Born November 19 1989 in Varese (Italy)
Languages: Italian (native), English (fluent),
           French (fluent)

PhD Applied Mathematics

Associate Professor (Chargé de recherche CNRS)
Université Paris-Saclay
Laboratory of Signals and Systems (L2S)
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Married, one child.

1 Academic Positions

- From 10/2021: Associate Professor (Chargé de Recherche CNRS) at Université Paris-Saclay, Laboratory of Signals and Systems (L2S) at CentraleSupélec School of Engineering.

- 08/2018–07/2021: Postdoctoral Fellow at the Autonomous Systems Laboratory (Director Prof Marco Pavone), Aeronautics & Astronautics Department at Stanford University.

2 Education

- 04/2015–07/2018: PhD in Applied Mathematics with Highest Honors (Grade: avec félicitations du jury[1]), Sorbonne Université. Collaboration between Inria, Laboratoire Jacques-Louis Lions, and ONERA-The French Aerospace Lab. Advisors: Prof Emmanuel Trélat and Dr Bruno Hérissé.

- 03/2012–12/2014: MSc in Mathematical Engineering with Honors (Grade: 111.75/110), Politecnico di Milano.

- 03/2014–08/2014: Professional Internship, IFP Energies Nouvelles.

- 10/2011–02/2012: Graduate Specialization in Numerical Analysis (Credits: 30 ECTS), Politecnico di Milano.

- 10/2008–09/2011: BSc in Physical Engineering, Politecnico di Milano.

- 09/2008: Scientific High-School Diploma, Liceo Scientifico Vittorio Sereni (Italy).

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[1]Since 2016, honorifics legally ceased to be used for the completion of a PhD in France. Nevertheless, honorifics can be informally awarded by the PhD defense committee after the defense.

3   Awards, Distinctions, and Funding

- 2023–2026: PI of the ANR JCJC project ROCH–Risk-averse Optimal Control via Homotopy. Financing: 229 277€.

- 2021: Ranked 1° place, French national CNRS selection in Systems and Control 07/02.

- 2021: Ranked 2° place, French national CNRS selection in Mathematics 41/05.

- 2018: Postdoctoral fellowship at Stanford University funded by NASA space program.

- 2018: ONERA Best PhD student award 2018 - DTIS Department (link in french).

4   Publications

4.1   Journal Papers

[J12] **R. Bonalli** and A. Rudi, *Non-Parametric Learning of Stochastic Differential Equations with Fast Rates of Convergence.* Submitted. Pdf file.

[J11] C. Leparoux, **R. Bonalli**, B. Hérissé, and F. Jean, *Statistical Linearization for Robust Motion Planning.* Submitted. Pdf file.

[J10] T. Lew, **R. Bonalli**, L. Janson, and M. Pavone, *Estimating the Convex Hull of the Image of a Set with Smooth Boundary: Error Bounds and Applications.* Submitted. Pdf file.

[J9] **R. Bonalli**, C. Leparoux, B. Hérissé, and F. Jean, *On the Accessibility and Controllability of Statistical Linearization for Stochastic Control: Algebraic Rank Conditions and their Genericity.* Submitted. Pdf file.

[J8] T. Lew, **R. Bonalli**, and M. Pavone, *Sample Average Approximation for Stochastic Programming with Equality Constraints.* Submitted. Pdf file.

[J7] **R. Bonalli** and B. Bonnet, *First-Order Pontryagin Maximum Principle for Risk-Averse Stochastic Optimal Control Problems.* Accepted in **SIAM J. Control Optim.** Pdf file.

[J6] **R. Bonalli**, T. Lew, and M. Pavone, *Analysis of Theoretical and Numerical Properties of Sequential Convex Programming for Continuous-Time Optimal Control.* **IEEE Transactions on Automatic Control**, Early Access (2022). Pdf file.

[J5] M. P. Chapman, **R. Bonalli**, K. M. Smith, I. Yang, M. Pavone, and C. J. Tomlin, *Risk-sensitive safety analysis using Conditional Value-at-Risk.* **IEEE Transactions on Automatic Control**, 67 (2022), pp. 6521–6536. Pdf file.

[J4] **R. Bonalli**, T. Lew, and M. Pavone, *Sequential Convex Programming for Non-Linear Stochastic Optimal Control.* **ESAIM: Cont. Optim. Calc. Var.**, 28 (2022), total pp. 34. Pdf file.

[J3] D. Malyuta, T. P. Reynolds, M. Szmuk, T. Lew, **R. Bonalli**, M. Pavone, and B. Açıkmeşe, *Convex Optimization for Trajectory Generation: A Tutorial on Generating Dynamically Feasible Trajectories Reliably and Efficiently.* **IEEE Control Systems Magazine**, 42 (2022), pp. 40–113. Pdf file.

[J2] **R. Bonalli**, B. Hérissé and E. Trélat, *Optimal Control of Endo-Atmospheric Launch Vehicle Systems: Geometric and Computational Issues.* **IEEE Transactions on Automatic Control**, 65 (2020), pp. 2418–2433. Pdf file.

[J1] **R. Bonalli**, B. Hérissé and E. Trélat, *Continuity of Pontryagin Extremals with Respect to Delays in Nonlinear Optimal Control.* **SIAM J. Control Optim.**, 57 (2019), pp. 1440–1466. Pdf file.

4.2 Proceedings in Conferences

[C12] T. Lew, **R. Bonalli**, and M. Pavone, *Exact Characterization of the Convex Hulls of Reachable Sets*. Submitted. Pdf file.

[C11] F. Mahlknecht, J. I. Alora, S. Jain, E. Schmerling, **R. Bonalli**, G. Haller, and M. Pavone, *Using Spectral Submanifolds for Nonlinear Periodic Control*. Proc. IEEE Conference on Decision and Control, 2022, Cancun. Pdf file.

[C10] T. Lew, L. Janson, **R. Bonalli**, and M. Pavone, *A Simple and Efficient Sampling-based Algorithm for General Reachability Analysis*. Proc. Learning for Dynamics and Control Conference, 2022, Stanford. Pdf file.

[C9] A. Bylard, **R. Bonalli**, and M. Pavone, *Composable Geometric Motion Policies using Multi-Task Pullback Bundle Dynamical Systems*. Proc. International Conference on Robotics and Automation, 2021, Xi'an. Pdf file.

[C8] T. Lew, **R. Bonalli**, and M. Pavone, *Chance-Constrained Sequential Convex Programming for Robust Trajectory Optimization*. Proc. European Control Conference, 2020, Saint Petersburg. Pdf file.

[C7] S. Banerjee, T. Lew, **R. Bonalli**, A. Alfaadhel, I. A. Alomar, H. M. Shageer, and M. Pavone, *Learning-based Warm-Starting for Fast Sequential Convex Programming and Trajectory Optimization*. Proc. IEEE Aerospace Conference, 2020, Big Sky. Pdf file.

[C6] M. Kleinbort, K. Solovey, **R. Bonalli**, E. Granados, *Refined Analysis of Asymptotically-Opimal Kinodynamic Planning in the State-Cost Space*. Proc. International Conference on Robotics and Automation, 2020, Paris. Pdf file.

[C5] **R. Bonalli**, A. Cauligi, A. Bylard, T. Lew and M. Pavone, *Trajectory Optimization on Manifolds: A Theoretically-Guaranteed Embedded Sequential Convex Programming Approach*. proc. Robotics: Science and Systems, 2019, Freiburg. Pdf file.

[C4] **R. Bonalli**, A. Cauligi, A. Bylard and M. Pavone, *GuSTO: Guaranteed Sequential Trajectory Optimization via Sequential Convex Programming*. Proc. International Conference on Robotics and Automation, 2019, Montreal. Pdf file.

[C3] **R. Bonalli**, B. Hérissé, H. Maurer and Emmanuel Trélat. *The Dubins Car Problem with Delay and Applications to Aeronautics Motion Planning Problems*. Proc. 18th French - German - Italian Conference on Optimization, 2017, Paderborn.

[C2] **R. Bonalli**, B. Hérissé and E. Trélat. *Analytical Initialization of a Continuation-Based Indirect Method for Optimal Control of Endo-Atmospheric Launch Vehicle Systems*. Proc. IFAC World Congress, 2017, Toulouse. Pdf file.

[C1] **R. Bonalli**, B. Hérissé and E. Trélat. *Solving Optimal Control Problems for Delayed Control-Affine Systems with Quadratic Cost by Numerical Continuation*. Proc. American Control Conference, 2017, Seattle. Pdf file.

4.3 Graduate Thesis

[T1] PhD Thesis – **R. Bonalli**, *Optimal Control of Aerospace Systems with Control-State Constraints and Delays*. Defended on July 13, 2018 (Sorbonne Université). Dissertation committee: Jean-Baptiste Caillau, Jean-Michel Coron, Bruno Hérissé, Nicolas Petit, Jean-Baptiste Pomet, Emmanuel Trélat and Hasnaa Zidani. Pdf file.

5 Software and Hardware Experiments

5.1 Software

[S3] `PBDS` - Julia package implementing Pullback Bundle Dynamical Systems, a differential geometric paradigm for real-time policy generation. Developed in collaboration with Andrew Bylard and Marco Pavone during my postdoc at Stanford University, this library provides composed policies in real time (300-500 Hz) for high-DOF robotic systems operating in cluttered environments. The open source code can be found here.

[S2] `GuSTO` - Julia package implementing `GuSTO`, a sequential convex programming paradigm for real-time trajectory optimization. Developed in collaboration with Andrew Bylard, Abhishek Cauligi, Marco Pavone, and Thomas Lew during my postdoc at Stanford University, this library combines ease-of-use with fast computation, providing solutions in real-time for many autonomous systems. The open source code can be found here.

[S1] `SOCP` - `C++` package implementing shooting methods for optimal control problems, specialized for launch vehicles. This paradigm has been developed during my PhD at Sorbonne Univeristé and ONERA in collaboration with Bruno Hérissé, and can compute optimal solutions for endo-atmospheric rendezvous problems in few milliseconds. The open source code can be found here.

5.2 Hardware Experiments

[E1] Freeflyer experiments on simulated two-dimensional micro-gravity environments at Stanford University, in collaboration with Andrew Bylard, Abhishek Cauligi, and Marco Pavone during my postdoc at Stanford University, the video can be found here. Preliminary tests were conducted in late 2021 by NASA aboard the International Space Station, you may find the video here.

6 Organized Seminars, Sessions, and Workshops

6.1 Seminars

- From 03/2022: *Séminaire d'Automatique du Plateau de Saclay*. Seminar series in systems and control at Laboratory of Signals and Systems (L2S), Université Paris-Saclay, CNRS, Centrale-Supélec. Organizers: N. Amini, **R. Bonalli**, and G. Mazanti.

6.2 Sessions and Workshops

- Session *Theoretical and Numerical Advances on the Optimal Control of Complex Systems*. 18th IFAC Workshop on Control Applications of Optimization, 2022, Gif-sur-Yvette. Organizers: **R. Bonalli** and L. Pfeiffer.

- Workshop *Space Robotics*. Robotics: Science and Systems, 2019, Freiburg. Organizers: **R. Bonalli**, M. Pavone, N. Ahmed, D. Szafir, C. Heckman, J. McMahon and E. Komendera.

7 Visitings and Invited Talks

7.1 Visitings

- November 2022, Visiting Prof's Florian Dörfler group at Institut für Automatik (IfA), ETH Zürich.

7.2 Invited Talks

- July 26 2023, *First Order Conditions for Optimality for Non-Smooth Risk-Averse Optimal Control*. Talk at the invited session "Geometric Control Theory with Quantum and Classical Applications", SIAM Conference on Control and Its Applications 2023, Philadelphia.

- March 22 2023, *On Learning- and Optimization-based Methods for Risk-Averse Control of Autonomous Systems.* Talk at the Finance and Euler Institutes (USI), Lugano.

- February 22 2023, *On Learning- and Optimization-based Methods for Risk-Averse Control of Autonomous Systems.* Talk (seminar series "Machine Learning Seminar") at the Faculty of Science, Technology and Medicine (University of Luxembourg), Luxembourg.

- December 6 2022, *On Learning- and Optimization-based Methods for Risk-Averse Control of Autonomous Systems.* Talk at Laboratoire de Mathématiques de l'INSA (INSA Rouen Normandie), Rouen.

- November 15 2022, *On Learning- and Optimization-based Methods for Risk-Averse Control of Autonomous Systems.* Talk at Institut für Automatik (ETH), Zürich.

- October 18 2022, *Overview and perspectives of the project ROCH (Risk-averse Optimal Control via Homotopy).* Talk at Pôle Automatique et Systèmes of CentraleSupélec, Gif-sur-Yvette.

- July 7 2022, *Optimization- and Learning-Based Control for Autonomous Systems.* Talk at "Journée hors murs L2S", Jouy-en-Josas.

- October 29 2021, *Combining Stochastic Sequential Convex Programming with Pullback Bundle Dynamical Systems for the control of complex systems.* Talk (seminar series "GdT Contrôle") at Laboratoire Jacques-Louis Lions (Sorbonne Université), Paris.

- October 18 2021, *On Optimal Control of Complex Dynamical Systems.* Talk at Pôle Automatique et Systèmes of CentraleSupélec, Gif-sur-Yvette.

- February 10 2021, *On Optimal Control of Complex Dynamical Systems.* Talk at the Department of Aeronautics (Imperial College), London.

- January 29 2021, *On Optimal Control of Complex Dynamical Systems.* Talk at UW Aeronautics and Astronautics (University of Washington), Seattle.

- January 25 2021, *On Optimal Control of Complex Dynamical Systems.* Talk at Université Catholique de Louvain, Louvain-la-Neuve.

- January 20 2021, *Robust Optimal Control of Distributed Thermo-Fluid Plants.* Talk at Delft Center for Systems and Control (TU Delft), Delft.

- December 3 2020, *On Optimal Control of Complex Dynamical Systems.* Talk at Centre automatique et systèmes (MINES ParisTech), Paris.

- November 19 2020, *On Optimal Control of Complex Dynamical Systems.* Talk at Laboratoire d'analyse et d'architecture des systèmes, Toulouse.

- November 17 2020, *Towards Principled Algorithms for Stochastic Optimal Control of Nonlinear Dynamical Systems.* Talk at Laboratoire des signaux et systèmes (CentraleSupélec), Gif-sur-Yvette.

- October 27 2020, *Towards Principled Algorithms for Stochastic Optimal Control of Nonlinear Dynamical Systems.* Talk at Inria SPHINX (Institut Elie Cartan de Lorraine), Nancy.

- October 19 2020, *Composable Geometric Motion Policies using Multi-Task Pullback Bundle Dynamical Systems.* Talk (seminar series "Autonomy Talk") at ETH Zurich, Zurich.

- July 7 2020, *Towards Principled Algorithms for Stochastic Optimal Control of Nonlinear Mechanical Systems.* Talk (seminar series "Progetto di Eccellenza") at Politecnico di Torino, Turin.

- July 2 2020, *Sequential Convex Programming for Non-Linear Stochastic Optimal Controls.* Talk at Stanford University, Stanford.

- May 24 2019, *Real-time Optimal Control of Robotics Systems.* Talk at Concordia University, Montreal.

- May 15 2019, *Real-time Optimal Control of Endo-Atmospheric Launch Vehicles.* Talk (seminar series "Informal Systems Seminar") at McGill University, Montreal.

- October 1 2018, *Methods for Real-time Optimal Guidance of Launch Vehicles.* PhD Students Welcoming Day at ONERA - The French Aerospace Lab, Palaiseau.

8 Evaluation Committees

- September 15 2022, Member of the evaluation committee for the L2S Best PhD Presentation Award 2022 at CentraleSupélec (Université Paris-Saclay).

9 Teaching Activity

- From 2023: Principal instructor for the course *Optimal Control of Ordinary Differential Equations (SOD311)* co-taught with L. Pfeiffer at ENSTA ParisTech.

- From 2022: Collaborating instructor for the course *Systems and Control (AUT201)* held at ENSTA ParisTech by Prof Frédéric Jean.

- 2019–2020: Collaborating instructor for the course *Optimal and Learning-Based Control (AA203)* held at Stanford University by Prof Marco Pavone.

- 2016–2017: Teaching assistant for the course *Quadratic Optimization (AO101)* held at ENSTA ParisTech by Prof Hasnaa Zidani.

- 2015–2017: Teaching assistant for the course *Analysis and Stability of Dynamical Systems (AO102)* held at ENSTA ParisTech by Prof Frédéric Jean.

10 Academic Supervision

10.1 PhD Students

- Gabriel Velho, Université Paris-Saclay, from 11/2022 (co-supervision with J. Auriol).

- Thomas Lew (PhD 2023), Stanford University, 09/2019–09/2023 (co-supervision with M. Pavone).

- Andrew Bylard (PhD 2021), Stanford University, 08/2018–11/2021 (co-supervision with M. Pavone).

10.2 Master Students

- Yassine Oj, ENSTA ParisTech, 04/2023–09/2023 (co-supervision with A. Saoud and A. Girard).

- Gabriel Velho, École Polytechnique, 04/2022–09/2022.

- Alessandro Melone, DLR Munich and Università degli Studi di Napoli Federico II, 09/2021–03/2022 (co-supervision with R. Lampariello).

- Spencer Richards, Stanford University, 09/2020–07/2021 (co-supervision with M. Pavone).

- Somrita Banerjee, Stanford University, 03/2018–08/2019 (co-supervision with M. Pavone).

- Abhishek Cauligi, Stanford University, 08/2018–08/2019 (co-supervision with M. Pavone).

- Quentin Chan-Wai-Nam, MINES ParisTech, 03/2017–08/2017 (co-supervision with B. Hérissé).

11 Review Activity

I am peer-reviewer for conferences and journals in the field of theoretical and numerical control for aerospace and robotics. The list of journals includes: Acta Applicandae Mathematicae; ESAIM COCV; European Journal of Control; IEEE Control System Letters; IEEE Transactions on Automatic Control; IEEE Transactions on Robotics; Mathematical Control and Related Fields; Mathematics of Control, Signals, and Systems; Optimal Control, Applications and Methods; SIAM Journal on Control and Optimization; The Aeronautical Journal.