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🎓 [Google Scholar \(Rxx9W98\)](https://scholar.google.com/citations?user=Rxx9W98)

EDUCATION

Ph.D. candidate in Computer Science *Boston University*

2018 – AUGUST 2025

Advisor: Renato Mancuso, GPA: 3.9/4.0

Depth exam: *Control Theory and Embedded Systems*

PASSED 2022

Committee: [Renato Mancuso ♦ Rich West ♦ Kate Saenko]

Doctoral Dissertation: *Minimizing the Intent-To-Reality Gap*

PASSED 2025

Committee: [Renato Mancuso ♦ Kate Saenko ♦ Sabrina Neuman ♦ Bingzhao Zhong]

M.S. in Computer Science *Boston University*

2023

Thesis: *Tree Shaping, a solution to the expression problem*

Committee: [Marco Gaboardi ♦ Renato Mancuso]

B.S. in Computer Science *American University of Beirut*

2012 – 2015

RESEARCH INTERESTS

My research focuses on enabling roboticists to **faithfully** translate high-level objectives into **robust** learned behaviors, particularly for *resource-constrained* robotic systems. By combining programming languages and machine learning techniques, I develop methods to synthesize controllers that perform **reliably** in real-world environments. My work emphasizes principled *adaptation* and *sim-to-real* transfer approaches to ensure learned controllers maintain their intended behavior when deployed.

My topics of interest include:

Reinforcement Learning ♦ Embedded Systems ♦ Type Theory ♦ Metaheuristics ♦ Control Systems

PUBLICATIONS

- [1] **Mabsout B.*** ♦ Mysore S.* ♦ Saenko K. ♦ Mancuso R. (CITATIONS: 28) 2021
How to train your quadrotor: A framework for consistently smooth and responsive flight control via reinforcement learning
ACM Trans. Cyber-Phys. Syst., 5(4): [10.1145/3466618](https://doi.org/10.1145/3466618) ♦ website: cpslab.bu.edu/projects/httpq
- [2] **Mabsout B.*** ♦ Mysore S.* ♦ Saenko K. ♦ Mancuso R. (CITATIONS: 102) 2021
Regularizing Action Policies for Smooth Control with Reinforcement Learning
ICRA: [10.1109/ICRA48506.2021.9561138](https://doi.org/10.1109/ICRA48506.2021.9561138) ♦ website: cpslab.bu.edu/projects/caps/
- [3] Mysore S. ♦ **Mabsout B.** ♦ Mancuso R. ♦ Saenko K. (CITATIONS: 12) 2021
Honey, I Shrank The Actor: A Case Study on Preserving Performance with Smaller Actors in Actor-Critic Reinforcement Learning
IEEE CoG: [10.1109/CoG52621.2021.9619008](https://doi.org/10.1109/CoG52621.2021.9619008)

- [4] **Mabsout B.** 2023
Tree Shaping, a solution to the expression problem showcased via a compiler for a programming language named Puler
 Masters Thesis, Boston University: hdl.handle.net/2144/49330 ♦ [github: bmabsout/puler](https://github.com/bmabsout/puler)
- [5] **Mabsout B.*** ♦ Abdelgawad A.* ♦ Mancuso R. 2025
Closing the Intent-to-Behavior Gap via Fulfillment Priority Logic
 IROS: [2503.05818](https://arxiv.org/abs/2503.05818) ♦ [github: bmabsout/FPL-IROS25](https://github.com/bmabsout/FPL-IROS25)

* Authors contributed equally

ONGOING RESEARCH

Anchored Learning for On-the-Fly Adaptation

SUBMITTED TO RA-L

A novel strategy for enhancing the robustness of reinforcement learning agents in crossing the sim-to-real gap. Our method maximizes multiple Q-values across domains, ensuring high performance in both simulation and reality, achieving a near-50% reduction in power consumption while maintaining controllable, stable flight

arXiv: [2301.06987](https://arxiv.org/abs/2301.06987) ♦ [github: bmabsout/AnchoredActorCritic](https://github.com/bmabsout/AnchoredActorCritic)

Scrap Your Schedules with PopDescent

ONGOING

A population-based hyperparameter optimization method which adaptively controls hyperparameter selection via a normalized fitness function. The method combines the exploration benefits of evolutionary algorithms with the exploitation of gradient descent, outperforming the use of schedules by up to 18%

arXiv: [2310.14671](https://arxiv.org/abs/2310.14671)

Boolean Function Differentiation for Efficient Backpropagation

ONGOING

We propose a method for efficiently computing the gradient of Boolean functions. Our method avoids the standard pitfalls of lack of gradient information by constructing computational graphs effectively.

[github: bmabsout/discrete_learning](https://github.com/bmabsout/discrete_learning)

Adaptive Lyapunov-based controller learning

ONGOING

We construct learned controllers using quickly converging learned bounded Lyapunov functions for maintaining stability under multiple complex dynamical systems at the same time. This technique is then used to take advantage of learned dynamics as well as idealized models, improving the probability of stable and high-performance control when deployed in the real world

[github: bmabsout/SystemDescent](https://github.com/bmabsout/SystemDescent)

Risk-aware path planning using 2D-Gaussian mixtures

ONGOING

In order to maximize the safety and performance of autonomous vehicles, we propose a risk-aware path planning framework that uses 2D-Gaussian mixtures. We propose an efficient method for computing the risk of trajectories allowing for real-time sampling and optimization on computationally constrained F1tenth vehicles

[github: bmabsout/gaussian_racer_jax](https://github.com/bmabsout/gaussian_racer_jax)

PROPOSAL WRITING

GenZero Proposal PIs: [Benjamin Lubin ♦ Marco Caccamo ♦ Sandro Pinto ♦ Renato Mancuso] 2024

Selected proposal and *Best Presentation Award* winner at the GenZero Workshop. I contributed to the development of the proposal and led the successful prototype demonstration, coordinating efforts between PhD. students at Boston University, Technical University of Munich, and University of Minho. The project proposes a framework that separates data ownership, processing, and usage concerns, demonstrated through ML workloads. We advanced to the final phase following the competitive selection process.

BU Technology Development Ignition Award PI: [Renato Mancuso] 2024

Accepted Letter of Interest for a proposed plug-and-play solution for confidential computing. Allowing secure application execution on traditional server hardware without requiring costly upgrades, and maintaining security even when the server is compromised.

Efficient Control for Small-Scale Limbed Robots PIs: [Renato Mancuso ♦ Sabrina Neuman] 2024

NSF-medium proposal focused on three research thrusts: improving neural network control for under-instrumented limbed robots, exploring HW/SW architectures for energy-efficient control, and designing efficient learned runtime adaptation techniques on constrained platforms. Aims to enable a new class of cost- and power-efficient robots

Solar-Powered UAV for Sustainable Agriculture PIs: [Renato Mancuso ♦ Marco Caccamo] 2023

NSF-medium Research proposal on eco-friendly UAV design for agriculture through solar power and energy-efficient computing. We propose a novel architecture that enables sustainable long-endurance missions by designing neural networks that maximize power-efficient control and formal safety bounds.

Certified Survivability PIs: [Renato Mancuso ♦ Chuchu Fan] 2022

Joint proposal with MIT focused on developing certifiably safe and robust neural network-based controllers for robots that can adapt to substantial system damages while maintaining provable safety guarantees. The project builds on my work on neural network-based control and transfer learning.

SELECTED PROJECTS

Control Theory Survey DEPTH EXAM – BU

This survey explores the landscape of safe robot learning, investigating methods that balance high-performance control with rigorous safety constraints. By examining classical control techniques, learning-based approaches, and embedded system design, the research seeks to understand how robotic systems can be developed to prevent hazardous states while maintaining optimal performance.

arxiv: [2501.01432](https://arxiv.org/abs/2501.01432)

Stochastic dynamics learning BU/MIT

Achieving safer learned model-based control requires accurate models, given most real-world systems are stochastic, I built Generative Adversarial Networks modeling the distribution of a system's trajectories.

github: [bmabsout/swirls](https://github.com/bmabsout/swirls) ♦ github: [bmabsout/SystemDescent](https://github.com/bmabsout/SystemDescent)

Honda Ridesharing SAIL

In collaboration with BU's SAIL and Honda, we worked on privacy preserving (using [MPC](#)) preferential ride-sharing. My responsibilities included defining optimization constraints so users with similar preferences get pooled together

Seizure Prediction

MACHINE LEARNING – CS542

A [Kaggle competition](#) project which accurately predicted seizure activity in epileptic patients. Utilizing machine learning techniques, we achieved the highest score with a significant margin (AUC score of 0.92), our model was tested by the competition's organizers and was found to be the best performing model.

preprint: tinyurl.com/seizure-prediction

Simplifying Nash- ϵ equilibrium complexity

COMPLEXITY THEORY – CS535

We simplify an existing proof of the complexity class specifying the run-time of finding Nash- ϵ equilibria

preprint: tinyurl.com/nash-complexity

Haskell Blog

PERSONAL BLOG

I created a programming languages focused blog exploring geometry, automatic differentiation, and dependently typed vector construction. The blog garnered [interest](#) and was featured on [Haskell Weekly](#)

blog: bmabsout.com/blog

WORK EXPERIENCE

Cofounder/CSO *Neobotics Foundation Inc.*

2025 – PRESENT

Leading the development of an open-source platform democratizing autonomous systems education through affordable racing kits and comprehensive learning materials. Building a community-driven ecosystem that makes robotics education more accessible while advancing the field of autonomous racing.

Founder *Scanman*

2020 – PRESENT

Developed a full-stack inventory management system combining React Native barcode scanning and real-time web dashboard for inventory tracking. System acquired by Meathouse for supply chain management.

Cofounder/CTO *Zahera*

2018 – 2022

Led development of an app-based photo printing service reaching over 15,000 installations. Managed product design, technology stack, and 3 developers

instagram: [@zahera_me](#)

Researcher *American University of Beirut*

2016 – 2018

Developed *neural-swarm*, a collection of experimental optimization algorithms for learning decentralized swarm control systems using neural networks, implemented in Haskell

github: [neural-swarm](#)

Software Developer *CCC*

2015 – 2017

Core team member of C3D, a leading 3D construction project control application designed for energy projects. I performed optimizations that improved performance by 2000%, refactored main architectural components of the huge codebase increasing maintainability and type-safety, and implemented bug fixes in Java. I also contributed to [JFoenix](#)

website: cctintl.com/solutions/c3d-project-control.html

MEDIA

Presentations

- Minimizing the Intent-To-Reality Gap** 2025
Defended my doctoral dissertation presenting Fulfillment Priority Logic, a new framework and algorithm that improve multi-objective reinforcement learning efficiency and performance.
- Guest Lecture Embedded Systems 454/654** 2025
Gave two guest lectures on control theory for the embedded systems course in Boston University
- Indiana University Bloomington** 2025
Presented my job talk titled “Minimizing the Intent-to-Reality Gap”, for a tenure-track position in ISE
- Ph.D. Prospectus** [*“Document”*](#) ◊ [*“Slides”*](#) 2025
Presented my thesis proposal on bridging the gap between high-level objectives and real-world performance in robotic systems, focusing on expressive policy specification and robust deployment.
- WASP** [*“wasp-sweden.org”*](#) 2023
Presented my research to the Wallenberg AI, Autonomous Systems and Software Program group on increasing controller robustness and reducing power consumption on complex robots
- Galois Inc.** [*“Achieving Robustness in Learned Control”*](#) 2023
Presented work on combining formal verification with reinforcement learning for control, exploring the challenges of defining and proving specifications for learned controllers while maintaining performance and robustness.
- M.S. Thesis Defense** [*“Slides”*](#) 2023
Presented novel compiler design techniques using Tree Shaping to address the expression problem, demonstrating how it enables more maintainable and extensible language implementations.
- Depth Oral Exam** [*“Slides”*](#) 2022
Presented comprehensive analysis of control methodologies spanning classical control theory to modern learning-based approaches, with emphasis on safety properties and real-world deployment challenges.
- BU Systems Seminar** [*“Slides”*](#) 2022
Presented my PhD journey around efficient reinforcement learning and embedded systems
- AI4ALL** [*“Slides”*](#) 2022
Presented an introduction to robotics and reinforcement learning to high school students, focusing on making complex concepts accessible and inspiring the next generation of researchers.
- BU AIR** [*“bu.edu/hic/centers-initiatives-labs/air”*](#) 2021
Presented findings on reward design [1] and minimizing actuation [2] for real world RL-based control
- ICRA** [*“\[2\]”*](#) 2021
Presented my paper on regularizing action policies for smooth control
- CoG** [*“\[3\]”*](#) 2021
Presented work on minimizing actor sizes for real-time control in actor-critic RL
- Honda Research Institute** [*“honda-ri.de/institute”*](#) 2019
Presented work on privacy-preserving ridesharing using secure multi-party computation (MPC), focusing on optimization constraints for pooling users with similar preferences, and presented methodology for n-dimensional similarity matching using the Hilbert space-filling curve

News Articles

Haskell Weekly	<u>“Issue 82”</u>	2017
BU Hub Innovation Center	<u>“Simplifying Machine Learning for Drone Flight Control”</u>	2021

MENTORSHIP

F1Tenth Racing Team *Boston University* 2024

Mentored a team of 11 students (Koneshka Bandyopadhyay, Muhammad Aseef Imran, Shah Nawaz Fakir, Georgina Focia, Ruihang Liu, Hyunjin Jung, Jiawei Sun, Patrick Kuzdzal, Yann Arif, Jiyayi Shen) in developing an autonomous racing platform. Led the development of simulation environments, classic control algorithms, computer vision systems, and hardware integration. The team successfully competed and won second place in an official F1Tenth competition. We developed novel approaches to autonomous racing including obstacle avoidance and path planning algorithms, as well as Gaussian-mixture-based control methods, and explored Gaussian-splatting-based localization.

Unified Local-Cloud Decision-Making via Reinforcement Learning *Boston University* 2023

Mentored Kathakoli Sengupta and Sandesh Bharadwaj in developing UniLCD, a hybrid inference framework for local-cloud collaboration in mobile robotics. Guided the implementation of the complete control pipeline in CARLA simulator and guided the design of the reward structure for the reinforcement learning system following [1], contributing to a 35% performance improvement over baselines. Their work was accepted at ECCV 2024.

paper: [UniLCD](#) ♦ Kathakoli (web): [diasengupta.github.io](#) ♦ Sandesh (linkedin): [bharadwaj97](#)

RISE Program *Boston University* 2022

Mentored Abhinav Pomalappally in gradient-based optimization research, this work led to the population-based optimization paper. Provided recommendation letter leading to his admission to UC Berkeley. Led weekly reading groups on advanced topics in control theory and optimization.

linkedin: [apomalappally](#)

Kilachand Honors College Keystone Project *Boston University* 2024

Advised Rithvik Doshi on embedded systems localization project. Implemented pedestrian detection system using ESP32 Bluetooth modules and integrated RTK-GPS for precise positioning. This project was part of the explorations that evolved into building SafeSteps, a startup focused on pedestrian safety.

website: [doshir.dev/about](#)

BU Spark *Boston University* 2023

Supervised a team of 5 students in building a 3d printed quadrotor which uses a jetson for onboard processing for research purposes. The quadrotor successfully completed flight tests.

Zahera 2021

Mentored Shadi Shahin, Marwa Karaki, and Pierre Kamel in building an application with heavy image processing components. Guiding them on modern development practices, code quality, and system architecture. I Led technical training sessions and provided guidance on best practices in software development.

Scanman 2022

Mentored two developers in development on live real-time data processing, database design, and program architecture. Provided guidance on algorithm implementations, code optimization, and full-stack development.

ACADEMIC SERVICES

Peer Review Venues

ICLR ♦ ICRA ♦ COG ♦ ROBOT ♦ EMSOFT ♦ DATE ♦ ECRTS ♦ RTSS ♦ TJCA ♦ RTAS

Teaching Experience

Teaching Fellow - CS 350 Distributed Systems *Boston University* 2024

Supported Prof. John Liagouris in teaching distributed systems concepts. Designed and implemented a Raft-based distributed locking homework assignment, including testing infrastructure. Held regular office hours to assist students with distributed systems challenges.

Teaching Fellow - CS 454/654 Embedded Systems *Boston University* 2023

Led weekly lab sections for 24 students using the AmazingBall platform. Designed a PyBullet simulation environment to teach filtering and PID control fundamentals. Created and supervised four successfully completed projects: (1) embedded system identification and simulation enhancement, (2) real-time vision processing for state estimation, (3) higher-level control using reinforcement learning, and (4) low-latency communication system for remote control. Projects emphasized practical embedded systems challenges including real-time constraints and hardware-software integration.

Teaching Fellow - CS 506 Data Science *Boston University* 2018

Assisted Prof. Andrei Lapets by delivering secondary lectures in core data science topics including feature space design, clustering algorithms, classification methods (decision trees, SVM, kNN), regression techniques, neural networks. Supervised industry-partnered projects such as fraud detection for Painting with Data, aviation safety analysis for ACAS, and a project for the City of Boston.

HONORS

Best Demonstration Award *GenZero Workshop - UAE* 2024

Awarded for outstanding presentation and demonstration of novel computation frameworks for data ownership and processing.

Second Place *F1Tenth Autonomous Racing Competition - Boston University* 2024

Led the team to a second place finish, developing innovative approaches to autonomous racing including obstacle avoidance and Gaussian-based control methods.

Fourth Place *ACM LCPC* 2014

Achieved fourth place in the ACM Languages and Compilers for Parallel Computing competition.

First Place *AUB Science, Mathematics and Technology Fair* 2011

Won first place in the Annual Science, Mathematics and Technology fair.

Model United Nations *MUN* 2010

Participated in the Model United Nations conference.

TECHNICAL SKILLS

Programming Languages

IMPERATIVE	C ♦ C++ ♦ Go ♦ Java
FUNCTIONAL	Haskell ♦ F# ♦ Clojure
SCRIPTING	Python ♦ Bash ♦ Fish
THEOREM PROVERS	Rocq ♦ Lean ♦ ATS
WEB	JavaScript ♦ TypeScript ♦ Elm
BUILD SYSTEMS	Nix ♦ Make
GRAPHICS	GLSL ♦ WGSL
MARKUP	LaTeX ♦ Typst ♦ HTML ♦ CSS ♦ XML ♦ Markdown

Frameworks & Libraries

ML	TensorFlow ♦ PyTorch ♦ JAX ♦ Keras ♦ NumPy ♦ SciPy
ROBOTICS	Stable Baselines ♦ Spinning Up ♦ PyBullet ♦ Gurobi
DATABASES	PostgreSQL ♦ Firebase ♦ Pandas
CROSS-PLATFORM	React Native
HASKELL	Megaparsec ♦ Recursion-Schemes ♦ Polysemy ♦ ImplicitCAD

Tools

DEVELOPMENT	Git ♦ Nix ♦ GNU Utils ♦ Make ♦ Docker
SOFTWARE	AutoCAD ♦ GIMP ♦ Photoshop ♦ Jupyter Notebook
HARDWARE	Soldering ♦ Electrical Tools ♦ Development Boards

PERSONAL INFORMATION

Nationalities

Lebanese ♦ Portuguese

Languages

English (Fluent) ♦ Arabic (Native) ♦ French (Intermediate)
