

# Tobia Marcucci

Assistant Professor of Electrical and Computer Engineering  
University of California, Santa Barbara

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## Research interests

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My research lies at the intersection of convex and combinatorial optimization, with applications to robotics, motion planning, and control. I focus on optimal decision making in circumstances where discrete and continuous choices have to be made jointly. I work on these problems on a mathematical and computational level: I design efficient formulations as optimization problems and fast solution algorithms.

## Employment

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- **University of California, Santa Barbara** 3/2025 to present  
*Assistant Professor of Electrical and Computer Engineering*  
*Affiliate of the Department of Mechanical Engineering*  
*Affiliate of the Center for Control, Dynamical Systems, and Computation*
- **Amazon Robotics** 6/2024 to 2/2025  
*Postdoctoral Scientist*  
*Research focus: high-performance optimization algorithms for robot motion planning*

## Education

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- **Massachusetts Institute of Technology** 6/2018 to 5/2024  
*Doctoral Degree in Computer Science with minor in Mathematics*  
*Advisors: Russ Tedrake and Pablo Parrilo*  
*Thesis: [Graphs of Convex Sets with Applications to Optimal Control and Motion Planning](#)*  
*Recipient of the [MIT EECS George M. Sprowls Ph.D. Thesis Award in AI and Decision Making](#)*
- **University of Pisa** 12/2013 to 9/2015  
*Master's Degree in Mechanical Engineering*  
*Final evaluation: 110/110 cum laude*
- **University of Pisa** 11/2010 to 11/2013  
*Bachelor's Degree in Mechanical Engineering*  
*Final evaluation: 110/110*

## Additional Research Experience

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- **Stanford University** 11/2022 to 10/2023  
*Visiting Ph.D. student with Stephen Boyd*
- **Massachusetts Institute of Technology** 1/2017 to 11/2017  
*Visiting Ph.D. student with Russ Tedrake*
- **University of Pisa and Istituto Italiano di Tecnologia** 9/2015 to 1/2018

Ph.D. student with Antonio Bicchi (uncompleted, moved to MIT)

## Journal publications

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- [J1] **Fast Path Planning Through Large Collections of Safe Boxes** 2024  
*Tobia Marcucci, Parth Nobel, Russ Tedrake, and Stephen Boyd*  
IEEE Transactions on Robotics (TRO)
- [J2] **Shortest Paths in Graphs of Convex Sets** 2024  
*Tobia Marcucci, Jack Umenberger, Pablo A. Parrilo, and Russ Tedrake*  
SIAM Journal on Optimization
- [J3] **Motion Planning around Obstacles with Convex Optimization** 2023  
*Tobia Marcucci, Mark Petersen, David von Wrangel, and Russ Tedrake*  
Science Robotics
- [IEEE RAS TC Model Based Optimization for Robotics Best Paper Award](#)
  - [Cover of November 2023 issue](#)
- [J4] **Warm Start of Mixed-Integer Programs for Model Predictive Control of Hybrid Systems** 2020  
*Tobia Marcucci and Russ Tedrake*  
IEEE Transactions on Automatic Control (TAC)
- [J5] **A Two-Stage Trajectory Optimization Strategy for Articulated Bodies with Unscheduled Contact Sequences** 2017  
*Tobia Marcucci, Marco Gabiccini, and Alessio Artoni*  
IEEE Robotics and Automation Letters (RAL)

## Conference publications

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- [C1] **A Biconvex Method for Minimum-Time Motion Planning Through Sequences of Convex Sets** 2025  
*Tobia Marcucci, Mathew Halm, William Yang, Dongchan Lee, and Andrew Marchese*  
Robotics: Science and Systems (RSS)
- [C2] **A New Semidefinite Relaxation for Linear and Piecewise-Affine Optimal Control with Time Scaling** 2025  
*Lujie Yang, Tobia Marcucci, Pablo Parrilo, and Russ Tedrake*  
IEEE International Conference on Robotics and Automation (ICRA)
- [C3] **On the Sample Complexity of Imitation Learning for Smoothed Model Predictive Control** 2024  
*Daniel Pfrommer, Swati Padmanabhan, Kwangjun Ahn, Jack Umenberger, Tobia Marcucci, Zakaria Mhammedi, and Ali Jadbabaie*  
IEEE Conference on Decision and Control (CDC)
- [C4] **Multi-Query Shortest-Path Problem in Graphs of Convex Sets** 2024  
*Savva Morozov, Tobia Marcucci, Alexandre Amice, Bernhard Paus Graesdal, Rohan Bosworth, Pablo Parrilo, and Russ Tedrake*  
International Workshop on the Algorithmic Foundations of Robotics (WAFR)

- [C5] **Towards Tight Convex Relaxations for Contact-Rich Manipulation** 2024  
*Bernhard P. Graesdal, Shao Y.C. Chia, Tobia Marcucci, Savva Morozov, Alexandre Amice, Pablo Parrilo, and Russ Tedrake*  
 Robotics: Science and Systems (RSS)
- [C6] **Approximating Robot Configuration Spaces with few Convex Sets using Clique Covers of Visibility Graphs** 2024  
*Peter Werner, Alexandre Amice, Tobia Marcucci, Daniela Rus, and Russ Tedrake*  
 IEEE International Conference on Robotics and Automation (ICRA)
- [C7] **Model-Based Control with Sparse Neural Dynamics** 2023  
*Ziang Liu, Jeff He, Genggeng Zhou, Tobia Marcucci, Li Fei-Fei, Jiajun Wu, and Yunzhu Li*  
 Conference on Neural Information Processing Systems (NeurIPS)
- [C8] **Mixed-Integer Formulations for Optimal Control of Piecewise-Affine Systems** 2019  
*Tobia Marcucci and Russ Tedrake*  
 ACM International Conference on Hybrid Systems: Computation and Control (HSCC)
- [C9] **Approximate Hybrid Model Predictive Control for Multi-Contact Push Recovery in Complex Environments** 2017  
*Tobia Marcucci, Robin Deits, Marco Gabiccini, Antonio Bicchi, and Russ Tedrake*  
 IEEE International Conference on Humanoid Robots (Humanoids)
- [C10] **Parametric Trajectory Libraries for Online Motion Planning with Application to Soft Robots** 2017  
*Tobia Marcucci, Manolo Garabini, Gian Maria Gasparri, Alessio Artoni, Marco Gabiccini, and Antonio Bicchi*  
 International Symposium on Robotic Research (ISRR)
- [C11] **Towards Minimum-Information Adaptive Controllers for Robot Manipulators** 2017  
*Tobia Marcucci, Cosimo Della Santina, Marco Gabiccini, and Antonio Bicchi*  
 IEEE American Control Conference (ACC)
- [C12] **Approximate Explicit Model Predictive Control for Push Recovery Using Mixed-Integer Convex Optimization** 2017  
*Robin Deits, Tobia Marcucci, Lucas Manuelli, Twan Koolen, and Russ Tedrake*  
 Dynamic Walking

## Preprints

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- [P1] **A Unified and Scalable Method for Optimization over Graphs of Convex Sets** 2025  
*Tobia Marcucci*  
 Under review in Mathematical Programming  
 arXiv:2510.20184
- [P2] **Mixed Discrete and Continuous Planning using Shortest Walks in Graphs of Convex Sets** 2025  
*Savva Morozov, Tobia Marcucci, Bernhard Paus Graesdal, Alexandre Amice, Pablo Parrilo, and Russ Tedrake*  
 arXiv:2507.10878

## Teaching experience

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### Main instructor:

- *Introduction to Robotics: Planning and Kinematics* Spring 2025  
Undergraduate course at the University of California, Santa Barbara (ECE/ME 179P)

### Teaching assistant:

- *Underactuated Robotics* Spring 2020  
Graduate course taught by Russ Tedrake at MIT
  - Gave two lectures (available on the [class YouTube channel](#))
  - Developed the exercises in the [class lecture notes](#)
- *Automatic Controls and Robot Mechanics* Fall 2015  
Graduate course taught by Antonio Bicchi and Marco Gabiccini at the University of Pisa
  - Gave multiple lectures

### Guest lecturer:

- *Optimal Control: from Calculus of Variations to Numerical Optimization* Summer 2020  
Doctorate course taught by Manolo Garabini at the University of Pisa
  - Lecture material available at [https://github.com/TobiaMarcucci/optimal\\_control\\_pisa](https://github.com/TobiaMarcucci/optimal_control_pisa)
- *Intelligent Robot Manipulation* Fall 2018  
Graduate course taught by Russ Tedrake and Tomás Lozano-Pérez at MIT

## Conference and workshop organization

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- [World Symposium on the Algorithmic Foundations of Robotics](#) 2026  
Co-chair with Stephane Caron, Steven LaValle, Basak Sakcak, Oren Salzman
- [ScaleOPT: GPU-accelerated and Scalable Optimization](#) 2025  
Workshop at Conference on Neural Information Processing Systems (NeurIPS)  
Organizer with Parth Nobel, Fangzhao Zhang, Maximillian Schaller, Tetiana Parshakova, Stephen Boyd
- [Decision and Control Blending Combinatorial and Continuous Optimization](#) 2023  
Workshop at SIAM Conference on Optimization  
Main organizer with Jack Umenberger
- [Optimal planning and control fusing offline and online algorithms](#) 2019  
Workshop at IEEE International Conference on Robotics and Automation  
Main organizer with Manolo Garabini
- **"Robotics I" session** 2017  
IEEE American Control Conference  
Co-chair

## Invited talks

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### Motion Planning around Obstacles with Convex Optimization:

- Stanford University (Interactive Perception and Robot Learning Laboratory) 7/2023
- University of California Berkeley (EECS Seminar) 5/2023
- Stanford University (SystemX Robotics Spotlights) 2/2023
- Cornell University (Verifiable Robotics Group) 10/2022
- Istituto Italiano di Tecnologia (iCub Research Lines) [[recording](#)] 9/2022

### Graphs of Convex Sets:

- International Conference on Continuous Optimization (ICCOPT) (session on “Optimization for robotics”) 7/2025
- INFORMS Annual Meeting (session on “Global optimization”) 10/2023
- SIAM Conference on Optimization (session on “Decision and control blending combinatorial and continuous optimization”) 6/2023
- Stanford University (Linear Algebra and Optimization Seminars) 1/2023
- [Joint Mathematics Meetings](#) (SIAM mini-symposium in combinatorial optimization) 1/2023
- [International Conference on Optimization and Decision Science](#) (session on “Path and routing problems in industry”) 8/2022
- Université Catholique de Louvain (Cyber-Physical Systems Laboratory) 5/2022
- [IMT School for Advanced Studies Lucca](#) 12/2021
- Stanford University (Autonomous Systems Laboratory) 11/2021
- University of California Berkeley (MPC Laboratory) 11/2021
- California Institute of Technology (AMBER Laboratory) 11/2021
- Massachusetts Institute of Technology (Embodied Intelligence Submissions Seminars) 9/2021

### Others:

- *Control through Contacts via Approximate Explicit Model Predictive Control* 5/2019  
IEEE International Conference on Robotics and Automation  
[Workshop on optimal planning and control fusing offline and online algorithms](#)

## Invited posters

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### Graphs of Convex Sets:

- Brown University ([ICERM workshop on Linear and Non-Linear Mixed Integer Optimization](#)) 2/2023
- Cornell University ([ORIE Young Researchers Workshop](#)) 10/2022

## Awards

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- [MIT EECS George M. Sprowls Ph.D. Thesis Award in Artificial Intelligence and Decision Making](#) 2025

- IEEE RAS TC Model Based Optimization for Robotics Best Paper Award 2023
- SIAM Student Travel Award 2023
- Grass Instruments Company Fellow 9/2018 to 5/2019

## Reviewer

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- International journals and conferences, including: Automatica, IEEE Transactions on Automatic Control (TAC), IEEE Transactions on Robotics (TRO), International Journal of Robotics Research (IJRR), Journal of Robust and Nonlinear Control, Journal of Optimization Theory and Applications (JOTA), and Science Robotics.