ALEXANDRE AMICE

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EDUCATION

Massachusetts Institute of Technology (M.I.T) August 2020 - May 2025 (expected)
Doctor of Philosophy: Electrical Engineering and Computer Science
Advisors: Pablo Parrilo and Russ Tedrake

University of Pennsylvania August 2018 - May 2020
Masters of Science in Engineering: Robotics
Thesis: Optimal Constraint Relaxation: Theory and Application to Problems in Robotics
Advisors: Alejandro Ribeiro and C.J. Taylor

University of Pennsylvania August 2016 - May 2020
Bachelors of Science in Engineering: Electrical Engineering and Mathematics *Summa Cum Laude*

RESEARCH INTERESTS

My research focuses on fundamental advances in optimization and computational algebra to push the frontiers of optimal and efficient decision-making in a broad range of engineering fields. I am particularly motivated by problems in the control and verification of complex dynamical systems.

ACADEMIC PUBLICATIONS

(* denotes co-first authorship/equal contribution)

Journals

[1] Luiz FO Chamon, **Alexandre Amice**, and Alejandro Ribeiro. "Approximately supermodular scheduling subject to matroid constraints". In: *IEEE Transactions on Automatic Control* 67.3 (2021).

Conferences

[1] **Alexandre Amice***, Hongkai Dai*, Peter Werner, Annan Zhang, and Russ Tedrake. "Finding and Optimizing Certified, Collision-Free Regions in Configuration Space for Robot Manipulators". In: *Workshop on the Algorithmic Foundation of Robotics (WAFR)* ***Outstanding Paper Award***. 2022.

[2] **Alexandre Amice** and Pablo Parrilo. "Solving Least Squares Problems on Partially Ordered Sets". In: *IEEE 60th Conference on Decision and Control (CDC)*. IEEE. 2022.

[3] Lujie Yang, Kaiqing Zhang, **Alexandre Amice**, Yunzhu Li, and Russ Tedrake. "Discrete Approximate Information States in Partially Observable Environments". In: *2022 American Control Conference (ACC)*. IEEE. 2022, pp. 1406–1413.

[4] Luiz FO Chamon, **Alexandre Amice**, Santiago Paternain, and Alejandro Ribeiro. "Resilient control: Compromising to adapt". In: *59th IEEE Conference on Decision and Control (CDC)* ***Roberto Tempe Award Nominee***. IEEE. 2020.

[5] Luiz FO Chamon, **Alexandre Amice**, and Alejandro Ribeiro. "Matroid-constrained approximately supermodular optimization for near-optimal actuator scheduling". In: *IEEE 58th Conference on Decision and Control (CDC)*. IEEE. 2019.

Preprints

[1] Hongkai Dai*, **Alexandre Amice***, Peter Werner, Annan Zhang, and Russ Tedrake. "Certified Polyhedral Decompositions of Collision-Free Configuration Space". In: *International Journal of Robotics Research (In Review)* (2023).

EXPERIENCE

MIT CSAIL and LIDS: Research Assistant — August 2020 - Present

- Graduate research assistant in MIT's Laboratory for Information and Decision Systems (LIDS) and MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) advised by Pablo Parrilo and Russ Tedrake.
- Research on structured decision making problems, particularly those arising in control theory and robotic applications. Emphasize fundamental advances in convex algebraic geometry, algebraic graph theory, and optimization to enable new tractable motion planning and certification algorithms arising in robot kinematics and distributed control.

Alelab University of Pennsylvania: Research Assistant — Jan 2018 - July 2020

- Research in discrete and convex optimization with applications in optimal control, multi-agent control, machine learning, and computer vision.
- Completed master's thesis on optimal trade-offs in overspecified robotics problems. Applied novel theory to credibility assignment problems in machine learning and resilient control in teams of drones.

Uber Advanced Technologies Group: Robotic Perception Intern — May 2019 - August 2019

- Designed and implemented a novel radar tracking algorithm in Python enabling onboard vehicle radars to perform instance segmentation. Decreased the time from first detection to full-state estimation of objects in the environment by a factor of six.
- Refactored C++ based radar tracking pipeline to allow sensor fusion across radars. Improved performance on proprietary metrics by 20% while reducing computational overhead.

SOFTWARE

Drake

- Contributor in both C++ and Python to Drake, an open source model-based simulator for robotics.
- Provided implementations of algebraic parametrizations for kinematics occurring in rigid body systems.
- Implemented geometric operations commonly performed on sets in optimization problems.
- Extended the available symbolic algebra library to improve available algebraic optimization tools.

SERVICE AND LEADERSHIP

Conference Reviewing

- IFAC Automatica 2023
- IEEE Conference on Decision and Control (CDC) 2022
- IEEE Robotics and Automation Letters (RA-L) 2022

Graduate Application Assistance Program: Mentor — August 2020 - Present

- MIT: Worked with eight prospective graduate students from underrepresented backgrounds in STEM to strengthen their graduate and fellowship application packages.
- University of Pennsylvania: Launching a graduate application assistance program at the University of Pennsylvania to match prospective graduate students with young alumni to provide mentorship throughout the graduate application process.

NCAA Varsity Athletics: Men's Foil — August 2016 - May 2020

- Dedicated fourteen hours per week to team practice, strength training, and individual coaching sessions. Improved team dynamics through social outings and assisted underclassmen with scheduling and courses.
- Voted most dedicated fencer of 2016-2017 by captains and coaches for outstanding efforts and contributions to the team.

TECHNICAL STRENGTHS

Languages	English (Native Speaker), French (Native Speaker), Spanish (Proficient)
Computer Languages	Python, C++, MATLAB, Java
Libraries	Drake, PyTorch, OpenCV, PyCrypto, CVX/YALMIP

TEACHING

Applied Convex Optimization: Lecturer — IAP 2022
MIT 6.S098

- Designed and taught month long course on the fundamentals of convex optimization. Demonstrated applications in finance, control theory, civil planning, and machine learning.
- Overall course quality was rated 6.0/7.0 and overall lecture quality was rated 6.6/7.0 by the class of 10 students.

Underactuated Robotics: Teaching Assistant — Spring 2022
MIT 6.832 — *Supervisor: Russ Tedrake*

- Supported a class of 90 students through office hours for graduate qualifying course in underactuated dynamics and control. Taught review sessions in prerequisite optimization theory to improve student outcomes.
- Overall instruction quality was rated 6.2/7.0. Commended by multiple students for dedication to the course in written reviews.

Modern Convex Optimization: Teaching Assistant — Spring 2020
University of Pennsylvania ESE 605 — *Supervisor: Nikolai Matni*

- Assisted students through office hours in a second year graduate course in convex optimization theory.
- Taught review sessions on prerequisite mathematical foundations to improve student retention.
- Produced solution sets and graded homeworks and exams for a course of 53 students.

Control of Autonomous Systems: Teaching Assistant — Fall 2019
University of Pennsylvania ESE 421 — *Supervisor: Bruce Kothmann*

- Assisted in designing undergraduate labs teaching the basics of robotic perception and control theory. Attended four hours of lab a week to review essential material, lead code design session, and assist students in their development of a rudimentary autonomous vehicle.
- Hosted office hours for four hours a week to provide individual feedback. Taught coding workshops to familiarize students from mechanical, electrical, and computer engineering with the basics of coding in Arduino, C++, and Python. Introduced students to common libraries and modern coding standards.

HONORS AND AWARDS

Albert P. Godsho Engineering Prize — University Of Pennsylvania: Spring 2020

- Awarded to the graduating senior in the School of Engineering and Applied Science who has been selected by the faculty as having displayed the best grasp of the mathematical principles underlying the profession of engineering.

Societal Impact Award — University of Pennsylvania: 2020

- Awarded to the senior design capstone team in the department of Electrical and System Engineering whose project based on information systems best proposes a solution to a societal problem.

Hewlett Packard Fellowship — M.I.T: Fall 2020 - Spring 2021

- One year fellowship awarded by M.I.T's Department of Electrical Engineering and Computer Science granting full financial support to a small number of incoming students.

Graduate Research Fellowship Honorable Mention NSF: 2020

· Awarded by the National Science Foundation to meritorious applicants who did not receive the Graduate Research Fellowship award.

Norman J. Goldring Award University of Pennsylvania: Spring 2020

· Awarded to the graduating male and the graduating female varsity student-athlete with the highest GPA of any varsity sport at the University of Pennsylvania.

E. Stuart Eichert Jr. Memorial Prize University Of Pennsylvania: Spring 2019

· Awarded to the junior who in the judgement of the faculty of the Electrical Engineering and Computer Science departments best demonstrates initiative, intellectual attainment, and commitment to the professional practice of engineering.

THESES

Optimal Constraint Relaxation: Theory and Application to Problems in Robotics 2019-2020

Masters Thesis *Advisors: Alejandro Ribeiro and C.J. Taylor*

· Proved a novel connection between the optimal dual variables and the optimal slacks of a soft-constrained optimization problem and used this connection to provide a novel algorithm for solving the optimal constraint relaxation problem.

· Provided novel definition of resiliency in control systems based on the relaxing of problem constraints. Applied the theory of resiliency to multi-drone formation simulations using ROS, Gazebo, and Python demonstrating the resilience property's ability to automatically design novel maneuvers for the formation.

· Reformulated the classic machine learning problem of the joint minimization of loss and model risk as the constrained minimization of model risk subject to achieving a specified loss on each training example. Implemented a novel optimizer in PyTorch for training models using this formulation.

· Applied the theory of optimal constraint relaxation to the classification of the Fashion-MNIST dataset and demonstrated the novel formulation's ability to detect mislabelled data, improving classification robustness and prediction confidence.

Car-Tooning 2019-2020

Undergraduate Senior Design *Advisor: Manfred Morari*

· Designed a decentralized model predictive control scheme for vehicular platooning applications which was robust by design against random network delays.

· Implemented a realistic autonomy stack on low performing hardware to demonstrate the algorithm's capability to overcome poor network performance even in challenging environments.