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

PhD Applied Mathematics

Tenured CNRS reseacher (Chargé de Recherche)
Laboratory of Signals and Systems (L2S)
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1 Academic Positions

- From 10/2021: Tenured CNRS researcher (Chargé de Recherche), Laboratory of Signals and Systems (L2S), at Université Paris-Saclay, CNRS, CentraleSupélec.
- 08/2018–07/2021: Postdoctoral Researcher 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).

3 Awards and Distinctions

- 2021: Ranked 1° place, French national CNRS competition in Automatics 07/02.
- 2021: Ranked 2° place, French national CNRS competition 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).

[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.

4 Major Project Achievements

[A4] `PBDS` - Julia package implementing Pullback Bundle Dynamical Systems, a differential geometric paradigm for real-time policy generation. Developed in collaboration with Andrew Bylard during my postdoc at Stanford University, this library provides composed policies in real time (300-500 Hz) for robotic systems with high degree of freedom operating in highly cluttered environments. The open source code can be found here.

[A3] Freeflyer experiments on simulated two-dimensional micro-gravity environments at Stanford University, in collaboration with Andrew Bylard and Abhishek Cauligi. Tests will be conducted in September 2021 aboard the International Space Station. The video can be found here.

[A2] `GuSTO` - Julia package implementing `GuSTO`, a sequential convex programming paradigm for real-time trajectory optimization. Developed in collaboration with Andrew Bylard, Abhishek Cauligi 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.

[A1] `SOCP` - `C++` package implementing indirect shooting methods for optimal control problems, specialized in 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. A (partial) open source version can be found here.

5 Publications

5.1 Work in Progress

[P2] A. Bylard, **R. Bonalli**, and M. Pavone, *Composable Geometric Motion Policies using Multi-Task Pullback Bundle Dynamical Systems*. Work in progress to be submitted to International Journal of Robotics Research.

[P1] B. Hérissé, **R. Bonalli**, and E. Trélat, *An Indirect Multiple Shooting Method for Anytime Motion Planning*. Work in progress to be submitted to Optimization Methods & Software.

5.2 Journal Papers

[J6] **R. Bonalli**, T. Lew, and M. Pavone, *Sequential Convex Programming for Non-Linear Stochastic Optimal Control*. Submitted to **ESAIM: COCV** Pdf file.

[J5] **R. Bonalli**, T. Lew, and M. Pavone, *Analysis of Theoretical and Numerical Properties of Sequential Convex Programming for Continuous-Time Optimal Control*. Submitted to **IEEE Transactions on Automatic Control**. Pdf file.

[J4] D. Malyuta, T. P. Reynolds, M. Szmuk, T. Lew, **R. Bonalli**, M. Pavone, and B. Açikmeşe, *Optimization for Trajectory Generation*. To appear in **IEEE Control Systems Magazine**. Pdf file.

[J3] 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**, Early Access (2021). 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.

5.3 Proceedings in Conferences

[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.

5.4 PhD Thesis

[T1] **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.

6 Organized Workshops

- *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 Invited Talks

- 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 Welcome Day at ONERA - The French Aerospace Lab, Palaiseau.

8 Teaching Activity

- Spring 2019 and Spring 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.

9 Student Supervision

9.1 PhD Students

- Thomas Lew, Stanford University, from 09/2019 (co-supervision with M. Pavone).
- Spencer Richards, Stanford University, from 09/2020 (co-supervision with M. Pavone).
- Andrew Bylard (PhD 2021), Stanford University, 08/2018–11/2021 (co-supervision with M. Pavone).

9.2 Master Students

- 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).

10 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; European Journal of Control; IEEE Control System Letters; IEEE Transactions on Automatic Control; IEEE Transactions on Robotics; Mathematical Control and Related Fields; Optimal Control, Applications and Methods; SIAM Journal on Control and Optimization; The Aeronautical Journal.