Bartolomeo **Stellato**

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Education

University of Oxford, Oxford, United Kingdom — 2017
PhD in Engineering Science
Thesis: "Mixed-Integer Optimal Control of Fast Dynamical Systems"
Supervision: Prof. P. Goulart

ETH Zürich, Zürich, Switzerland — 2014
MSc in Robotics, Systems and Control
Thesis: "Data-Driven Chance constrained Optimization"
Supervision: Prof. B. Van Parys, Prof. J. Lygeros
Final Grade: 5.51/6

Politecnico di Milano, Milano, Italy — 2012
BSc in Automation Engineering
Final Grade: 110/110

Research Interests

Optimization, Machine Learning, Optimal Control

Research Experience

MIT Sloan School of Management, Cambridge MA, USA — Jan 2018 – Present
Postdoctoral Research Associate
Project: "Machine Learning for Optimization"
Supervision: Prof. D. Bertsimas

Introduced the machine learning framework "The Voice of Optimization" for solving continuous and integer optimization.

- Reformulated optimization algorithms as machine learning tasks (classification or regression) mapping data to the optimal solutions.
- Gained insights on the optimal solution behavior using interpretable machine learning models.
- Obtained multiple orders of magnitude speed improvements over state-of-the-art algorithms.

Stanford University, Stanford CA, USA — 2016 – 2018
Visiting Student Researcher and Collaborator
Project: "OSQP: An Operator Splitting Solver for Quadratic Programs"
Supervision: Prof. S. Boyd

Lead the development of the open-source numerical optimization software OSQP (osqp.org): the first industry-grade first-order algorithm for quadratic optimization (1 mln downloads).

- Corporate users include: Google, Lyft, Adobe, LinkedIn, Baidu, Amazon, Siemens.
- Academic users include: MIT, Stanford, Berkeley, UCLA, Oxford, ETH Zürich.
- Applications in Finance, Robotics, Machine Learning, Self-Driving Cars, Control.
- Outreach: created project website, users forum (osqp.discourse.group) and integrated it with CVXPY community.

University of Oxford, Oxford, United Kingdom — Sep 2014 – Dec 2017
European Union Marie Curie Fellow

Project: "TEMPO: Training in Embedded Predictive Control and Optimization"
Supervision: Prof. P. Goulart

Developed new algorithms for mixed-integer programming for optimal control problems of fast dynamical systems with discrete controls.

- Proposed approximate dynamic programming methods to solve mixed-integer optimization problems in $< 25\ \mu s$ (First Paper Prize for IEEE Transactions on Power Electronics)
- Developed efficient smooth optimization algorithms to solve mixed-integer optimal control problems for switched dynamical systems (software package SwitchTimeOpt.jl).
- Outreach and dissemination: organized internal seminar activities, group website and github organization for software development and distribution at the Oxford Control Group.

IMT Lucca, Lucca, Italy — Jan 2017
Guest Scholar

Project: "Mixed-Integer Quadratic Programming using the OSQP Solver"
Supervision: Prof. A. Bemporad

Developed extensions of the OSQP solver for mixed-integer quadratic optimization with applications to embedded optimization (software package miOSQP).

ETH Zürich, Automatic Control Laboratory, Zurich, Switzerland — Feb 2014 – Aug 2014
Master Thesis Student

Project: "Data-Driven Chance Constrained Optimization"
Supervision: Prof. B. Van Parys, Dr. X. Zhang, Prof. P. Goulart and Prof. J. Lygeros

Derived data-driven tractable algorithms with guarantees for uncertain optimization programs based on distributionally robust optimization.

Siemens, Building Technologies Division, Zug, Switzerland — Jul 2013 – Dec 2013
Research Intern

Project: "Adaptive Superheat Control on HVAC systems"
Supervision: B. Baumann

Developed adaptive control schemes for safe automatic tuning of HVAC system controllers for large commercial buildings.

ETH Zürich, Institute for Dynamic Systems and Control, Zurich, Switzerland — Feb 2013 – Jun 2013
Semester Student

Project: "A new quaternion-based LQR Controller for Quadrocopters"
Supervision: Dr. R. Ritz, Prof. R. D'Andrea

Implemented and tested an efficient low level optimal controller for quadcopters based on quaternions able perform actobatic maneuvers.

Awards

IEEE Trans. on Power Electronics First Place Prize Paper Award, PELS (1000$)	Sep 2018
Vice-Chancellors' Fund, University of Oxford (3000£)	May 2017
Masterclass Award, St Edmund Hall, University of Oxford (1000£)	Apr 2015
Marie Curie PhD Fellowship, European Commission (250,000€)	Sep 2014

Teaching Experience

MIT Teaching & Learning Laboratory — Aug 2019
Kaufman Teaching Certificate Program

Completed teaching program based on eight workshops aimed at developing teaching skills, organizing new courses, structuring classes and interacting with the students.

University of Oxford Sep 2015 – Jun 2016
Tutor

Responsible for holding weekly *tutorials*: small interactive teaching sessions with groups of four students with in-depth discussions. Designed and evaluated problem sets.

Undergraduate courses taught:

- System Identification (Trinity 2016)
- Optimal Control (Hilary 2016)
- Linear Dynamical Systems (Michaelmas 2015)

University of Oxford Jun 2015 – Jun 2017
Laboratory Assistant

Co-organized hands-on laboratory courses in the undergraduate engineering program.

Laboratories covered:

- LEGO Football Laboratory (Trinity 2017)
- Instrumentation and Control Laboratory (Hilary 2017)
- Helicopter Laboratory (Trinity 2015)

Academic Experience

Supervision

Shuvomoy Das Gupta, PhD Student, MIT Sep 2019 – Present
First-order methods for nonconvex and combinatorial optimization

Liangyuan Na, PhD Student, MIT Apr 2019 – Present
Robust optimization with a machine learning lens

Luca Mingardi, MBAn Student, MIT Sep 2019 – Present
Hearth disease predictions from ECG data

Review

IEEE Transactions on Automatic Control, The American Statistician, IEEE Transactions on Power Electronics, Autonomous Robots, INFORMS Journal of Optimization, Optimal Control Applications and Methods, Computers and Operations Research, IEEE Access, IEEE Transactions on Control Systems Technology, IEEE Transactions on Neural Networks and Learning Systems.

Conferences and seminars organization

Invited session "Mixed-Integer Programming in Control" Sep 2016
European Conference on Computational Optimization (EUCCO), KU Leuven

Control and Optimization Seminars 2016 – 2017
University of Oxford

Publications

Journal Articles

Stellato, B., G. Banjac, P. Goulart, A. Bemporad, and S. Boyd. "OSQP: An Operator Splitting Solver for Quadratic Programs". In: *Mathematical Programming Computation (to appear)* (2020). DOI: https://doi.org/10.1007/s12532-020-00179-2. arXiv: 1711.08013 [math.OC].

Banjac, G., P. Goulart, **B. Stellato**, and S. Boyd. "Infeasibility detection in the alternating direction method of multipliers for convex optimization". In: *Journal of Optimization Theory and Applications* (Aug. 2019). DOI: https://doi.org/10.1007/s10957-019-01575-y.

Stellato, B., T. Geyer, and P. Goulart. "High-Speed Finite Control Set Model Predictive Control for Power Electronics". In: *IEEE Transactions on Power Electronics* 32.5 (May 2017). **First Prize Paper Award for IEEE Transaction on Power Electronics**, pp. 4007–4020. DOI: http://dx.doi.org/10.1109/TPEL.2016.2584678.

Stellato, B., S. Ober-Blöbaum, and P. Goulart. "Second-Order Switching Time Optimization for Switched Dynamical Systems". In: *IEEE Transactions on Automatic Control* 62.10 (Oct. 2017), pp. 5407–5414. DOI: 10.1109/TAC.2017.2697681.

Stellato, **B.**, B. P.G. Van Parys, and P. Goulart. "Multivariate Chebyshev Inequality with Estimated Mean and Variance". In: *The American Statistician* 71.2 (2017), pp. 123–127. DOI: http://dx.doi.org/10.1080/00031305.2016.1186559.

Preprints

Agrawal, A., S. Barratt, S. Boyd, and **B. Stellato**. "Learning Convex Optimization Control Policies". In: *2nd Learning 4 Dynamics and Control Conference (to appear)* (2020). arXiv: 1912.09529 [math.OC]. URL: https://arxiv.org/abs/1912.09529.

Bertsimas, D. and **B. Stellato**. "The Voice of Optimization". In: *Machine Learning (minor revision)* (2020). arXiv: 1812.09991 [math.OC]. URL: https://arxiv.org/pdf/1812.09991.

Bertsimas, D. and **B. Stellato**. "Online Mixed-Integer Optimization in Milliseconds". In: *INFORMS Journal on Computing (major revision)* (2019). arXiv: 1907.02206 [math.OC]. URL: https://arxiv.org/abs/1907.02206.

Working papers

Bertsimas, D., L. Na, and **B. Stellato**. "Robust Optimization under a Modern Machine Learning Lens". In: *Working paper* (2019).

Bertsimas, D. and **B. Stellato**. "Differentiabile Programming for Adaptive Optimization". In: *Working paper* (2019).

Das Gupta, S., **B. Stellato**, and B. Van Parys. "A Unifying Framework Between First and Second Order Optimization Algorithms". In: *Working paper* (2019).

Conference Proceedings

Stellato, **B.**, V. V. Naik, A. Bemporad, P. Goulart, and S. Boyd. "Embedded Mixed-Integer Quadratic Optimization Using the OSQP Solver". In: *European Control Conference (ECC)*. July 2018. URL: https://ieeexplore.ieee.org/document/8550136.

Banjac, G., **B. Stellato**, N. Moehle, P. Goulart, A. Bemporad, and S. Boyd. "Embedded Code Generation Using the OSQP Solver". In: *IEEE Conference on Decision and Control (CDC)*. Dec. 2017. URL: https://ieeexplore.ieee.org/document/8263928.

Stellato, **B.** and P. Goulart. "High-Speed Direct Model Predictive Control for Power Electronics". In: *European Control Conference (ECC)*. July 2016, pp. 129–134. URL: http://ieeexplore.ieee.org/document/7810275/.

Stellato, **B.** and P. Goulart. "Real-time FPGA Implementation of Direct MPC for Power Electronics". In: *IEEE Conference on Decision and Control (CDC)*. Dec. 2016, pp. 1471–1476. URL: https://doi.org/10.1109/CDC.2016.7798474.

Stellato, **B.**, S. Ober-Blöbaum, and P. Goulart. "Optimal Control of Switching Times in Switched Linear Systems". In: *IEEE Conference on Decision and Control (CDC)*. Dec. 2016, pp. 7228–7233. URL: https://doi.org/10.1109/CDC.2016.7799384.

Theses

Stellato, B. "Mixed-Integer Optimal Control of Fast Dynamical Systems". PhD thesis. University of Oxford, 2017. URL: https://stellato.io/assets/downloads/publications/stellato_thesis.pdf.

Stellato, B. "Data-driven chance constrained optimization". MA thesis. ETH Zürich, 2014. URL: http://dx.doi.org/10.3929/ethz-a-010266857.

Selected Invited Talks

The Voice of Optimization — Nov 2019
Fields Institute Focus Program on Data Science and Optimization, Toronto, CA

The Voice of Optimization — Oct 2019
IEOR Seminars, UC Berkeley, USA

The Voice of Optimization — Oct 2019
SISL Seminars, Stanford, USA

The Voice of Optimization — Oct 2019
Invited Session at the INFORMS Annual Meeting 2019, Seattle, USA

The Voice of Optimization — May 2019
Operations Research Center IAP Seminar, MIT, USA

The Voice of Optimization — Jan 2019
IDSS Seminar on Algebra Statistics and Optimization, MIT, USA

OSQP: An Operator Splitting Solver for Quadratic Programs — Jul 2018
International Symposium of Mathematical Programming (ISMP), Bordeaux, France

OSQP: An Operator Splitting Solver for Quadratic Programs — Nov 2017
Mathematical Institute, University of Oxford, UK

OSQP: An Operator Splitting Solver for Quadratic Programs — Jun 2017
Control Systems Group, Cambridge University, UK

OSQP: An Operator Splitting Solver for Quadratic Programs — Jun 2017
Operations Research Center, MIT, USA

High-Speed Integer Optimal Control Using Approximate Dynamic Programming — Jan 2017
DYSCO Research Group, IMT Lucca, Italy

High-Speed Integer Optimal Control Using Approximate Dynamic Programming — Oct 2016
MPC Laboratory, UC Berkeley, USA

Switching Time Optimization — Sep 2016
European Conference on Computational Optimization (EUCCO), KU Leuven, Belgium

High-Speed Integer Optimal Control Using Approximate Dynamic Programming — Sep 2016
European Conference on Computational Optimization (EUCCO), KU Leuven, Belgium

Technical Skills

Programming	Python, Julia, C, C++, SLURM, MATLAB, Git, Bash, LaTeX
Web Design	HTML, CSS, Javascript
Embedded Design	Xilinx FPGA Programming

Languages

Italian (Mother tongue) English (Fluent C2) French (Intermediate B1) German (Basic A2)

Interests and Activities

Music Collection and playing

- Piano diploma (5^{th} year), *Istituto Superiore di Studi Musicali "F. Vittadini", Pavia, Italy*, Grade 8.50/10
- Music theory and solfeggio diploma, *Istituto Superiore di Studi Musicali "C. Monteverdi", Cremona, Italy*, Grade 9.60/10

MITaly Member of the MIT Italian Association Board.

- Organized large events in collaboration with Italian communities and the Consulate General of Italy in Boston.
- Organized seminar series with Italian professors at MIT and Harvard.
- Developed the association main website (mitaly.mit.edu).

References

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