Leonardo Colombo

Department of Automatic Control, School of Electrical Engineering, KTH Royal Institute of Technology
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Born: October 21, 1986 (Age: 30 years old)–Buenos Aires, Argentina. Nationality: Argentina
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Areas of Research and Interests

Nonlinear control theory • Geometric mechanics, dynamics & Integration • Hybrid and Multi-agent systems

Employment

-Postdoctoral Researcher, KTH (From June 2017).
ACCESS Linnaeus Center, School of Electrical Engineering, Royal Institute of Technology (KTH), Stockholm, Sweden.
Supervisor: Dimos Dimaragonas.

-Postdoc Assistant Professor, UM (September 2014-May 2017).
Department of Mathematics, University of Michigan, Ann Arbor, USA.
Mentor: Anthony M. Bloch.

-JAE-Pre Position, CSIC (September 2010-August 2014).
Insituto de Ciencias Matemáticas (Institute of Mathematical Science), Consejo superior de Investigaciones Científicas, Madrid, Spain.
Advisor: David Martín de Diego.

Education

Ph. D. in Mathematics (July 2014)
Instituto de Ciencias Matemáticas, ICMAT-CSIC, Spain
and *Department of Mathematics, Universidad Autónoma de Madrid*, Spain.
THESIS:"Geometric and Numerical Methods for Optimal Control of Mechanical Systems."
ADVISOR: David Martín de Diego, ICMAT-CSIC.
GRADE: Sobresaliente Cum Laude distinction and International doctorate mention.

Master degree (MSc) in Applied Mathematics (October 2012)
Department of Mathematics, Universidad Autónoma de Madrid, Spain.
THESIS: "Higher-Order Euler-Poincaré equations and its applications to optimal control."
ADVISOR: David Martín de Diego, ICMAT-CSIC.

Degree in Mathematics (Bachelor degree Bc.) (September 2009)
Universidad Nacional de La Plata, Facultad de Ciencias Exactas, Buenos Aires, Argentina.
THESIS: Optimal Control of underactuated mechanical systems: A geometric approach.
ADVISORS: Dr. David Martin de Diego (ICMAT-CSIC) - Dra. Marcela Zuccalli (Facultad de Ciencias Exactas-UNLP).

Visiting research positions

Instituto de Ciencias Matemáticas, Madrid, Spain within the *Geometric Mechanics* group. From May 1st to June 11.

Centro de Matemática da Universidade de Coimbra, Coimbra, Portugal: within the *Differential Geometry and Applications* group. From June 12 to June 19.

Instituto de Ciencias Matemáticas, Madrid, Spain within the *Geometric Mechanics* group. From March 2 to March 7 and from July 14 to July 24.

Universidad Nacional del Sur, Bahia Blanca, Buenos Aires, Argentina: within the *Geometric Mechanics* group. Supervisor: Hernán Cendra. From February 3 to February 24.

Isaac Newton Institute for Mathematical Science, Cambridge University, Cambridge, UK in order to attend *Mathematical Approaches to Complex Fluids - a Two Week Summer School* . From July 21st to August 3er . Founded by a fellowship of Isaac Newton Institute.

Universidad Nacional del Sur, Bahia Blanca, Buenos Aires, Argentina: within the *Geometric Mechanics* group. Supervisor: Hernán Cendra. From April 26 to June 26.

Imperial College of London, London, England: within the *Geometric Mechanics* group. Supervisor: Darryl Holm. From September 2012 to January 2013.

Fields Institute of Research in Mathematical Science. Toronto, Canada in order to attend *Focus Program on Geometry, Mechanics and Dynamics at Fields Institute* . From July 6 to August 27 . Founded by a fellowship of Fields Institute of Research in Mathematical Science.

Universidad Nacional del Sur, Bahia Blanca, Buenos Aires, Argentina: within the *Geometric Mechanics* group. Supervisor: Hernán Cendra. From December 1 to January 8.

Universidad de La Laguna, Canary Islands, Spain within the *Geometric and topology* group. Supervisor: Juan Carlos Marrero. From September 3 to September 26.

Supelec, Paris Sud University, Paris, France: from February 21 to March 4, in order to attend the graduate courses of 2011 HYCON-EECI Graduate School on Control:

1. *Cooperative Navigation and Control of Multiple Robotic Vehicles.* Instructors: Professors Antonio M. Pascoal and Antonio P. Aguiar

2. *Normal Forms for Nonlinear Control Systems*. Instructor: Professor Witold Respondek.

Instituto de Ciencias Matemáticas, Madrid, Spain within the *Geometric Mechanics* group. Supervisor: David Martin de Diego. From February 3 to March 8.

Instituto de Ciencias Matemáticas, Madrid, Spain within the *Geometric Mechanics* group. Supervisor: David Martin de Diego. From February 20 to March 12 and from June 20 to September 21.

Publications

Submitted Articles

J20. A. Bloch, M. Camarinha and L. Colombo. Dynamic Interpolation for obstacle avoidance on Riemannian manifolds. Submitted, 2017

J19. L. Abrunheiro and L. Colombo. Lagrangian Lie subalgebroids generating dynamics for second-order mechanical systems on Lie algebroids. Submitted, 2017.

J18. A. Bloch, W. Clark, L. Colombo and P. Rooney. Time minimum Quantum Purity for 2-Level Lindblad equations. Submitted, 2017.

C11. L. Colombo, A. Bloch, W. Clark. Time reversal symmetries and zero dynamics for simple hybrid Hamiltonian control systems. Submitted. 2017.

Journal Articles

J17. A. Bloch, L. Colombo, R. Gupta and T. Ohsawa. Optimal control problems with symmetries breaking cost functions. *SIAM journal on Applied Algebra and Geometry.* Accepted for publication, 2017.

J16. L. Colombo. A variational-geometric approach for the optimal control of nonholonomic systems. *I. J. Dynamics and Control.* To appear, 2017 (In press). doi:10.1007/s40435-017-0326-6.

J15. L. Colombo. Second-order constrained variational problems on Lie algebroids: Applications to optimal control. *Journal Geometric Mechanics.* Vol 9, n1, 2017, 1-45.

J14. L. Colombo, S. Ferraro and D. Martín de Diego. Geometric Integrators for Higher-Order Variational Systems and their applications to Optimal Control . *Journal of Nonlinear Science.* 26 - 6, pp. 1615 - 1650, 2016.

J13. L. Colombo and D. Martín de Diego. Higher-order variational problems on Lie groupoids and optimal control applications. *Discrete and Continuous Dynamical Systems, Serie A.* Vol 36 (11), 6023-6064, 2016.

J12. L. Colombo and P. Prieto Martínez. Regularity properties of fiber derivatives associated with higher-order mechanical systems. *Journal of Mathematical Physics*, 57 (8), 2016.

J11. L. Colombo, F. Jiménez and D. Martín de Diego. Varational Integrators for Mechanical Control Systems with Symmetries. *Journal of Computational Dynamics*. Vol 2, n. 2, 193-225, 2015.

J10. L. Colombo and H. Jacobs. Lagrangian Mechanics on centered semi-direct products. *Geometry, mechanics, and dynamics: the legacy of Jerry Marsden, Fields Inst. Communications*, Vol. 73,167-184, 2015.

J9. A. Bloch, L. Colombo, R. Gupta and D. Martín de Diego. A Geometric Approach to the Optimal Control of Nonholonomic Mechanical Systems. *Analysis and Geometry in Control Theory and its Applications*. INdAM series. Vol 12. 2015.

J8. L. Colombo and D. Martín de Diego. On the geometry of higher-order variational problems on Lie groups. *Journal Geometric Mechanics*, Vol. 6, number 4, 451-478, 2014.

J7. L. Colombo and P. Prieto-Martínez. Unifed formalism for higher-order variational problems and its applications in optimal control. *International Journal of Geometric Methods in Modern Physics*. Vol 11, n4, 2014,

J6. L. Colombo, M. de León, P. Prieto Martínez and N. Román-Roy. Geometric Hamilton-Jacobi theory for higher-order autonomous systems. *J. Phys. A: Math. Theor.* 47, 235203, 2014.

J5. L. Colombo, M. de León, P. Prieto Martínez and N. Román-Roy. Unified formalism for higher-order geometric Hamilton-Jacobi theory. *International Journal of Geometric Methods in Modern Physics*. Vol 11, n6, 2014.

J4. L. Colombo, D. Martín de Diego and M. Zuccalli. Discrete higher-order variational problems with constraints. *Journal of Mathematical Physics*. Vol 54, 093507, 2013.

J3. L. Colombo, F. Jiménez and D. Martín de Diego. Discrete second-order Euler-Poincaré equations. Applications to optimal control. *International Journal of Geometric methods in Modern Physics*. Vol 9, N4, 2012.

J2. L. Colombo, D. Martín de Diego and Marcela Zuccalli. On Variational Integrators for Optimal Control of Mechanical Control Systems. *Revista de la Real Academia de Ciencias Exactas, Fisicas y Naturales. Serie A. Matematicas* (Journal of Spanish Royal Society of Science) Volume 106, Issue 1, Page 161-171, 2012.

J1. L. Colombo, D. Martín de Diego and Marcela Zuccalli. Optimal Control of Underactuated Mechanical Systems: A Geometric Approach. *Journal Mathematical Physics*. Vol 51, 083519, 2010.

Conference (Refereed) Proceedings

C10. L. Colombo, A. Bloch, W. Clark. Quasivelocities and symmetries in simple hybrid systems. IEEE Conference Proceedings, CDC Conference 2017, Melbourne, Australia. To appear.

C9. L. Colombo, A. Bloch, M. Camarinha. Variational obstacle avoidance problem on Riemannian manifolds. IEEE Conference Proceedings, CDC Conference 2017, Melbourne, Australia. To appear.

C8. W. Clark, A. Bloch, L. Colombo and P. Rooney. Optimal Control of Quantum Purity for $n = 2$ Systems. IEEE Conference Proceedings, CDC Conference 2017, Melbourne, Australia. To appear.

C7. L. Colombo, A. Bloch, R. Gupta and D. Martín de Diego. Variational discretization for optimal control problems of nonholonomic mechanical systems. Proc. 54th. IEEE Conference on Decision and Control (CDC), 4047-4052, 2015.

C6. L. Colombo, A. Bloch and R. Gupta. Higher-Order Constrained Variational Problems on Principal Bundles with Applications to Optimal Control of Underactuated Systems. *IFAC Conference Proceedings*. 5th IFAC Workshop on Lagrangian and Hamiltonian Methods for Non Linear Control, p.87-92, 2015.

C5. L. Colombo, D. Martín de Diego and Marcela Zuccalli. On the construction of structure preserving algorithms for optimal control problems of nonholonomic mechanical systems. *Actas del XII Congreso Monteiro*, 135-147, 2014.

C4. L. Colombo. "On the plate ball optimal control problem." *Actas del IV Congreso de Matemática Aplicada, Computacional e industrial (MACI)*, 2013, pp. 698-701.

C3. L. Colombo and D. Martín de Diego. Optimal control of underactuated mechanical systems with symmetries. Dynamical Systems and Differential Equations, *Discrete and Continuous Dynamical Systems*, November 2013. Proceedings of the 9th AIMS international conference, Orlando, Florida, USA. 149-158.

C2. L. Colombo, F. Jiménez and D. Martín de Diego. Second-order Euler-Poincaré equations for trivial principal bundles. *Proceedings of the American Institute of Physics, Geometry and Physics*, 1460, 185-191 2012.

C1. L. Colombo and D. Martín de Diego. Quasivelocities and optimal contol of underactuated mechanical systems. joint work with D. Martín de Diego. *Proceedings of the American Institute of Physics, Geometry and Physics*, 1260, 133-140, 2011.

Notes

∘ "Continuous and discrete mechanics for the attitude dynamics of a rigid body on SO(3)". Joint work with F. Jiménez. *GMC Notes, Number 1 (2012)* Available at http://gmcnetwork.org.

Articles in Popular Science

∘ "Sobre el uso de la descomposición en valores singulares para el tratamiento de imagenes."(On the use of the singular value decomposition to images)
joint work with R. Lafuente. *Matematicalia, Digital Journal. Vol.7, n4, 2011.*

Participation in research projects

- **2014-2017** Geometric structures and integrability in dynamical systems and control theory: MTM2013-42870-P.
  Principal researcher: David Martín de Diego (ICMAT-CSIC), Daniel Peralta Salas (ICMAT-CSIC). Spain.

- **2014-2016** NSF-INSPIRE Track 1: The Mathematics of Balance in Mechanical Systems with Impacts, Unilateral Constraints, Underactuation and Hyper-sensing: Application to Agile bipedal Locomotion.

(IP and Co-IP): Grizzle, Jessy; Anthony Bloch. University of Michigan, Ann Arbor-Michigan, US.

- **2012-2016** Geometric Mechanics and Mathematical Physics: PID/X628.
  Principal researcher: Marcela Zuccalli, Universidad Nacional de La Plata, Argentina

- **2011-2015** IRSES network GEOMECH. The network is financially sponsored within Marie Curie's International Research Staff Exchange Scheme (irses) in the 7th European Framework Program, under project nr 246981.
  Principal researcher: Frans Cantrijn. Ghent University. Belgium.

- **2012-2013** Geometry, Mechanics and control: MTM 2011-15725-E,
  Principal researcher: Edith Padrón Fernandez, Universidad de La Laguna,Spain.

- **2010-2013** Global Structures and Numerical Methods in Mechanics, Dynamical Systems and Control: MTM2010-21186-C02-01.
  Principal researcher: David Martín de Diego. ICMAT-CSIC. Spain.

- **2011-2012** Geometry, Mechanics and Control: MTM2010- 12116- E,
  Principal researcher: Juan Carlos Marrero Gonzalez, Universidad de La Laguna,Spain.

- **2010-2011** Geometry, Mechanics and Control: MTM2009-08166-E,
  Principal researcher: Juan Carlos Marrero Gonzalez, Universidad de La Laguna,Spain.

- **2010-2012** Geometric Mechanics and Mathematical Physics: PID/X002.
  Principal researcher: Marcela Zuccalli, Universidad Nacional de La Plata, Argentina

- **2009-2010** Applied analysis and mathematical physics: 11/X376.
  Principal researcher: Jorge Solomin, Universidad Nacional de La Plata, Argentina

Fellowships and Awards

Fellowships

ACCESS Linnaeus Center Scholarship, KTH.
Selected as one of 2 winning candidates from around 60 applicants (2017).

Fellowship from Isaac Newton Institute for Mathematical Science, Cambridge University, Cambridge, UK in order to attend *Mathematical Approaches to Complex Fluids: a Two Week Summer School* . From July 21st to August 3er, 2013 .

Fellowship from Fields Institute of Research in Mathematical Science. Toronto, Canada in order to attend *Focus Program on Geometry, Mechanics and Dynamics at Fields Institute* . From July 6 to August 27, 2012 .

Predoctoral Ph.D fellowship JAE-Predoc in the framework of the JAE program financed by CSIC-Spain and co-funded by the European Union., 2010-2014.

Pregraduate *Fellowship JAE-Intro* in the framework of the JAE program by CSIC-Spain, three months (From July 2009 to September 2009).

Pregraduate fellowship financed by *Fundación YPF* , from May 2006 to September 2009.

Pregraduate fellowship financed by *Ministerio de Educación, Argentina* , from March 2005 to September 2009.

Awards

Premio Vicent Caselles 2016 (Vicent Caselles Award - 2016) from the Real Sociedad Matemática Española (Spanish Mathematical Royal Society) and BBVA Foundation (best Spanish 6 young researchers in mathematics).

Outstanding Postdoctoral Assistant Professor Teaching Award in Mathematics, University of Michigan, 2016.

Best Poster in XVIII International Workshop on Geometry and Physics: Quasivelocities and Optimal Control for Underactuated Mechanical Systems, 2010.

UPSILON PI EPSILON-Honor Society for Computing and Information Disciplines: Recognition of teams at the 2009 ACM-ICPC.

Internacional Collegiate Programming Contest:
1. 2008-South America Regionals, second position of Argentina, and third position Tercer of south América.
2. 2009-Final World- Honorable Mention- Stockholm, Sweden

Award to the Best undergraduate students 2009 of Municipalidad de La Costa, Argentina

Award to the Best undergraduate students 2008 of Municipalidad de La Costa, Argentina

Award to the Best undergraduate students 2007 of Municipalidad de La Costa, Argentina

Others

Member of the Scientific Committee: *International Young Researchers Workshop on Geometry, Mechanics and Control*. From May 2016.

Reviewer of AMS Mathematical Reviewers (from 2013).

Reviewer of international journals papers: Automatica, IEEE Transactions on Automatic Control, Nonlinear Dynamics, Systems and Control Letters, IEEE Control Systems Letters, Journal of Mathematical Physics, SIGMA, Journal Geometric Mechanics, Mediterranean Journal of Mathematics, International Journal of Geometric Methods in Modern Physics, Mathematics and Mechanics of Solids, Annales Mathematicae Silesianae, Journal of Engineering Mechanics, Adv. Math. Phys, Ain Shams Engineering Journal.

Science mentor of the setcion Mathematics for Frontiers for Young Minds http://home.frontiersin.org/

Reviewer of International Conference Proceedings: Communications, Computing and Control Applications (CCCA11), IEEE Conference on Decision and Control (CDC 2017), Dynamical Systems and Control Conference (DSCC 17), American Control Conference (ACC 2018).

Nominated for Golden Apple Award (the only student nominated award that recognizes outstanding university teaching), 2017.

Volunteer of X AIMS Conference, July 2014, Madrid, Spain.

I collaborated in the blog of popular science *Las Matemáticas y sus frontéras* (*Mathematics and its frontiers*) (MatBlog).

Member of "Unidad de cultura matemática" (department of outreach in mathematics), Consejo Superior de Investigaciones Científicas.

Colaborator in the programs: "Company-School and mathematics" (Instituto de Ciencias Matemáticas and three high-schools of Madrid) and "Graffiti and maths".

Organizer and founder of the young researchers seminars (ICMAT-Universidad Autónoma de Madrid).

Undergraduate representative in the council of the mathematics department at Universidad Nacional de La Plata, Argentina between November of 2007 and November of 2009.

Participant of the Advisor Committee of two positions of associate professor in the mathematical department of Universidad Nacional de La Plata, Argentina, 2009.

Mentoring and Advising

Jacob Goodman. Mentor of the research training of the undergraduate student Jacob Goodman from the department of Mathematics at University of Michigan during Fall 2017 and Winter 2018. Research topic: Variational Integrators and controlled Lagrangians for simple hybrid systems.

William Clark. Academic Mentor of a Ph.D student in the Interdisciplinar Mathematics Ph.D program at University of Michigan, along Winter 15 and Fall 16 and advised by A. Bloch. Research topic: Optimal Control of Quantum Purity for 2-Level Lindblad equations

Emma Eyrea Irazu. Ph.D student co-advised with Marcela Zuccalli from April 2015. Universidad Nacional de La Plata-Argentina. Thesis title: Geometric and numerical methods associated to mechanical systems with magnetic terms.

Memberships

I am a member of RSME (Spanish Royal Mathematical Society).

I was a member of the *Geometric Mechanics* group at ICMAT-CSIC (2010-2014).

I am a member of the *Geometry, Mechanics and Control Network* (gmcnetwork.org).

I was a member of the IRSES program. The network was financially sponsored within Marie Curie's International Research Staff Exchange Scheme (irses) in the 7th European Framework Program, under project n.246981 (From 2010 to 2015). http://www.geomechnetwork.ugent.be/.

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Presentations: Conference Talks, Seminars & Posters

2017

○ "Optimal control problems with symmetries breaking cost functions" (invited talk)
5th Iberoamerican conference on Geometry, Mechanics and Control, La Laguna, Tenerife, Spain.

2016

○ "Variational integrators and stability analogies between hybrid mechanical systems and nonholonomic systems"(seminar)
Seminar. Department of Automatic Control, School of Electrical Engineer, KTH. Stockholm, Sweden.

○ "New developments in the optimal control of nonholonomic mechanical systems"(talk)
7th European Congress of Mathematics, Berlin, Germany.

○ "Geometric Integrators for Higher-Order Variational Systems and their applications to Optimal Control"(poster)
10th ICMAT International GMC Summer School on Geometry, Mechanics and Control La Cristalera, Madrid, Spain.

○ "Geometric and Numerical methods for optimal control of mechanical systems"(seminar)
Seminar of Geometry and Applications Universidad de Coimbra, Portugal.

2015

○ "Higher-Order Constrained Variational Problems on Principal Bundles with Applications to Optimal Control of Underactuated Systems" (talk)
5th IFAC Workshop on Lagrangian and Hamiltonian Methods for Non Linear Control. Lyon, France.

○ "Optimal control of left invariant systems on Lie groups "(poster)
Joint STAMP conference and 9th ICMAT International GMC Summer School on Symplectic Geometry, Classical Mechanics and Interactions with Spectral Theory. La Cristalera, Madrid, Spain.

2014

○ "Regularizaton of Hamilton's principle for higher-order Lagrangian systems"(seminar)
Junior Seminar Universidad Autónoma de Madrid, Spain.

○ "Geometric and Numerical methods for optimal control of mechanical systems"(seminar)
Seminar of Applied Mathematics Universidad Autónoma de Madrid, Spain.

2013

○ "Geometry of optimal control problems of nonholonomic mechanical sytems"(poster)
deLeónfest Madrid, Spain.

○ "Optimal Control of nonholonomic mechanical systems"(poster)
8th International Young Researchers Workshop on Geometry, Mechanics and Control. Barcelona, Spain.

○ "Unified formalism for higher-order geometric Hamilton-Jacobi theory," (poster)
XXII fall workshop on Geometry and Physics. Evora, Portugal.

○ "Optimal control of nonholonomic mechanical systems" (talk)
VII Summer School on Geometry, Mechanics and Control. La Cristalera, Madrid, Spain.

○ "Optimal control of nonholonomic mechanical systems" (talk)
XII Congreso Dr. Antonio Monteiro. Bahia Blanca, Argentina.

○ "On the plate ball optimal control problem" (talk)
IV Congreso de Matemática Aplicada, Computacional e Industrial. Ciudad Autónoma de Buenos Aires, Argentina.

○ "Lagrangian submanifolds generating second-order Lagrangian mechanics on Lie algebroids" (invited talk)
XV Encuentro de Invierno de Geometría, Mecánica y Control. Zaragoza, Spain.

○ "On the geometry of higher-order mechanical systems on Lie groups" (seminar)
Seminar on Geometry of the Universitat Politècnica de Catalunya. Facultad de Matemática y Estadistica, UPC, Barcelona, Spain.

2012

○ "On the variational discretization of optimal control problems" (invited talk)
XXI Fall workshop on Geometry and Physics. Burgos, Spain.

○ "Optimal control of underactuated mechanical systems with symmetries" (invited talk)
Focus program on geometry, mechanics and dynamics: the Legacy of Jerry Marsden, Fields Institute, Toronto, Canada.

○ "On the geometry of mechanical control systems on Lie groups" (talk)
9th. AIMS Conference on Dynamical systems, differential equations and applications. Orlando, Florida, USA.

○ " On the geometry of discrete higher-order Lagrangian problems" (talk and poster)
6th. Summer school on geometry, mechanics and control.
Miraflores de la Sierra, Madrid, Spain.

○ " Higher-order mechanics from Hamilton-Pontryagin principle and optimal control." (seminar). *Seminario Junior ICMAT-UAM.* Universidad Autónoma de Madrid, Madrid, Spain.

2011

○ "Groupoids and Mechanics on Lie groupoids " (seminar)
Geometry seminar, Maths department, Universidad Nacional de La Plata, Argentina.

○ "On the geometry of higher-order Euler-Poincaré equations " (seminar)
Seminar on Geometry and Physics, Universidad Complutense de Madrid, Spain.

○ "Second order Lagrangian mechanics on Lie algebroids" (talk and poster)
European Mathematical Society and Spanish Royal Academy of Science, joint weekend.
Bilbao, Spain.

○ " On variational problems on Lie groups"(talk)
Primer Encuentro de Jovenes Investigadores en Matemticas Universidad de La Laguna (PE-JIM 2011).
La Laguna, Canary Islands, Spain.

○ "Quasivelocities and optimal control of mechanical systems"(seminar)
Seminar of Geometry, Departamento de Matemática Fundamental, Universidad de La Laguna.

○ " Discrete variational problems on Lie groupoids"(talk)
Congress of Young researchers of the Spanish Royal Mathematical Society.
Soria, Castilla y León, Spain.

○ " Higher Order Mechanics on Lie Algebroids"(poster)
XX International Workshop on Geometry and Physics.
ICMAT, Madrid, Spain.

○ " On the Geometry of higher order problems on Lie groups" (poster)
Poisson Geometry and applications, Figueira da Foz, Portugal.

○ "An introduction to higher-order mechanic on Lie algebroids"(talk)
Meeting of Geometry, Mechanics and Control, ICMAT, Madrid, Spain.

○ " Discrete second order mechanics on Lie groupoids." (poster)
5th *International Summer School on GMC*, La Cristalera, Madrid, Spain.

○ " A Variational and Geometric Approach for the Second Order Euler-Poincar Equations"(talk)
XIII Winter Meeting on Geometry, Mechanics and Control and Thematic day on Fields, Zaragoza, Spain.

○ "Optimal Control of Underactuated Mechanical Systems on Lie Groups" and "Higher Order Discrete Vakonomic Mechanics for Optimal Control of Underactuated Systems" (posters)
Second Iberoamerican Meeting on Geometry, Mechanics and Control, in Honor of Hernán Cendra, Centro Atómico de San Carlos de Bariloche, Argentina.

2010

○ "Optimal Control of Underactuated Mechanical Systems on Lie Groups"(talk)
5th Young Researchers Workshop on Geometry, Mechanics and Control, Universidad de La Laguna, Tenerife, Spain.

○ "Variational Integrators for Optimal Control of Mechanical Systems. 5th Young Reaserchers" (poster)
5th Young Researchers Workshop on Geometry, Mechanics and Control, Universidad de La Laguna, Tenerife, Spain.

2009

○ "Control Óptimo de Sistemas Mecánicos Infractuados: Una Aproximación Geométrica" (talk)
LIX Reunión Anual de la Unión Matemática Argentina, Mar del Plata, Buenos Aires, Ar-

gentina.

○ "Variational Integrators in Optimal Control for Underactuated Mechanical Systems" (poster)
Variational Integrators in Nonholonomic and Vakonomic Mechanics: an exploratory workshop, Real Academia de Ciencias, Madrid, Spain.

○ "A Survey of Optimal Control for Underactuated Mechanical Systems in Quasivelocities" (talk)
XVIII International Workshop on Geometry and Physics, Benasque, Spain.

○ "Quasivelocities and Optimal Control for Underactuated Mechanical Systems" (poster)
XVIII International Workshop on Geometry and Physics, Benasque, Spain.

○ "Una Aproximación Geométrica a la Teoría de Control Óptimo de Sistemas Infractuados" (talk)
XX Jornadas SIMUMAT de Geometría y Control Óptimo, Universidad Carlos III de Madrid, Spain.

○ "Optimal Control for Underactuated Mechanical Systems" (poster)
III Summer School on Geometry, Mechanics and Control, L'Ametlla del Mar, Catalonia, Spain.

Attendances

2017

○ *V Iberoamerican meeting on Geometry, Mechanics and Control.* Tenerife, Canary Islands, Spain.

○ *11th. International Young Researchers Workshop on Geometry, Mechanics and Control* Tenerife, Canary Islands, Spain.

2016

○ *7th European Congress of Mathematics.* Berlin, Germany.

○ *10th ICMAT International GMC Summer School on Geometry, Mechanics and Control* La Cristalera, Madrid, Spain.

2015

○ *5th IFAC Workshop on Lagrangian and Hamiltonian Methods for Non Linear Control.* Lyon, France.

○ *Joint STAMP conference and 9th ICMAT International GMC Summer School on Symplectic Geometry, Classical Mechanics and Interactions with Spectral Theory.* La Cristalera, Madrid, Spain.

2014

○ *X AIMS Conference.* Madrid, Spain. July 2014.

○ *8th Summer School on Geometry, Mechanics and Control.* La Cristalera, Madrid, Spain. June 2014.

○ *deLeonfest.* Madrid, Spain. December 2013.

○ *8th. International Young Researchers Workshop on Geometry, Mechanics and Control* Barcelona, Spain. December 2013.

○ *XXII Fall workshop on Geometry and Physics.* Evora, Portugal. September 2013.

○ *Mathematical Approaches to Complex Fluids - a Two Week Summer School* Isaac Newton Institute for Mathematical Science, Cambridge University, Cambridge, UK. July-August 2013.

○ *Topics in Numerical Analysis for Differential Equations.* Madrid, Spain. July 2013.

○ *VII Summer School on Geometry, Mechanics and Control* Miraflores de la Sierra, Madrid, Spain. July 2013.

○ *XII Congreso Dr. Antonio Monteiro,* May 2013, Bahia Blanca, Buenos Aires, Argentina.

○ *IV Congreso de Matemática Aplicada, Computacional e Industrial,* May 2013, Buenos Aires, Argentina.

○ *XIV Winter Meeting on Geometry, Mechanics and Control and Thematic day on Dirac Structures and applications,* January 2013, Zaragoza, Spain.

○ *XXI Fall workshop on Geometry and Physics.* Burgos, Spain. August 2012.

○ *Focus Program on Geometry, Mechanics and Dynamics at Fields Institute.* Fields Institute of Research in Mathematical Science. Toronto, Canadá. July de 2012.

○ *Ninth AIMS Conference on Dynamics Systems, Differential Equations and Application.* Orlando, Florida, USA. July 2012.

○ *VI Summer School on Geometry, Mechanics and Control* Miraflores de las Sierras, Madrid, Spain. July 2012.
○ *Applied and Numerical Optimal Control spring School & Workshop .* París, France. April 2012.

○ *IX Winter Meeting on Geometry, Mechanics and Control and Thematic day on Poisson, February, Zaragoza, Spain.*

○ *European Mathematical Society and Spanish Royal Academy of Science, joint weekend.* September, Bilbao, Spain.

○ *Primer Encuentro de Jovenes Investigadores en Matemticas,* Universidad de La Laguna (PEJIM 2011). La Laguna, Canary Islands, Spain.

○ 20th *International Fall Workshop on Geometry and Physics*, September, Madrid, Spain.

○ *Congress of Young researchers of the Spanish Royal Mathematical Society.* Soria, Spain.

○ *V International Summer School on Geometry, Mechanics and Control*, July, La Cristalera, Madrid, Spain.

○ *EECI-HYCON2 Graduate School on Control,* Spring 2011, European Embedded Control Institute, Paris, France.

○ *Thematic day on Classic Field Theory*, January, Universidad de Zaragoza, Spain.

○ *XIII Winter Meeting on Geometry, Mechanics and Control*, January, Universidad de Zaragoza, Spain.

○ *Second Iberoamerican Meeting on Geometry, Mechanics and Control in Honor of Hernán Cendra*, January, San Carlos de Bariloche, Argentina.

2010

○ *5th Young Researchers Workshop on Geometry, Mechanics and Control*, December, La Laguna, Tenerife, Spain.

○ *Geometry of Constraints and Control- New Developments,* November, Banach Center, Warsaw, Poland.

○ *Workshop on Geometric and Topological Methods in Control and Robotics*, October, La Cristalera, Madrid, Spain.

2009

○ *LIX Reunión Anual de la Unión Matemática.* Mar del Plata, Mar del Plata.

○ *Variational Integrators in Non-holonomic and Vakonomic mechanics: an exploratoty workshop*: September, Real Academia de Ciencias, Madrid, Spain.

○ *XVIII International Fall Workshop on Geometry and Physics*: September, Centro para la Ciencia 'Pedro Pascual', Benasque, Spain.

○ *III International Summer School on Geometry, Mechanics and Control*: June, L'Ametlla de Mar, Spain.

2008

○ *Primer Encuentro Iberoamericano de Geometría, Mecánica y Control.* Universidad de Santiago, Santiago de Compostela, Spain.

○ *II Summer School on Geometry, Mechanics and Control* La Palma, Spain. June 2008.
○ *Tercer Encuentro Internacional de EDPs no-lineales* Buenos Aires, Buenos Aires, Argentina.

2006

○ *LIV Reunión Anual de la Unión Matemática Argentina.* Bahia Blanca, Argentina.

Teaching experience

Assistant Professor

Mathematics Department, Michigan University, Ann Arbor, USA.

• Fall Term 2014 (Sept-Dec 2014): Math 115. Calculus. Sections 036 and 046. Lecturer. Taught class to ~ 64 (2 sections of 32 students each one)

• Winter Term 2015 (Jan-April 2015): Math 115. Calculus. Sections 018 and 023. Lecturer. Taught class to ~ 64 (2 sections of 32 students each one)

• Fall Term 2015 (Sept-Dec 2015): Math 216. Differential Equations. Sections 020 and 030. Lecturer. Taught class to ∼ 200 (2 sections of 100 students approximately each one)

• Winter Term 2016 (Jan-April 2016): Math 471. Introduction to Numerical Methods. Lecturer. Taught class to ∼ 20 graduate and undergraduate students.

• Fall Term 2016 (Sept-Dec 2016): Math 115. Calculus. Lecturer. Taught class to 2 sections of 17 students each one.

• Winter Term 2017 (Jan-April 2017): Math 316. Differential Equations. Lecturer. Taught class to 2 sections of 25 undergraduate students each one.

Teaching Assistant

1. Mathematics Department, Universidad Autónoma de Madrid, Spain. Taught problem class to ∼ 30 undergraduate students in mathematics

• Sept 2013-Feb 2014: Mathematical Analysis (Multivariable calculus and calculus in manifolds, 2 hours per week).

2.a) National University of La Plata, Argentina. In charge of problem classes of . ∼ 100 students together with other TA's and Class Tutor At the Mathematics department,

• May 2006- July 2007: Algebra (BA in Mathematics, four hours per week)
• May 2007-Aug 2010: Mathematical Analysis (BA in Mathematics four hours per week)
• Nov 2009-Aug 2010: Mathematical Analysis II (Multivariable calculus) (BA in Mathematics, six hours per week)
• March 2010-Aug 2010: Mathematical Analysis II (Multivariable calculus) (BA in biotechnology, pharmacy and biochemistry, six hours per week)
• May 2010-Aug 2010: Algebra (BA in biotechnology, pharmacy and biochemistry, six hours per week)
• May 2010-Aug 2010: Mathematical Analysis (BA in biotechnology, pharmacy and biochemistry, six hours per week)

• Feb 2007-March 2007: Precalculus (6 hours per week)
• Feb 2008-March 2008: Precalculus (12 hours per week)

2.b) At Engineering faculty

• March 2007-April 2010: Mathematical Analysis (three hours per week)