Curriculum Vitæ

Riccardo Bonalli

Born the 19th November 1989 in Varese (Italy)

PhD Applied Mathematics

Postdoctoral Researcher
Autonomous Systems Laboratory (ASL)
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1 Academic Positions

- From 07/2018: Postdoctoral Researcher at the Autonomous Systems Laboratory (Director Prof Marco Pavone), Aeronautics & Astronautics Department at Stanford University, under a NASA Early Career Faculty Grant.

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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. 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).

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3 Awards and Distinctions

- 2018 : ONERA Best PhD student award 2018 at ONERA - TIS Department.
  https://www.onera.fr/fr/rejoindre-onera/prix-des-doctorants (French)

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4 Publications

4.1 Preprints and Work in Progress

[P1] **R. Bonalli**, T. Lew, and M. Pavone, *Analysis of Theoretical and Numerical Properties of Sequential Convex Programming for Continuous-Time Optimal Control*. To be submitted to IEEE Transactions on Automatic Control by September 30, 2020. Preliminary version available on arXiv.org. Pdf file.

[P2] **R. Bonalli**, T. Lew, and M. Pavone, *Sequential Convex Programming for Non-linear Stochastic Optimal Control*. To be submitted to SIAM J. Control Optim. by September 30, 2020. Preliminary version available on arXiv.org. Pdf file.

[P3] A. Bylard, **R. Bonalli**, and M. Pavone, *Composable Geometric Motion Policies using Hierarchical Pullback Bundle Dynamical Systems*. Work in progress to be submitted to International Conference on Robotics and Automation, 2021.

[P4] M. P. Chapman, J. P. Lacotte, K. M. Smith, I. Y., Yuxi Han, **R. Bonalli**[1], M. Pavone, and C. J. Tomlin, *Risk-sensitive safety specifications for stochastic systems using Conditional Value-at-Risk*. Work in progress to be submitted to IEEE Transactions on Automatic Control.

[P5] M. Szmuk, D. Malyuta, T. P. Reynolds, T. Lew, **R. Bonalli**, B. Açikmeşe, and M. Pavone, *Convex Optimization-Based Trajectory Generation*. Work in progress to be submitted to IEEE Control Systems Magazine.

4.2 Journal Papers

[J1] **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.

[J2] **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.

4.3 Proceedings in Conferences

[C1] 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.

[C2] 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.

[C3] M. Kleinbort, K. Solovey, **R. Bonalli**, E. Granados, *Refined Analysis of Asymptotically-Opimal Kino-dynamic Planning in the State-Cost Space*. Proc. International Conference on Robotics and Automation, 2020, Paris. Pdf file.

[C4] **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.

[C5] **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.

[C6] **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.

[1] Added as a new author.

[C7] **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.

[C8] **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.

4.4 Ph.D. 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.

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5 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.

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6 Presentations

6.1 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.

6.2 Invited Talks

- 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.

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7 Software and Hardware Experiments

- `GuSTO` - Julia package implementing GuSTO, a sequential convex programming paradigm for real-time trajectory optimization. Developed in collaboration with Andrew Bylard and Abhishek Cauligi during my Postdoc at Stanford University, this library combines ease-of-use with fast computations, providing solutions in real-time for many robotic systems. The open source code is available at: https://github.com/StanfordASL/GuSTO.jl.
- `SOCP` - C++ package implementing shooting for optimal control problems, specialized in launch vehicles. This paradigm has been developed during my PhD in collaboration with Bruno Hérissé, and can compute optimal solutions for aerospace rendezvous problems in few milliseconds. A (partial) open source version is available at: https://github.com/bherisse/socp.
- Freeflyer experiments on simulated two-dimensional micro-gravity environment at Stanford University, in collaboration with Andrew Bylard and Abhishek Cauligi. Flight test will be conducted in September 2021 aboard the International Space Station. The video is available at: https://www.youtube.com/watch?v=GHehE-If5nY.

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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.

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9 Student Supervision

9.1 Ph.D. Students

- 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%).

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10 Review Activity

I am peer-reviewer for conferences and journal 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.

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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 from March 2014 to August 2014 to improve algorithms inside a C++ thermodynamics library using different nonlinear optimization techniques.
