Triggered Control of Cyber Physical Systems with Communication Channels Constraints
CNS-1446891. Funding: NSF. PI: J. Cortés.

2013 – 2018 Robust Team-Triggered Coordination for Real-Time Control of Networked Cyber-Physical Systems
CNS-1329619. Funding: NSF. PI: J. Cortés.

2014 – 2017 Homotopy Moment Maps
Funding: Ciência sem Fronteiras (CNPq). PI: M. Zambon.

2011 – 2013 Estructuras Globales y Métodos Numéricos
MTM2010-21186-C02-01. Funding: MICINN (now MICIU). PI: D. Martín de Diego.

2011 – 2014 GEOMECH – Geometric Mechanics
FP7-PEOPLE-2009-IRSES, grant 246981. Funding: EU.
Coordinator: F. Cantrijn; PI in Spain: D. Martín de Diego.

2011 Geometría Diferencial, Mecánica y Teoría de Campos
Funding: Agencia Canaria. PI: J.C. Marrero.

Teaching Experience

At IE University (2021–2026), I have taught **24 undergraduate sections across six courses**, comprising 645 scheduled sessions and 634 course enrollments. The **session-weighted overall-professor rating (Q7) is 4.81/5**, based on 389 responses (61.4% response rate). The annual session-weighted Q7 average reached 4.94/5 in 2025.

The table lists all 24 IE undergraduate sections with official evaluations, plus earlier teaching at UAM. Q7 is the overall-professor item; Comp. mean is the competency mean. Both use a 1–5 scale, matching Table 1 of the teaching statement. Section codes follow the official reports.

Semester	Course	Sec.	Program	Q7	Comp. mean
Fall 2014	Mathematics (problem sessions, 60 h)	—	UAM	—	—
Spring 2021	Fund. of Data Analysis (6 ECTS)	S.B	BBA + DBA	4.33	4.44
Spring 2021	Mathematics (6 ECTS)	S.A	PPLE + DBA	3.67	3.88
Fall 2021	Calculus 0 (3 ECTS)	S.A	BCSAI	4.76	4.72
Fall 2021	Calculus for CS (6 ECTS)	M.A	BCSAI	4.81	4.85
Spring 2022	Fund. of Data Analysis (6 ECTS)	M.B	BBA + DBA	4.77	4.81
Spring 2022	Mathematics (6 ECTS)	S.A	PPLE + DBA	5.00	4.98
Fall 2022	Calculus 0 (3 ECTS)	S.A	BCSAI	4.86	4.76
Fall 2022	Calculus 0 (3 ECTS)	S.B	BCSAI	4.91	4.70
Fall 2022	Calculus for CS (6 ECTS)	M.A	BCSAI	4.91	4.83
Spring 2023	Fund. of Data Analysis (6 ECTS)	S.A	BBA + DBA	5.00	4.90
Spring 2023	Mathematics (6 ECTS)	S.A	PPLE + DBA	5.00	4.90
Fall 2023	Calculus 0 (3 ECTS)	M.A	BCSAI	4.69	4.61
Fall 2023	Calculus 0 (3 ECTS)	S.A	BCSAI	4.74	4.72
Fall 2023	Calculus 1 (6 ECTS)	S.A	BAM	4.75	4.59
Spring 2024	Fund. of Data Analysis (6 ECTS)	S.A	BBA + DBA	5.00	4.97
Spring 2024	Mathematics (6 ECTS)	S.A	PPLE + DBA	5.00	4.84
Fall 2024	Calculus 0 (3 ECTS)	M.A	BCSAI	4.63	4.51
Fall 2024	Calculus 0 (3 ECTS)	S.A	BCSAI	4.85	4.63
Fall 2024	Calculus 1 (6 ECTS)	S.A	BAM	4.82	4.80
Spring 2025	Fund. of Data Analysis (6 ECTS)	S.A	BBA + DBA	5.00	5.00
Spring 2025	Mathematics (6 ECTS)	S.A	PPLE + DBA	5.00	5.00
Fall 2025	Calculus for CS (6 ECTS)	S.A	BCSAI	4.86	4.91
Fall 2025	Numerical Methods (6 ECTS)	S.A	BAM	4.90	4.83
Spring 2026	Fund. of Data Analysis (6 ECTS)	S.A	BBA + DBA	4.94	4.91

Professional teaching. *Mathematical Methods in Optimization*, Aramco Big Data Master's: 15 sessions; reported evaluation 3.96/5.

Languages

Spanish

Galician

English

Portuguese

French

References

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