Marco Caponigro

Contact Information

Conservatoire National des Arts et Métiers
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Personal Data

Date of Birth: January 11, 1983
Place of Birth: Roma, Italy
Status: Married, 2 children (2015 & 2017).

Position Held

Maître de Conférences (Associate Professor) **since September 2012**
Département Ingénierie mathématique (IMATH), équipe: M2N
Conservatoire National des Arts et Métiers

Past Positions

Full-time 1yr CNRS leave **September 2016 to August 2017**
(*Délégation CNRS*)
Laboratoire Jacques-Louis Lions
UPMC, Paris 6

Postdoctoral Research Associate **Novembre 2011 to August 2012**
Department of Mathematical Sciences & CCIB
Rutgers University, NJ, USA

Postdoctoral fellowship **March 2010 to October 2011**
Project: CORIDA,
INRIA Nancy - Grand Est, Nancy, France

Postdoctoral fellowship **November 2009 to January 2010**
Sector of Functional Analysis and Applications
SISSA, Trieste, Italy

Scientific Education

SISSA, Trieste, Italy **26 October 2009**
PhD Degree in Applied Mathematics,
Thesis: *Controllability on the group of diffeomorphisms*,
Advisor: Andrei A. Agrachev.

University of Trieste & SISSA, Trieste, Italy **October 2006**
Master Degree in Mathematics ("Laurea Magistrale in Matematica"),
Thesis: *Biforcazione globale e applicazioni alla fluidodinamica*,
Advisor: Antonio Ambrosetti,
Grade: 110/110 cum laude.

University of Roma Tre, Roma, Italy **October 2004**
Bachelor Degree in Mathematics ("Laurea Triennale in Matematica"),
Grade: 110/110 cum laude.

Musical Education

Conservatorio "G. Tartini", Trieste, **24 February 2010**
Degree in Classical Guitar Performance,

Maestro: P. L. Corona.

Conservatorio "G. Tartini", Trieste, **October 2004 to February 2010**
Conservatory Student in Classical Guitar,
Maestro: P. L. Corona.

Conservatorio "S. Cecilia", Roma, **October 2000 to October 2004**
Conservatory Student in Classical Guitar,
Maestro: A. De Rose.

Publications

Journal papers

[1] A. Agrachev, M. Caponigro, *Controllability on the Group of Diffeomorphisms*, Annales de l'Institut Henri Poincaré (C) Analyse Non Linéaire, 26 (2009), pp. 2503-2509.

[2] A. Agrachev, M. Caponigro, *Dynamics Control by a Time–varying Feedback*, JDCS, Vol. 16 (2010), 2 (April), pp. 149–162.

[3] M. Caponigro, *Families of vector fields which generate the group of diffeomorphisms,* Proc. Steklov Inst. Math. (2010), Vol. 270, pp. 141–155.

[4] U. Boscain, M. Caponigro, T. Chambrion, M. Sigalotti, *A weak spectral condition for the controllability of the bilinear Schrödinger equation with application to the control of a rotating planar molecule,* Communications in Mathematical Physics, Vol. 311, Issue 2 (2012), 423–455.

[5] N. Boussaïd, M. Caponigro, T. Chambrion, *Weakly-coupled systems in quantum control*, IEEE Transactions on Automatic Control. Volume 58, Issue 9 (Sept. 2013), 2205–2216.

[6] M. Caponigro, M. Fornasier, B. Piccoli, E. Trélat, *Sparse stabilization and optimal control of the Cucker–Smale model*, Math. Cont. Related Fields 3 (2013), no. 4, 447–466.

[7] U. Boscain, M. Caponigro, M. Sigalotti, *Multi-input Schrödinger equation: controllability, tracking, and application to the quantum angular momentum*, Journal of Differential Equations 256 (2014), pp. 3524–3551.

[8] M. Caponigro, M. Fornasier, B. Piccoli, E. Trélat, *Sparse stabilization and control of alignement models*, Math. Models Methods Appl. Sci. Vol. 25, No. 03, pp. 521–564 (2015).

[9] S. Wongkaew, M. Caponigro, A. Borzì, *On the control through leadership of the Hegselmann–Krause opinion formation model*, Math. Models Methods Appl. Sci. Vol. 25, No. 03, pp. 565–585 (2015).

[10] M. Caponigro, A. C. Lai, B. Piccoli, *A nonlinear model of opinion formation on the sphere*, Discrete Contin. Dyn. Syst. Ser. A. Vol, No. 09, pp. 4241–4268 (2015).

[11] M. Bravo, M. Caponigro, E. Leibowitz, B. Piccoli, *Keep right or left? Towards a cognitive-mathematical model for pedestrians*, Networks and Heterogeneous Media, Vol.10, Issue 3 (September 2015), pp. 559 – 578.

[12] S. Wongkaew, M. Caponigro, K. Kułakowski, A. Borzì, *On the control of the Heider balance model*, The European Physical Journal Special Topics, December 2015, Vol 224, Issue 17, pp 3325-3342.

[13] M. Caponigro, B. Piccoli, F. Rossi, E. Trélat, *Mean-Field Sparse Jurdjevic–Quinn Control*, Mathematical Models and Methods in Applied Sciences, Volume 27, Issue 07, 1223–1253 (2017).

[14] M. Caponigro, B. Piccoli, F. Rossi, E. Trélat, *Sparse Jurdjevic–Quinn stabilization of dissipative systems*, Automatica, Volume 86, December 2017,pp 110–120.

PREPRINTS

[15] M. Caponigro, R. Ghezzi, B. Piccoli, E. Trélat, *Regularization of chattering phenomena via bounded variation control*, arXiv:1303.5796. *Submitted.*

[16] M. Caponigro, M. Sigalotti, *Exact controllability in projections of the bilinear Schrödinger equation*, hal-01509971. *Submitted.*

[17] N. Boussaïd, M. Caponigro, T. Chambrion, *Regular propagators of bilinear quantum systems*, hal-01016299. *Submitted.*

CONFERENCE PROCEEDINGS

[18] M. Caponigro, *Orientation preserving diffeomorphisms and flows of control-affine systems,* Proceedings of IFAC 18th world congress, Milan 2011.

[19] M. Caponigro, U. Boscain, T. Chambrion, M. Sigalotti, *Control of the bilinear Schrödinger equation for fully coupling potentials*, Proceedings of IFAC 18th world congress, Milan 2011.

[20] N. Boussaïd, M. Caponigro, T. Chambrion, *Periodic control laws for bilinear quantum systems with discrete spectrum*, Proceedings of the 2012 American Control Conference, Montreal, Canada, 2012.

[21] N. Boussaïd, M. Caponigro, T. Chambrion, *Implementation of logical gates on infinite dimensional quantum oscillators*, Proceedings of the 2012 American Control Conference, Montreal, Canada, 2012.

[22] N. Boussaïd, M. Caponigro, T. Chambrion, *Small time reachable set of bilinear quantum systems*, Proceedings of the 51^{st} IEEE Conference on Decision and Control, Maui, Hawaii, 2012.

[23] U. Boscain, M. Caponigro, M. Sigalotti, *Controllability of the bilinear Schrödinger equation with several controls and application to a* $3D$ *molecule*, Proceedings of the 51^{st} IEEE Conference on Decision and Control, Maui, Hawaii, 2012.

[24] N. Boussaïd, M. Caponigro, T. Chambrion, *Approximate controllability of the Schrödinger equation with a polarizability terms*, Proceedings of the 51^{st} IEEE Conference on Decision and Control, Maui, Hawaii, 2012.

[25] N. Boussaïd, M. Caponigro, T. Chambrion, *Which notion of energy for bilinear quantum systems?*, Proceedings of the 4^{th} IFAC Workshop on Lagrangian and Hamiltonian Methods for Non Linear Control, Bertinoro, Italy, 2012.

[26] N. Boussaïd, M. Caponigro, T. Chambrion, *Energy estimates for low regularity bilinear Schrdinger equations*, Proceedings of the 1st IFAC Workshop on Control of Systems Modeled by Partial Differential Equations, Paris, France, 2013.

[27] N. Boussaïd, M. Caponigro, T. Chambrion, *Total Variation of the Control and Energy of Bilinear Quantum Systems*, Proceedings of the 52^{nd} IEEE Conference on Decision and Control, Florence, Italy, 2013.

[28] N. Boussaïd, M. Caponigro, T. Chambrion, *An Approximate Controllability Result with Continuous Spectrum : The Morse Potential with Dipolar Interaction*, Proceedings of the 2015 SIAM Conference on Control and Its Applications, Paris, France, 2015.

[29] M. Caponigro, B. Piccoli, F. Rossi, E. Trélat, *Sparse feedback stabilization of multi-agent dynamics* Proceedings of the 55^{th} IEEE Conference on Decision and Control, Las Vegas, Nevada, 2016.

[30] M. Caponigro, M. Sigalotti, *Controllability in projection of the simple spectrum bilinear Schrödinger equation*, Proceedings of the 20th World Congress of the International Federation of Automatic Control, Toulouse, France, 2017.

NOTES AND CHAPTERS IN BOOKS

[31] A. Aydogdu, M. Caponigro, S. McQuade, B. Piccoli, N. Pouradier-Duteil, F. Rossi, E. Trélat, *Interaction Network, State Space and Control in Social Dynamics* in "Active Particles - Volume 1 - Theory, Models, Applications", Editors: N. Bellomo, P. Degond, and E. Tadmor, Birkhäuser-Springer, Boston, USA. 2016.

[32] A. Borzí, M. Caponigro, *A control theoretical approach to crowd management: Comment on "Human behaviours in evacuation crowd dynamics: From modelling to "big data" toward crisis management" by Nicola Bellomo et al.*, Physics of Life Reviews, Volume 18, September 2016, Pages 27-28.

SOFTWARE

Q-Track. Algorithm for the computation of control laws for the bilinear Schrödinger equation. In collaboration with U. Boscain, T. Chambrion, and M. Sigalotti. Registered at the French "Agence pour la Protection des Programmes" on March, 12, 2011, ref: IDDN.FR.001.110021.000.S.P.2011.000.10000.

SUPERVISION

Phd Thesis Co-supervision, with Alfio BORZÌ (Wuerzburg University) of the Phd thesis in Applied Mathematics of Suttida WONGKAEW. Thesis defended on October 5th, 2015 at Wuerzburg University. Title: "On the control through leadership of multi-agent systems".

Stages de Master Supervision of the research master thesis (M2) at Rutgers - Camden, NJ, USA of Benjamin HEYMANN (École Polytechnique). Title : "Psychological insight in multi-scale models for pedestrian movements". February - August 2012.

Stages de Licence Supervision of the research stage (L3) for the *Licence en Mathématiques du CNAM* of Jean-Paul ING. Title: "Contrôlabilité, Stabilité, Observabilité : Le cas des systèmes linéaires". March - July 2014.

ADMINISTRATION

National manager for he CNAM of the undergraduate course MVA101- Analyse et

Calcul Matriciel. 2014–present

Organizer of the "Seminar M2N" at CNAM, Paris. 2013–present

Organizer of the conference "Control of PDEs", CNAM, Paris, France, March 2014.

Organizer of the session "Modeling and Control of Collective Dynamics" for the 1st IFAC Workshop on Control of Systems Modeled by Partial Differential Equations, Paris, France, September 2013.

Organizer of the double session "New directions of control design for quantum systems" for the 51^{st} IEEE Conference on Decision and Control, Maui, Hawaii, 2012.

Award

Prime d'Excellence Scientifique (PES/PEDR) 2013. **2013–2017**

Research projects

BFHZ-CCUFB grant **January to December 2016**
Collaboration between CNAM and Wuerzburg University. Role: PI. Eur ∼3500.

CNRS DEFI InFIniTI **January to December 2016**
Projet DISQUO. Role: Member. Eur ∼5000.

ANR - Appel à projets générique 2017. **January 2018 to December 2021**
QUACO - Contrôle quantique : systèmes d'EDPs et applications à l'IRM. Role: Member. Eur ∼210000Eur.

Graduate teaching

Mini-course *Stabilization and optimal control in multiagent dynamics.* University of Laguna, La Laguna, Spain. 11^{th} International Young Researcher Workshop on Geometry, Mechanics and Control.

Seminars and talks

Controllability in projections for the bilinear Schrödinger equation
Toulouse, France **July 2017**
The 20^{th} IFAC World Congress.

Exact controllability in projections for the bilinear Schrödinger equation
École Polytechnique, Palaiseau, France **May 2017**
Thematic day "A day in control theory"

Stabilisation creuse et contrôle à consensus de modèles multi-agents
Laboratoire Jacques-Louis Lions, Paris 6, France **March 2017**
Séminaire du Laboratoire.

Stabilization and optimal control in multiagent dynamics
University of La Laguna, La Laguna, Spain **January 2017**
11th International Young Researcher Workshop on Geometry, Mechanics and Control.

Control of the Schrödinger Equation: The Lie–Galerkin method,
SophiaTech Campus, Sophia Antipolis, France **June 2015**
27^{th} IFIP TC7 Conference.

Sparse stabilization in multi-agent systems,
SophiaTech Campus, Sophia Antipolis, France **June 2015**
27^{th} IFIP TC7 Conference.

Sparse stabilization in multi-agent systems,
IMB, Dijon, France **Avril 2015**
Séminaire SPOC.

Sparse stabilization in multi-agent systems,
Laboratoire Jacques-Louis Lions, Paris 6, France **January 2015**
"Groupe de Travail Contrôle".

Geometric Methods in Quantum Control,
CIRM, Marseille, France **December 2014**

"Colloque International du LEM2I".
Sparse stabilization of multi-agent models,
AMU, Marseille, France **December 2014**
Journée thématique "Optimisation et Contrôle".
Modeling and Control of Opinion Formation
Rutgers Camden, NJ, USA **October 2014**
Conference "Modeling and Control in Social Dynamics".
Modeling Opinion Formation,
CNAM, Paris, France **September 2014**
Journée M2N/MSDMA.
Regularization of chattering phenomena via bounded variation controls,
Lake Baikal, Russia, **August 2014**
Geometric control theory and analysis on metric structures.
Sparse Stabilization of Multi-Agent Systems,
Madrid, Spain, **July 2014**
10^{th} AIMS Conference on Dynamical Systems, Differential Equations and Applications.
Sparse control of alignement models,
SISSA, Trieste, Italy, **December 2013**
"Mathematical Control in Trieste".
Sparse Stabilization of the Cucker–Smale Model,
University of Paris Dauphine, France, **September 2013**
"ESF OPTPDE Workshop InterDyn2013 : Modeling and Control of Large Interacting Dynamical Systems".
Geometric Methods in Quantum Control
Rutgers Camden, NJ, USA **March 2013**
"Dynamical systems and Control".
Approximate controllability for the bilinear Schrödinger equation
Milan, Italy **September 2011**
"18th IFAC world congress".

Orientation preserving diffeomorphisms and flows of control-affine systems
Milan, Italy **September 2011**
"18th IFAC world congress".

Approximate controllability for the bilinear Schrödinger equation
Madrid, Spain **July 2011**
"V International Summer School on Geometry, Mechanics, and Control".

Un algorithme pour le contrôle de l'équation de Schrödinger bilinéaire
Université de Bourgogne, Dijon, **June 2011**
Seminars of the workgroup "Quantum Control" (in french).

Contrôlabilité approchée de l'équation de Schrödinger bilinéaire,
Laboratoire de Mathématiques de Besançon, **March 2011**
Seminars of the Numerical Analysis team (in french).

Contrôlabilité approchée de l'équation de Schrödinger bilinéaire,
Laboratoire Jacques-Louis Lions, Paris 6, France **March 2011**
"Groupe de Travail Contrôle".

Contrôlabilité approchée de l'équation de Schrödinger bilinéaire,
Institut Elie Cartan, Nancy, **March 2011**
Seminars of the team "Équations aux drives partielles" (in french).

Controllability on the Group of Diffeomorphisms,
Santiago de Compostela, Spain **July 2010**
"IV International Summer School on Geometry, Mechanics, and Control".

Controllability on the Group of Diffeomorphisms,
Turin, Italy **April 2009**
"Mathematical Control Theory: Controllability, Optimization, Stability".

Families of Vector Fields Generating the Group of Diffeomorphisms,
Suzdal, Russian Federation **July 2008**
"International Conference on Differential Equations and Dynamical Systems".

Controllability on the Group of Diffeomorphisms,
Moscow, Russian Federation **June 2008**
"International Conference: Differential Equations and Topology".

Conferences and schools

Toulouse, France **July 2017**
The 20^{th} IFAC World Congress.

University of La Laguna, La Laguna, Spain **January 2017**
11th International Young Researcher Workshop on Geometry, Mechanics and Control.

SophiaTech Campus, Sophia Antipolis, France **June 2015**
27^{th} IFIP TC7 Conference.

CIRM, Marseille, France **December 2014**
Colloque International du LEM2I.

Rutgers University, Camden, NJ, USA **October 2014**
Modeling and Control in Social Dynamics.

Lake Baikal, Russia, **August 2014**
Geometric control theory and analysis on metric structures.

Madrid, Spain, **July 2014**
The 10^{th} AIMS Conference on Dynamical Systems, Differential Equations and Applications.

Tours, France, **June 2014**
Conference on "New Trends in Optimal Control".

SISSA, Trieste, Italie **December 2013**
Mathematical Control in Trieste.

IHP, Paris, France **September 2013**
Control of Systems Modeled by Partial Differential Equations - 1st CPDE 2013.

University of Paris Dauphine, France **September 2013**
ESF OPTPDE Workshop InterDyn2013 : Modeling and Control of Large Interacting Dynamical Systems.

Rutgers Camden, NJ, USA **March 2013**
Kinetic Interaction Team (KIT): Sparse Control of Large Groups.

CIRM, Marseille, France **November 2012**
Thematic school of the GDRE ConEDP: Control of PDE's, interactions and application challenges.

Milan, Italy **September 2011**
18th IFAC world congress.

Madrid, Spain **July 2011**
V International Summer School on Geometry, Mechanics, and Control.

Paris, France **October 2010 to December 2010**
Centro Emile Borel, Institut Henry Poincaré.
Trimester "Control of Partial and Differential Equations and Applications".

Cetraro, Italy **July 2010**
CIME course in Control of Partial Differential Equations.

Santiago de Compostela, Spain **July 2010**
IV International Summer School on Geometry, Mechanics, and Control.

Bilbao, Spain **November 2009**
BCAM courses on applied and computational mathematics:
"Control problems in quantum mechanics".

L'Ametlla de Mar, Catalunya, Spain **June 2009**
III International Summer School on Geometry, Mechanics, and Control.

Roma, Italy **June 2009**
Nonsmooth Analysis, Control Theory and Differential Equations.

Napoli, Italy **May 2009**
Summer school in "Hamiltonian PDEs".

Turin, Italy **April 2009**
Workshop "Mathematical Control Theory: Controllability, Optimization, Stability".

Pisa, Italy **November 2008**
Workshop on "Optimal Transportation and Applications".

Pisa, Italy **October 2008**
School on "Optimal Transportation, Geometry and Functional Inequalities".

Suzdal, Russian Federation **July 2008**
International Conference on "Differential Equations and Dynamical Systems".

Moscow, Russian Federation **June 2008**
International Conference: "Differential Equations and Topology".

Trieste, Italy **May 2007**
Workshop on "Control, Optimization and stability of non-linear systems: geometric and analytic methods".

Perugia, Italy **August 2003**
Summer school for INdAM fellowship holders.

Perugia, Italy **August 2002**
Summer workshop for INdAM fellowship holders.

Undegraduate Teaching

A.A. 2015/2016: 210 hours
CNAM, Paris
MVA 101 Analyse et Calcul Matriciel. 75 hours.
CNAM, Saint-Denis
MAA 111 Outils Mathématiques - SETII1. 37,5 hours.
MAA 112 Analyse de Fourier - IDEEI1. 43,5 hours.
Université de Bourgogne, Dijon Mathématiques de L'Économie. 36 hours.
A.A. 2014/2015: 195 hours
CNAM, Paris
MVA 101 Analyse et Calcul Matriciel. 75 hours.
CNAM, Saint-Denis
MAA 111 Outils Mathématiques - SETII1. 51,5 hours.
MAA 112 Analyse de Fourier - IDEEI1. 49 hours.
A.A. 2013/2014: 215 hours
CNAM, Paris
MVA 101 Analyse et Calcul Matriciel. 42 hours.
CNAM, Saint-Denis
MAA 111 Outils Mathématiques - SETII1. 51,5 hours.
MAA 111 Outils Mathématiques - SESFI1. 44,5 hours.
MAA 111 Outils Mathématiques - SECFI1. 38 hours.
MAA 121 Analyse matricielle et vectorielle - IDEEI2. 16 hours.
A.A. 2012/2013: 201 hours CNAM, Paris

MVA 901 Mise à Niveau en Math (1). 40 hours, 70 students.
MVA 902 Mise à Niveau en Math (2). 20 hours, 50 students.
MVA 101 Analyse et Calcul Matriciel. 30 hours, 50 students.
Tutorials MAPLE. 18 hours, 20 students.

CNAM, Saint-Denis

MAA 112 Analyse de Fourier - SETI. 49 hours, 26 students.
MAA 112 Analyse de Fourier - SESF. 44,5 hours, 20 students.