Bartolomeo Stellato

Assistant Professor Princeton University

Princeton University Sherrerd Hall, Charlton Street Princeton, NJ 08544, USA

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Education

Oxford, UK University of Oxford 2017 PhD in Engineering Science

- Thesis: "Mixed-Integer Optimal Control of Fast Dynamical Systems"

- Supervision: P. Goulart

ETH Zürich Zürich, CH 2014

MSc in Robotics, Systems and Control

- Thesis: "Data-Driven Chance constrained Optimization"

- Supervision: B. Van Parys, J. Lygeros

Politecnico di Milano Milano, IT BSc in Automation Engineering 2012

Research Interests

Data-driven computational tools to make decisions in highly dynamic and uncertain environments:

- Research: real-time and embedded optimization, robust optimization, optimization-based control, large scale optimization, machine learning for optimization.
- Applications: control of fast dynamical systems, robotics, finance, and autonomous systems.

Research Experience

Princeton University

Assistant Professor, Dept. of Operations Research and Financial Engineering

- Associated Faculty, Dept. of Electrical and Computer Engineering

- Associated Faculty, Dept. of Computer Science

- Associated Faculty, Center of Statistics and Machine Learning
- Affiliated Member, Robotics at Princeton Initiative
- Fellow, Whitman College

MIT Sloan School of Management

Postdoctoral Research Associate

- Project: "Machine Learning for Optimization"

- Supervision: D. Bertsimas

Stanford University

Visiting Student Researcher - Project: "OSQP: An Operator Splitting Solver for Quadratic Programs"

- Supervision: S. Boyd

- Open-source software: OSQP (osqp.org). 50+ M downloads. Widely used in academia and industry, including at Google, Blackrock, Lyft, etc.

University of Oxford

European Union Marie Curie Fellow

- Project: "TEMPO: Training in Embedded Predictive Control and Optimization"

- Supervision: P. Goulart

Princeton, NJ Jul 2020 - Present

Cambridge, MA Jan 2018 - Jul 2020

Stanford, CA

Oxford, UK

2016

Sep 2014 - Sep 2017

Siemens, Building Technologies Division

Research Intern

Zug, CH Jul 2013 – Dec 2013

- Project: "Adaptive Superheat Control on HVAC systems"

- Supervision: B. Baumann

Awards

CAREER Award (PI, \$500,000) National Science Foundation (NSF)	Mar 2023
 Franco Strazzabosco Young Investigator Award (\$3,000) Italian Scientists and Scholars in North America Foundation (ISSNAF) 	Nov 2022
Student Paper Award (as advisor) INFORMS Computing Society	Oct 2022
 Metropolis Project on Future Cities and Technologies (co-PI, \$100,000) Princeton School of Engineering and Applied Science (SEAS) 	Feb 2022
 Innovation Award in Data Science (PI, \$70,000) Princeton School of Engineering and Applied Science (SEAS) 	Feb 2022
 250th Anniversary Fund for Innovation in Undergraduate Education (\$23,000) Princeton University 	May 2021
Best Paper Award Mathematical Programming Computation	Jan 2021
Pierskalla Best Paper Award INFORMS Health Applications Society	Nov 2020
• First Place Prize Paper Award (\$1000) **IEEE Transactions on Power Electronics**	Sep 2018
 Vice-Chancellors' Fund (£3,000) University of Oxford 	May 2017
Masterclass Award (£1,000) St Edmund Hall, University of Oxford	Apr 2015
Marie Curie PhD Fellowship (€250,000) European Commission	Sep 2014

Teaching Experience

Princeton University, Principal Lecturer

Fall 2020 - Present

ORF522: Linear and Nonlinear Optimization (PhD level, 30+ students)

- Topics: linear optimization modeling, duality, sensitivity analysis and interior point methods. First order methods for nonlinear optimization, monotone operator theory, real-time optimization and data-driven algorithms.
- Applications: engineering, robotics, autonomous systems, finance, and machine learning.

Princeton University, Principal Lecturer

Spring 2021 – Present

ORF307: Optimization (BSc level, 95+ students)

- Topics: least squares optimization with multiple objectives and constraints.
 Linear optimization modeling, duality, the simplex method, interior point methods, and network flow optimization. Integer programming and branch-and-bound algorithms.
- Applications: engineering, finance, and machine learning.

MIT, Teaching & Learning Laboratory Participant Aug 2019 Kaufman Teaching Certificate Program - Completed teaching program based on eight workshops aimed at developing teaching skills, organizing new courses and interacting with the students. Sep 2015 - Jun 2016 **University of Oxford**, Tutor Courses: System Identification; Optimal Control; Linear Dynamical Systems - Responsible for holding weekly *tutorials*: small interactive teaching sessions with groups of four students with in-depth discussions. University of Oxford, Laboratory Assistant Jun 2015 -- Jun 2017 Laboratories: LEGO Football; Instrumentation and Control; Helicopter - Co-organized hands-on undergraduate laboratory courses. Supervision **Postdocs** • Gabriele Dragotto, Princeton (co-advised with Prof. Fernández Fisac) 2022-Present - Princeton DataX Postdoc Fellowship Graduate students • Yixuan Hua, PhD Princeton (co-advised with Prof. Amir Ali Ahmadi) 2023-Present PhD topic: Disjunctive Sum of Squares Optimization • Stefan Clarke, PhD Princeton 2022-Present PhD topic: Data-Driven Multi-Agent Decision Making • Rajiv Sambharya, PhD Princeton 2021-Present PhD topic: Learning to Accelerate Optimizers - Princeton Graduate School Excellence in Teaching Award (ORF307 course) • Vinit Ranjan, PhD Princeton 2021-Present PhD topic: Performance Certification for Real-Time Optimization • Irina Wang, PhD Princeton 2021-Present PhD topic: Learning for Optimization under Uncertainty - INFORMS Computing Society Student Paper Award - Princeton SEAS Award for Excellence • Shuvomoy Das Gupta, PhD MIT (co-supervised with Prof. B. Van Parys) 2019-2022 PhD topic: First-order Methods for Nonconvex Optimization • Liangyuan Na, PhD MIT (co-supervised with Prof. D. Bertsimas) 2019-2020 PhD topic: Coupled adaptive and robust optimization • Luca Mingardi, MBAn MIT (co-supervised with Prof. D. Bertsimas) 2019-2021 Master topic: Hearth disease predictions from ECG data Senior thesis students (Princeton) Annie Liang 2023-Present • Sophia Fang 2023-Present Anna Glowski 2022-2023 Title: "Optimizing Fun: A TSP-Based Approach to Route Optimization at Disneyland" • Nishant Kumar Singhal 2022-2023 Title: "Constructing Optimal Flow Networks: An Exploration Centered on the U.S. Flight Network" • Elliott N. Strahan 2022-2023 Title: "Batch Exchanges Moo-ving Forward: Formalization and Analysis of CFMM-Based Clearing Price Auctions" • Chen Leon 2022-2023 Title: "A Mixed-Integer Optimization Approach to Allocating Housing Resources for the Homeless"

Cole Becker Title: "Data-Driven Methods for Decision-Making Under Uncertainty"	2021–2022
John Ogden Bigelow Jr. Prize in Electrical EngineeringPrinceton SEAS Mueller Prize	
 Joyce Luo Title: "Equitable Data-driven Resource Allocation to Fight the Opioid Epidemic: a Mixed-integer Optimization Approach" — Sigma Xi Book Award 	2021–2022
 Diana Zhang Title: "Applications of Deep Implicit Layers and Convex Optimization in Portfolio and Risk Management" 	2021–2022
• Emma Zhao Title: "Don't Forget The Past: An Analysis Of Dementia Risk Factors Around The World"	2021–2022
Holly Cunningham Title: "Differentiable Transportation for On-Demand Transportation Systems"	2020–2021
 Ava Jiang <i>Title: "A Distributed Framework for Learning Agent Rationality"</i> 	2020–2021
Max Jun Kim Title: "A Computational Approach to Analyzing Supply Chain Sustainability"	2020–2021
Research software engineers (Princeton)	
Amit Solomon	2023-Present
Vineet Bansal	2021–2022

Service

Review

Mathematical Programming, Operations Research, Mathematics of Operations Research, Management Science, SIAM Journal on Optimization, Mathematical Programming Computation, IEEE Transactions on Automatic Control, ACM Transactions on Mathematical Software, 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 Neural Networks and Learning Systems.

Societies

 Vice-Chair of Computational Optimization and Software, INFORMS Optimization Society 	2023-2025
Conference committees, invited sessions, and seminar organization	
Cluster Chair: Emerging Applications of Optimization, INFORMS Optimization Society Conference (IOS)	2024
Organizer: Princeton Optimization Seminars	2020-Present
Chair of one invited session: INFORMS Annual Meeting	2023
 Chair of one invited session: Modeling and Optimization: Theory and Applications (MOPTA) 	2023
 Organizer of two minisymposia (16 speakers): SIAM Conf. on Optimization (SIOPT) 	2023
Chair of one invited session: INFORMS Annual Meeting	2022
Chair of two invited sessions: International Conference on Continuous Optimization (ICCOPT)	2022
 Program committee: 4th Learning for Dynamics and Control Conference (L4DC) 	2022
 Program committee: 3th Learning for Dynamics and Control Conference (L4DC) 	2021
Chair of one invited session: European Conference on Computational Optimization (EUCCO)	2016
Organizer: Oxford Control and Optimization Seminars	2016–2017

PhD committees

FID Committees	
 Zheng Yu, Princeton ECE (advised by Prof. Mengdi Wang) 	2022
 Abhishek Cauligi, Stanford Aeroastro (advised by Prof. Marco Pavone) 	2021
Cemil Dibek, Princeton ORFE (advised by Prof. Amir Ali Ahmadi)	2021
 Zachary Hervieux-Moore, Princeton ORFE (advised by Prof. Alain Kornhauser) 	2021
Sinem Uysal, Princeton ORFE (advised by Prof. John Mulvey)	2021
Hao Lu, Princeton ORFE (advised by Prof. Mengdi Wang)	2021
Bachir El Khadir, Princeton ORFE (advised by Prof. Amir Ali Ahmadi)	2020
General examination committees	
Stefan Clarke, Princeton ORFE	2023
Chenyu Yu, Princeton ORFE (advised by Prof. John Mulvey)	2023
 Jennifer Sun, Princeton ORFE (advised by Prof. Elad Hazan) 	2023
Anjian Li, Princeton ECE (advised by Prof. Ryne Beeson)	2023
 Haimin Hu, Princeton ECE (advised by Prof. Jaime Fernández Fisac) 	2021
Rajiv Sambharya, Princeton ORFE	2021
 Pierfrancesco Beneventano, Princeton ORFE (advised by Prof. Boris Hanin) 	2021
 Abraar Chaudhry, Princeton ORFE (advised by Prof. Amir Ali Ahmadi) 	2021
Yu Wu, Princeton ECE (advised by Prof. Mengdi Wang)	2021
Academic advising	
 23 undergraduate students/year, ORFE, Princeton University, 	2020-Present
 14 freshman students/year, Whitman college, Princeton University 	2021-Present
Other committees and panels	
NSF EPCN Proposal Reviewer	2024
Assoc. Director of Research Development hiring committee, Princeton Office of the Dean for Research	2023
Graduate Certificate Program Committee, Princeton Center for Statistics and Machine Learning	2023
 Independent Work grader, Princeton Center for Statistics and Machine Learning 	2022–2023
PhD admissions committee, Princeton ORFE	2022-2023
Open-source software	
CVXPY project maintainer (as part of NumFOCUS)	2021-Present
 OSQP project maintainer (supported by Princeton CSML and OIT) 	2022-Present

Publications

Journal articles

- [J12] D. Bertsimas and **B. Stellato**, "Online mixed-integer optimization in milliseconds," *INFORMS Journal on Computing*, vol. 34, no. 4, pp. 2229–2248, 2022.
- [J11] A. Cauligi, P. Culbertson, E. Schmerling, M. Schwager, **B. Stellato**, and M. Pavone, "CoCo: Online mixed-integer control via supervised learning," *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 1447–1454, 2022.
- [J10] M. Schaller, G. Banjac, S. Diamond, A. Agrawal, B. Stellato, and S. Boyd, "Embedded code generation with CVXPY," IEEE Control Systems Letters, vol. 6, pp. 2653–2658, 2022.
- [J9] D. Bertsimas, L. Boussioux, R. Cory Wright, A. Delarue, V. Digalakis, A. Jacquillat, D. Lahlou Kitane, G. Lukin, M. L. Li, L. Mingardi, O. Nohadani, A. Orfanoudaki, T. Papalexopoulos, I. Paskov, J. Pauphilet, O. Skali Lami, **B. Stellato**, H. Tazi Bouardi, K. Villalobos Carballo, H. Wiberg, and C. Zeng, "From predictions to prescriptions: A data-driven response to COVID-19," *Health Care Management Science*, vol. 24, pp. 253–272, Jun. 2021.
 - TINFORMS Health Applications Society Pierskalla Best Paper Award

- [J8] D. Bertsimas, L. Mingardi, and **B. Stellato**, "Machine learning for real-time heart disease prediction," *IEEE Journal of Biomedical and Health Informatics*, vol. 25, no. 9, pp. 3627–3637, 2021.
- [J7] D. Bertsimas and B. Stellato, "The voice of optimization," Machine Learning, vol. 110, pp. 249–277, 2 Feb. 2021.
- [J6] D. Bertsimas, G. Lukin, L. Mingardi, O. Nohadani, A. Orfanoudaki, B. Stellato, H. Wiberg, S. Gonzalez-Garcia, C. L. Parra-Calderon, K. Robinson, M. Schneider, B. Stein, A. Estirado, L. a Beccara, R. Canino, M. Dal Bello, F. Pezzetti, and A. Pan, "COVID-19 mortality risk assessment: An international multi-center study," PLOS One, Dec. 2020.
- [J4] G. Banjac, P. Goulart, **B. Stellato**, and S. Boyd, "Infeasibility detection in the alternating direction method of multipliers for convex optimization," *Journal of Optimization Theory and Applications*, vol. 183, no. 2, pp. 490–519, 2019.
- [J3] B. Stellato, T. Geyer, and P. Goulart, "High-speed finite control set model predictive control for power electronics," IEEE Transactions on Power Electronics, vol. 32, no. 5, pp. 4007–4020, May 2017.
 Prirst Prize Paper Award IEEE Transactions on Power Electronics
- [J2] **B. Stellato**, S. Ober-Blöbaum, and P. Goulart, "Second-order switching time optimization for switched dynamical systems," *IEEE Transactions on Automatic Control*, vol. 62, no. 10, pp. 5407–5414, Oct. 2017.
- [J1] **B. Stellato**, B. P. Van Parys, and P. Goulart, "Multivariate chebyshev inequality with estimated mean and variance," *The American Statistician*, vol. 71, no. 2, pp. 123–127, 2017.

Conference proceedings

- [C13] S. Clarke, G. Dragotto, J. Fernandez Fisac, and B. Stellato, "Learning rationality in potential games," in IEEE Conference on Decision and Control (CDC), Dec. 2023.
- [C12] R. Sambharya, G. Hall, B. Amos, and B. Stellato, "End-to-end learning to warm-start for real-time quadratic optimization," in *Proceedings of the 5th Annual Learning for Dynamics and Control Conference*, N. Matni, M. Morari, and G. J. Pappas, Eds., ser. Proceedings of Machine Learning Research, vol. 211, PMLR, Jun. 2023, pp. 220–234.
- [C11] M. Wang, I. McInerney, B. Stellato, S. Boyd, and H. So, "RSQP: Problem-specific architectural customization for accelerated convex quadratic optimization," in *Proceedings of the 50th Annual International Symposium on Computer Architecture*, ser. ISCA '23, Orlando, FL, USA: Association for Computing Machinery, 2023.
- [C10] J. Ichnowski, P. Jain, B. Stellato, G. Banjac, M. Luo, F. Borrelli, J. E. Gonzales, I. Stoica, and K. Goldberg, "Accelerating quadratic optimization with reinforcement learning," in Advances in Neural Information Processing Systems 35, Dec. 2021.
- [C9] T. Seyde, I. Gilitschenski, W. Schwarting, B. Stellato, M. Riedmiller, M. Wulfmeier, and D. Rus, "Is bang-bang control all you need? Solving continuous control with bernoulli policies," in Advances in Neural Information Processing Systems 35, Dec. 2021.
- [C8] A. Agrawal, S. Barratt, S. Boyd, and **B. Stellato**, "Learning convex optimization control policies," in *Proceedings of the 2nd Conference on Learning for Dynamics and Control*, ser. Proceedings of Machine Learning Research, vol. 120, PMLR, Jun. 2020, pp. 361–373.
- [C7] A. Cauligi, P. Culbertson, B. Stellato, D. Bertsimas, M. Schwager, and M. Pavone, "Learning mixed-integer convex optimization strategies for robot planning and control," in *IEEE Conference on Decision and Control (CDC)*, Dec. 2020.
- [C6] A. Cauligi, P. Culbertson, B. Stellato, M. Schwager, and M. Pavone, "CoCo: Learning strategies for online mixed-integer control," in Learning Meets Combinatorial Algorithms at NeurlPS2020, Dec. 2020.
- [C5] **B. Stellato**, V. V. Naik, A. Bemporad, P. Goulart, and S. Boyd, "Embedded mixed-integer quadratic optimization using the OSQP solver," in *European Control Conference (ECC)*, Jul. 2018.

- [C4] G. Banjac, 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.
- [C3] **B. Stellato** and P. Goulart, "High-speed direct model predictive control for power electronics," in *European Control Conference (ECC)*, Jul. 2016, pp. 129–134.
- [C2] B. Stellato 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.
- [C1] **B. Stellato**, 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.

Preprints

- [P10] H. Hu, G. Dragotto, Z. Zhang, K. Liang, B. Stellato, and J. Fernández Fisac, "Who plays first? Optimizing the order of play in Stackelberg games with many robots," arXiv e-prints, Feb. 2024. arXiv: 2402.09246.
- [P9] V. Ranjan and **B. Stellato**, "Verification of first-order methods for parametric quadratic optimization," *arXiv e-prints*, Mar. 2024. arXiv: 2403.03331.
- [P8] D. Bertsimas, L. Na, and **B. Stellato**, "The benefit of uncertainty coupling in robust and adaptive robust optimization," arXiv e-prints, Feb. 2023. arXiv: 2302.10369.
- [P7] S. Das Gupta, **B. Stellato**, and B. P. G. Van Parys, "Exterior-point optimization for sparse and low-rank optimization," *arXiv* e-prints, Aug. 2023. arXiv: 2011.04552.
- [P6] T. Diamandis, Z. Frangella, S. Zhao, **B. Stellato**, and M. Udell, "Genios: An (almost) second-order operator-splitting solver for large-scale convex optimization," *arXiv* e-prints, Oct. 2023. arXiv: 2310.08333.
- [P5] G. Dragotto, S. Clarke, J. Fernandez Fisac, and **B. Stellato**, "Differentiable cutting-plane layers for mixed-integer linear optimization," arXiv e-prints, Nov. 2023. arXiv: 2311.03350.
- [P4] Z. Frangella, S. Zhao, T. Diamandis, **B. Stellato**, and M. Udell, "On the (linear) convergence of generalized Newton inexact ADMM," *arXiv* e-*prints*, Feb. 2023. arXiv: 2302.03863.
- [P3] J. Luo and **B. Stellato**, "Equitable data-driven resource allocation to fight the opioid epidemic: A mixed-integer optimization approach," arXiv e-prints, Jun. 2023. arXiv: 2301.06179.
- [P2] R. Sambharya, G. Hall, B. Amos, and **B. Stellato**, "Learning to warm-start fixed-point optimization algorithms," arXiv e-prints, Sep. 2023. arXiv: 2309.07835.
- [P1] I. Wang, C. Becker, B. Van Parys, and **B. Stellato**, "Mean robust optimization," arXiv e-prints, Sep. 2022. arXiv: 2207.10820.
 - TINFORMS Computing Society Student Paper Award

Theses

- [T2] B. Stellato, "Mixed-integer optimal control of fast dynamical systems," PhD thesis, University of Oxford, 2017.
- [T1] B. Stellato, "Data-driven chance constrained optimization," MSc thesis, ETH Zürich, 2014.

Selected Invited Talks

 AAAI Workshop on Learnable Optimization, Vancouver, CA 	Feb 2024
Discrete Optimization Talks, Virtual, Zoom	Feb 2024
INFORMS Annual Meeting, Phoenix, AZ	Oct 2023
Thematic Einstein Semester, Zuse Institute Berlin, DE	Sep 2023
 International Conference on Stochastic Programming, UC Davis, CA 	Jul 2023
SIAM Conference on Optimization, Seattle, WA	May 2023
 Mixed-Integer Programming Workshop, University of Southern California, CA 	May 2023

• Conference on Information Sciences and Systems, Johns Hopkins University, MD	Mar 2023
• IPAM Workshop on Artificial Intelligence and Discrete Optimization, UCLA, CA	Feb 2023
Mechanical Engineering Seminar, UC Berkeley, CA	Nov 2022
• Future of OR Workshop at INFORMS Annual Meeting, Indianapolis, IN	Oct 2022
DEIB Seminar, Politecnico di Milano, IT	Jun 2022
Cornell ORIE Seminar, Cornell Tech, NY	Mar 2022
NASA JPL Multi-Agent Tech Talks, Virtual, Zoom	Mar 2022
INFORMS Annual Meeting, Anaheim, CA	Oct 2021
 Joint Princeton Robotics and Optimization Seminar, Virtual, Zoom 	May 2021
Raytheon Technologies Research Center, Virtual, Zoom	Jan 2021
• Invited Session at the INFORMS Annual Meeting 2020, Virtual, Zoom	Nov 2020
• Mathematics of Data and Decisions at Davis (MADDD) Seminars, UC Davis, CA	Jun 2020
• Fields Institute Focus Program on Data Science and Optimization, Fields Institute, CA	Nov 2019
• IEOR Seminars, UC Berkeley, USA	Oct 2019
SISL Seminars, Stanford, USA	Oct 2019
• Invited Session at the INFORMS Annual Meeting 2019, Seattle, WA	Oct 2019
Operations Research Center IAP Seminar, MIT, USA	May 2019
IDSS Seminar on Algebra Statistics and Optimization, MIT, USA	Jan 2019
• Intl. Symposium of Mathematical Programming (ISMP), Bordeaux, France	Jul 2018
Mathematical Institute, University of Oxford, UK	Nov 2017
Control Systems Group, Cambridge University, UK	Jun 2017
Operations Research Center, MIT, USA	Jun 2017
DYSCO Research Group, IMT Lucca, Italy	Jan 2017
MPC Laboratory, UC Berkeley, USA	Oct 2016
• European Conf. on Computational Optimization (EUCCO), KU Leuven, Belgium	Sep 2016

Technical Skills

Programming: Python, Julia, C/C++
Web design: HTML, CSS, Javascript, React
Tech/Tools: Git, Docker, SLURM
Embedded design: Xilinx FPGA

Languages

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

Interests and Activities

- Music, Collection and playing
 - Piano diploma (5th 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).