

Born the 19th November 1989 in Varese (Italy)

PhD Applied Mathematics

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1 Academic Positions

- From 08/2018: Postdoctoral Researcher at the Autonomous Systems Laboratory (Director Prof Marco Pavone), Aeronautics & Astronautics Department at Stanford University, under a NASA Early Career Faculty Grant.

2 Education

- 04/2015–07/2018: PhD in Applied Mathematics, Sorbonne Université, Paris. Collaboration between ONERA - The French Aerospace Lab and Laboratoire Jacques-Louis Lions. Advisors: Prof Emmanuel Trélat (Sorbonne Université) and Dr Bruno Hérissé (ONERA).
- 09/2012–12/2014: MSc in Mathematical Engineering, Politecnico di Milano, Milan. Graduated with 111.75/110 (Honors). Total SCH: 245/200.
- 09/2008–09/2011: BSc in Physical Engineering, Politecnico di Milano, Milan.
- 2008: Scientific High-School Diploma, Liceo Scientifico ”Sereni”, Luino (Italy).

3 Awards and Distinctions

- 2018: Postdoctoral Program at Stanford University under a NASA Early Career Faculty Grant.
- 2018: ONERA Best PhD student award 2018 - DTIS Department ([link in french](#)).

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](#). Videos 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] **SOCOP** - C++ package implementing indirect shooting methods for optimal control problems, specialized in launch vehicles. This paradigm has been developed during my PhD at Sorbonne Université and ONERA in collaboration with Bruno Hérisse, 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] M. Szmuk, D. Malyuta, T. P. Reynolds, T. Lew, **R. Bonalli**, B. Açıkmeşe, and M. Pavone, *Convex Optimization-Based Trajectory Generation*. Work in progress to be submitted to IEEE Control Systems Magazine.

[P1] B. Hérisse, **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

[J5] **R. Bonalli**, T. Lew, and M. Pavone, *Sequential Convex Programming for Non-Linear Stochastic Optimal Control*. Submitted to **SIAM J. Control Optim.** [Pdf file](#).

[J4] **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](#).

[J3] M. P. Chapman, J. P. Lacotte, **R. Bonalli**¹, K. M. Smith, I. Y., Yuxi Han, M. Pavone, and C. J. Tomlin, *Risk-sensitive safety specifications for stochastic systems using Conditional Value-at-Risk*. Under major revision in **IEEE Transactions on Automatic Control**. [Pdf file](#).

[J2] **R. Bonalli**, B. Hérisse 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. Hérisse 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*. Submitted to International Conference on Robotics and Automation, 2021. [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](#).

¹Added as a new author on July 2020.

- [C6] M. Kleinbort, K. Solovey, **R. Bonalli**, E. Granados, *Refined Analysis of Asymptotically-Optimal 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 Presentations

7.1 Conferences

- June 2019, *Robotics: Science and Systems*, Freiburg.
- May 2019, *International Conference on Robotics and Automation*, Montreal.
- September 2017, *18th French - German - Italian Conference on Optimizations*, Paderborn.
- July 2017, *IFAC World Congress*, Toulouse.
- May 2017, *American Control Conference*, Seattle.

7.2 Invited Talks

- October 2020, *Towards Principled Algorithms for Stochastic Optimal Control of Nonlinear Dynamical Systems*. Talk at Laboratoire des signaux et systèmes (CentraleSupélec), Gif-sur-Yvette.
- October 2020, *Composable Geometric Motion Policies using Multi-Task Pullback Bundle Dynamical Systems*. Talk (seminar series “Autonomy Talk”) at ETH Zurich, Zurich.

- October 2020, *Towards Principled Algorithms for Stochastic Optimal Control of Nonlinear Dynamical Systems*. Talk at Inria SPHINX (Institut Elie Cartan de Lorraine), Nancy.
- July 2020, *Towards Principled Algorithms for Stochastic Optimal Control of Nonlinear Mechanical Systems*. Talk (seminar series “Progetto di Eccellenza”) at Politecnico di Torino, Turin.
- June 2020, *Sequential Convex Programming for Non-Linear Stochastic Optimal Controls*. Talk at Stanford University, Stanford.
- May 2019, *Real-time Optimal Control of Robotics Systems*. Talk at Concordia University, Montreal.
- May 2019, *Real-time Optimal Control of Endo-Atmospheric Launch Vehicles*. Informal Systems Seminar at McGill University, Montreal.
- October 2018, *Methods for Real-time Optimal Guidance of Launch Vehicles*. PhD Students Welcome Day at ONERA - The French Aerospace Lab, Palaiseau.

8 Teaching Activity

8.1 Graduate Courses

- 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.

8.2 Undergraduate Courses

- 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 Ph.D. Students

- Spencer Richards, Stanford University, from 09/2020 (at 50%).
- Thomas Lew, Stanford University, from 09/2019 (at 50%).
- Andrew Bylard, Stanford University, from 08/2018 (at 50%).
- Abhishek Cauligi, Stanford University, 08/2018–08/2019 (at 50%).

9.2 Master Students

- Jonathan Lee, Stanford University, 08/2019–03/2020 (at 50%).
- Somrita Banerjee, Stanford University, 03/2018–08/2019 (at 30%).
- Quentin Chan-Wai-Nam, MINES ParisTech, 03/2017–08/2017 (at 30%).

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 Transactions on Automatic Control, IEEE Transactions on Robotics, The Aeronautical Journal.

11 Industrial Experience

1. 03/2015–07/2018: PhD at ONERA - The French Aerospace Lab, Paris.

Design of onboard methods for real-time computing of optimal strategies for launch vehicle systems. ONERA owns a software based on the latest version of my algorithm.

2. 2014: MSc Internship at IFP Energies Nouvelles, Paris.

Six months of internship (March 2014–August 2014) to improve algorithms inside a C++ thermo-fluid library using different nonlinear optimization techniques.