Ugo Rosolia
Research Scientist, Manager
Amazon

✉ ugo.rosolia@gmail.com
 github.com/urosolia
 🌐 ugorosolia.com
  Ugo Rosolia
 in ugo.rosolia

EDUCATION

University of California Berkeley — Berkeley, CA
Ph.D. in Control Engineering, Advisor: Prof. Francesco Borrelli. — Aug 2015 – Dec 2019

- Thesis: "Learning Model Predictive Control: Theory and Applications".
- Developed a theoretical Model-Based RL framework called Learning Model Predictive Control (LMPC).
- Leveraged the LMPC to teach an autonomous full-size car how to race in real-world experiments (video).
- The LMPC paper is among the most frequently accessed journals on IEEE Transaction on Automatic Control.

Politecnico di Milano — Milano, Italy
M.S. in Mechanical Engineering, Grade: 110 Cum Laude/110. — Sept 2012 – Sept 2014

- Thesis: "NMPC for Autonomous Vehicle". Advisors: Prof. Andrew Alleyne and Prof. Francesco Braghin
- Developed a solver for smooth nonlinear optimal control using continuation methods.
- Results published on the journal IEEE Transaction on Control System Technology.

Politecnico di Milano — Milano, Italy
B.S. in Mechanical Engineering. — Sept 2009 – Sept 2012

- Thesis: "Stress and Strain of a Disk Break: A Finite Element Modelling (FEM) Analysis".
- Developed a FEM solver. Results validated with a commercial solver which costs 20k+/year.

RESEARCH AND WORKING EXPERIENCE

Amazon — Luxembourg, Luxembourg
Manager, Research Science — Sept 2023 – Present
Senior Research Scientist — April 2023 – Present
Research Scientist — Oct 2021 – April 2023

- Developed an algorithm to jointly optimize speed and cost of the transportation network.
- Co-developed an ML-based method for solving large-scale Mixed-Integer Programs (MIPs).
- Managed a team of scientist to deliver science solutions to business problems.

California Institute of Technology — Pasadena, CA
Postdoctoral Scholar. Project: Test and Evaluation of Safety Critical Autonomous Systems. — Jan 2020 – Sept 2021

- Developed theory and solvers for constrained mixed observable Markov decision processes (CMOMDPs).
- Designed and tested on hardware an hierarchical framework for safety critical control.
- Mentoring and coordinating students.

University of California Berkeley — Berkeley, CA
Research Assistant. — Aug 2015 – Dec 2019

- Supervised and co-developed the Berkeley Autonomous Racing Car (BARC) platform (barc-project.com).
- Student Member of the Hyundai Center of Excellence. In charge of control design and testing.

École Polytechnique Fédérale de Lausanne (EPFL) — Lausanne, Switzerland
Visiting Scholar. — Nov 2019

Siemens PLM Software   Leuven, Belgium
Research Engineer. Project: Automated Testing.   Jan 2015 – Jun 2015
  − Developed C code to automatically synthesizing control policies using approximate dynamic programming.

Siemens PLM Software   Leuven, Belgium
Intern. Project: Automated Driving.   Jul 2014 – Sept 2014
  − First researcher to successfully test cooperative autonomous driving on Siemens's testing platform.

University of Illinois at Urbana-Champaign (UIUC)   Champaign, IL
Visiting Student, GPA 4/4.   Aug 2013 – May 2014
  − Attended six grad classes and conducted research at the ARG lab.

MINES ParisTech   Paris, France
Athens Student. Project: Plastic deformation of metals   Feb 2013

Tonji University   Shanghai, China
Double degree student.   Sep 2010 – Jun 2011

Scholarships and Awards

- Graduate Division Block Grant Award (11.4k$)   Summer 2019
- The Frank and Margaret Lucas Scholarship Fund (20.3k$)   Spring 2019
- Graduate Division Block Grant Award (18.8k$)   Spring 2017
- Graduate Division's Non-Resident Supplemental Tuition Award (7.5k$)   Spring 2017
- Master Degree Cum Laude (Top 5%)   2014
- Politecnico di Milano Scholarship (2k€/year)   2009 – 2014
- University of Illinois at Urbana-Champaing (UIUC) Scholarship (covered tuition)   Spring 2014
- Global E3 Project (covered tuition)   Fall 2013
- PoliTong Double Degree Project (1k€ + covered tuition)   Fall 2009 – Spring 2010

Teaching and Mentoring

- **Instructor** at the California Institute of Technology   Spring 2021
  Designed course on model-based reinforcement learning and predictive control (CS159)
  Lecture notes and HW available online at the course website ⊕1five9.github.io

- **Guest Lecturer** at the University of California Berkeley   Spring 2019 – Fall 2020
  Constrained Optimal Control and Model Predictive Control fundamentals (ME C231A)
  Introduction and advances topics on Learning Model Predictive Control (ME C231B)
  Helped with the preparation of homework and exams

- **PhD Students** at the California Institute of Technology   Jan 2020 – Present
  - Ivan Jimenez Rodriguez. Topic: "Model Learning for Control"
  - Prithvi Akella. Topic: "Bayesian Optimization for Testing and Evaluation"

- **MS Thesis Students** at the University of California Berkeley   Aug 2016 – Dec 2019
  - Maximilian Brunner. Topic: "Learning Model Predictive Control for Iterative Tasks"
  - Martin D'Hoffschmidt. Topic: "Deep Model Predictive Control"
  - Michael Garstka. Topic: "Adaptive LMPC"
  - Felix Nobis. Topic: "Obstacle Avoidance in Autonomous Racing"
  - Francesco Ricciuti. Topic: "Dynamic Obstacle Avoidance in Autonomous Racing"
  - Shuqi Xu. Topic: "Comparison of Model Learning Strategies for MPC"
  - Lukas Brunke. Topic: "Multi-agent Autonomous Racing"

- **Undergrad Students** at the University of California Berkeley   Aug 2016 – Dec 2019
  - Bike Zhang. Project: "Applications of Model Predictive Control"
  - Rohan Shina. Project: "Data-driven control"
  - Thiti Khomin. Project: "Autonomous Skateboard"
  - Paul Hsiao. Project: "Autonomous Skateboard"

Programming Skills

Python, ROS, C++, Git, MATLAB, Simulink, HTML, LaTeX

Selected Projects

For more details check ✪ ugorosolia.com

- Learning How to Race (Python, ⍜ repo)
  Model-based RL for autonomous car racing
- Planning Under Uncertainty (Python, ⍜ repo)
  Solver for mixed observable MDPs

- Learning MPC (Python, ⍜ repo)
  Repo of examples for teaching
- Multi-Rate MPC (C++, ⍜ repo)
  A control library for safety critical systems

Languages

Italian (mother tongue), **English** (proficient), **French** (basic)

Editorial Roles

Associate Editor: 2021 European Control Conference (ECC), 2022 European Control Conference (ECC), 2023 European Control Conference (ECC)

Reviewer: Transaction on Automatic Control (TAC), Automatica, Journal of Nonlinear and Robust Control, Transaction on Robotics (T-RO), Transaction on Control System Technology (TCST), Conference on Robot Learning (CoRL), Conference on Decision and Control (CDC), European Control Conference (ECC), American Control Conference (ACC), Cyber-Physical and Human Systems (CPHS), Optimal Control Applications and Methods, IFAC World Congress

Preprints

[1]   K. Benidis, **U. Rosolia**, S. Rangapuram, G. Iosifidis, and G. Paschos, *Solving recurrent mips with semi-supervised graph neural networks*, 2023.

[2]   T. Nagy, A. Amine, T. X. Nghiem, **U. Rosolia**, Z. Zang, and R. Mangharam, *Ensemble gaussian processes for adaptive autonomous driving on multi-friction surfaces*, 2023.

[3]   K. Huang, S. Lale, **U. Rosolia**, Y. Shi, and A. Anandkumar, *Cem-gd: Cross-entropy method with gradient descent planner for model-based reinforcement learning*, 2021.

*indicates equal contribution

Journal Publications

[1]   M. Ahmadi, **U. Rosolia**, M. D. Ingham, R. M. Murray, and A. D. Ames, "Risk-averse decision making under uncertainty", *IEEE Transactions on Automatic Control*, 2023, URL: https://ieeexplore.ieee.org/abstract/document/10091137.

[2] **U. Rosolia**, D. C. Guastella, G. Muscato, and F. Borrelli, "Model predictive control in partially observable multi-modal discrete environments", *IEEE Control Systems Letters*, 2023, URL: https://ieeexplore.ieee.org/abstract/document/10147354.

[3] J. Betz, H. Zheng, A. Liniger, **U. Rosolia**, P. Karle, M. Behl, V. Krovi, and R. Mangharam, "Autonomous vehicles on the edge: A survey on autonomous vehicle racing", *IEEE Open Journal of Intelligent Transportation Systems*, vol. 3, pp. 458–488, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9790832.

[4] M. Bujarbaruah, **U. Rosolia**, Y. R. Stürz, X. Zhang, and F. Borrelli, "Robust mpc for lpv systems via a novel optimization-based constraint tightening", *Automatica*, vol. 143, p. 110 459, 2022, URL: https://www.sciencedirect.com/science/article/abs/pii/S0005109822003156.

[5] Y. Chen, **U. Rosolia**, W. Ubellacker, N. Csomay-Shanklin, and A. D. Ames, "Interactive multi-modal motion planning with branch model predictive control", *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 5365–5372, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9729171.

[6] S. Daftry, N. Abcouwer, T. Del Sesto, S. Venkatraman, J. Song, L. Igel, A. Byon, **U. Rosolia**, Y. Yue, and M. Ono, "Mlnav: Learning to safely navigate on martian terrains", *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 5461–5468, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9729506.

[7] A. Pandala, R. T. Fawcett, **U. Rosolia**, A. D. Ames, and K. A. Hamed, "Robust predictive control for quadrupedal locomotion: Learning to close the gap between reduced-and full-order models", *IEEE Robotics and Automation Letters*, vol. 7, no. 3, pp. 6622–6629, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9779465.

[8] **U. Rosolia**, Y. Chen, S. Daftry, M. Ono, Y. Yue, and A. D. Ames, "The mixed-observable constrained linear quadratic regulator problem: The exact solution and practical algorithms", *IEEE Transactions on Automatic Control*, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9905925.

[9] **U. Rosolia**, Y. Lian, E. Maddalena, G. Ferrari-Trecate, and C. N. Jones, "On the optimality and convergence properties of the iterative learning model predictive controller", *IEEE Transactions on Automatic Control*, pp. 1–1, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9705072.

[10] **U. Rosolia**, A. Singletary, and A. D. Ames, "Unified multirate control: From low-level actuation to high-level planning", *IEEE Transactions on Automatic Control*, vol. 67, no. 12, pp. 6627–6640, 2022, URL: https://ieeexplore.ieee.org/abstract/document/9802791.

[11] D. R. Agrawal, H. Parwana, R. K. Cosner, **U. Rosolia**, A. D. Ames, and D. Panagou, "A constructive method for designing safe multirate controllers for differentially-flat systems", *IEEE Control Systems Letters*, vol. 6, pp. 2138–2143, 2021, URL: https://ieeexplore.ieee.org/abstract/document/9655322.

[12] Y. Chen, **U. Rosolia**, and A. D. Ames, "Decentralized task and path planning for multi-robot systems", *IEEE Robotics and Automation Letters*, vol. 6, no. 3, pp. 4337–4344, 2021, URL: https://ieeexplore.ieee.org/document/9384257.

[13] K. Garg, R. K. Cosner, **U. Rosolia**, A. D. Ames, and D. Panagou, "Multi-rate control design under input constraints via fixed-time barrier functions", *IEEE Control Systems Letters*, vol. 6, pp. 608–613, 2021, URL: https://ieeexplore.ieee.org/abstract/document/9442832.

[14] **U. Rosolia** and A. D. Ames, "Iterative model predictive control for piecewise systems", *IEEE Control Systems Letters*, 2021, URL: https://ieeexplore.ieee.org/abstract/document/9446940.

[15] **U. Rosolia** and F. Borrelli, "Minimum time learning model predictive control", *International Journal of Robust and Nonlinear Control*, vol. 31, no. 18, pp. 8830–8854, 2021, URL: https://onlinelibrary.wiley.com/doi/abs/10.1002/rnc.5284.

[16] **U. Rosolia**, X. Zhang, and F. Borrelli, "Robust learning model-predictive control for linear systems performing iterative tasks", *IEEE Transactions on Automatic Control*, vol. 67, no. 2, pp. 856–869, 2021, URL: https://ieeexplore.ieee.org/abstract/document/9440698.

[17] I. Batkovic, **U. Rosolia**, M. Zanon, and P. Falcone, "A robust scenario mpc approach for uncertain multi-modal obstacles", *IEEE Control Systems Letters*, vol. 5, no. 3, pp. 947–952, 2020, URL: https://ieeexplore.ieee.org/document/9133136.

[18] **U. Rosolia** and A. D. Ames, "Multi-rate control design leveraging control barrier functions and model predictive control policies", *IEEE Control Systems Letters*, vol. 5, no. 3, pp. 1007–1012, 2020, URL: https://ieeexplore.ieee.org/document/9137248.

[19] B. Thananjeyan*, A. Balakrishna*, **U. Rosolia**, F. Li, R. McAllister, J. E. Gonzalez, S. Levine, F. Borrelli, and K. Goldberg, "Safety augmented value estimation from demonstrations (saved): Safe deep model-based rl for sparse cost robotic tasks", *IEEE Robotics and Automation Letters*, vol. 5, no. 2, pp. 3612–3619, 2020, URL: https://ieeexplore.ieee.org/abstract/document/9013084.

[20] **U. Rosolia** and F. Borrelli, "Learning how to autonomously race a car: A predictive control approach", *IEEE Transactions on Control Systems Technology*, 2019, URL: https://ieeexplore.ieee.org/document/8896988.

[21] **U. Rosolia** and F. Borrelli, "Learning model predictive control for iterative tasks. a data-driven control framework", *IEEE Transactions on Automatic Control*, vol. 63, no. 7, pp. 1883–1896, Jul. 2018, URL: https://ieeexplore.ieee.org/abstract/document/8039204.

[22] **U. Rosolia**, X. Zhang, and F. Borrelli, "Data-driven predictive control for autonomous systems", *Annual Review of Control, Robotics, and Autonomous Systems*, vol. 1, pp. 259–286, 2018, URL: https://www.annualreviews.org/doi/abs/10.1146/annurev-control-060117-105215.

[23] **U. Rosolia**, S. De Bruyne, and A. G. Alleyne, "Autonomous vehicle control: A nonconvex approach for obstacle avoidance", *IEEE Transactions on Control Systems Technology*, vol. 25, no. 2, pp. 469–484, 2016, URL: https://ieeexplore.ieee.org/document/7489011.

[24] **U. Rosolia**, F. Braghin, A. Alleyne, and E. Sabbioni, "Nlmpc for real time path following and collision avoidance", *SAE International Journal of Passenger Cars-Electronic and Electrical Systems*, vol. 8, no. 2015-01-0313, pp. 401–405, 2015, URL: https://www.sae.org/publications/technical-papers/content/2015-01-0313/.

Conference Publications

[1] Y. Chen, **U. Rosolia**, C. Fan, A. D. Ames, and R. Murray, "Reactive motion planning with probabilistics safety guarantees", in *2020 Conference on Robot Learning (CoRL)*, URL: https://arxiv.org/pdf/2011.03590.pdf.

[2] K. Johansson, **U. Rosolia**, W. Ubellacker, A. Singletary, and A. D. Ames, "Mixed observable rrt: Multi-agent mission-planning in partially observable environments", in *2023 IEEE International Conference on Robotics and Automation (ICRA)*, URL: https://ieeexplore.ieee.org/abstract/document/10160392, IEEE, 2023, pp. 1386–1392.

[3] N. Csomay-Shanklin, A. J. Taylor, **U. Rosolia**, and A. D. Ames, "Multi-rate planning and control of uncertain nonlinear systems: Model predictive control and control lyapunov functions", in *2022 IEEE 61st Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/abstract/document/9992902, IEEE, 2022, pp. 3732–3739.

[4] M. Bujarbaruah, **U. Rosolia**, Y. R. Stürz, X. Zhang, and F. Borrelli, "A simple robust mpc for linear systems with parametric and additive uncertainty", in *the IEEE American Control Conference*, URL: https://ieeexplore.ieee.org/abstract/document/9482957, 2021.

[5] S. H. Nair, **U. Rosolia**, and F. Borrelli, "Output-lifted learning model predictive control", in *the 7th IFAC Conference on Nonlinear Model Predictive Control*, URL: https://www.sciencedirect.com/science/article/pii/S240589632101346X, 2021.

[6]   **U. Rosolia**, M. Ahmadi, R. M. Murray, and A. D. Ames, "Time-optimal navigation in uncertain environments with high-level specifications", in *in 2021 IEEE Conference on Decision and Control (CDC)*, URL: https://arxiv.org/abs/2004.03041, IEEE, 2021.

[7]   M. Ahmadi, **U. Rosolia**, R. M. Murray, and A. D. Ames, "Constrained risk-averse markov decision processes", in *Seventeenth AAAI Conference on Artificial Intelligence*, URL: https://ojs.aaai.org/index.php/AAAI/article/view/17393, 2020.

[8]   D. Papadimitriou, **U. Rosolia**, and F. Borrelli, "Control of unknown nonlinear systems with linear time-varying mpc", in *in 2020 IEEE Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/abstract/document/9304441, IEEE, 2020.

[9]   I. D. J. Rodriguez, **U. Rosolia**, A. D. Ames, and Y. Yue, "Learning unstable dynamics with one minute of data: A differentiation-based gaussian process approach", in *to appear in 2022 IEEE International Conference of Robotic and Automation (ICRA)*, URL: https://authors.library.caltech.edu/109029/, IEEE, 2020.

[10]   N. Scianca, **U. Rosolia**, and F. Borrelli, "Learning model predictive control for periodic repetitive tasks", in *2020 European Control Conference (ECC)*, URL: https://ieeexplore.ieee.org/abstract/document/9143857, IEEE, 2020, pp. 29–34.

[11]   Y. R. Stürz, E. L. Zhu, **U. Rosolia**, and F. Borrelli, "Distributed learning model predictive control for linear systems", in *2020 IEEE Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/abstract/document/9303820, IEEE, 2020.

[12]   B. Thananjeyan*, A. Balakrishna*, **U. Rosolia**, J. E. Gonzalez, A. D. Ames, and K. Goldberg, "Abc-lmpc: Safe sample-based learning mpc for stochastic nonlinear dynamical systems with adjustable boundary conditions", in *in 2020 Workshop on the Algorithmic Foundations of Robotics (WAFR)*, URL: http://robotics.cs.rutgers.edu/wafr2020/accepted-papers/, WAFR, 2020.

[13]   E. L. Zhu, Y. R. Stürz, **U. Rosolia**, and F. Borrelli, "Trajectory optimization for nonlinear multi-agent systems using decentralized learning model predictive control", in *to appear in 2020 IEEE Conference on Decision and Control (CDC)*, URL: https://arxiv.org/abs/2004.01298, IEEE, 2020.

[14]   **U. Rosolia** and F. Borrelli, "Sample-based learning model predictive control for linear uncertain systems", in *2019 IEEE Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/document/9030270, IEEE, 2019, pp. 2702–2707.

[15]   **U. Rosolia**, X. Zhang, and F. Borrelli, "Simple policy evaluation for data-rich iterative tasks", in *2019 IEEE American Control Conference (ACC)*, URL: https://ieeexplore.ieee.org/document/8814765, IEEE, 2019, pp. 2855–2860.

[16]   M. Bujarbaruah, X. Zhang, **U. Rosolia**, and F. Borrelli, "Adaptive mpc for iterative tasks", in *2018 IEEE Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/document/8618694, IEEE, 2018, pp. 6322–6327.

[17]   **U. Rosolia**, X. Zhang, and F. Borrelli, "A stochastic mpc approach with application to iterative learning", in *2018 IEEE Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/abstract/document/8619268, IEEE, 2018, pp. 5152–5157.

[18]   M. Brunner, **U. Rosolia**, J. Gonzales, and F. Borrelli, "Repetitive learning model predictive control: An autonomous racing example", in *2017 IEEE 56th Annual Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/abstract/document/8264027, IEEE, 2017, pp. 2545–2550.

[19]   **U. Rosolia** and F. Borrelli, "Learning model predictive control for iterative tasks: A computationally efficient approach for linear system", in *IFAC-PapersOnLine*, URL: https://www.sciencedirect.com/science/article/pii/S2405896317306523, vol. 50, Elsevier, 2017, pp. 3142–3147.

[20] **U. Rosolia**, F. Braghin, A. G. Alleyne, S. De Bruyne, and E. Sabbioni, "A decentralized algorithm for control of autonomous agents coupled by feasibility constraints", in *2017 American Control Conference (ACC)*, URL: https://ieeexplore.ieee.org/document/7963467, IEEE, 2017, pp. 3367–3372.

[21] **U. Rosolia**, A. Carvalho, and F. Borrelli, "Autonomous racing using learning model predictive control", in *2017 American Control Conference (ACC)*, URL: https://ieeexplore.ieee.org/document/7963748, IEEE, 2017, pp. 5115–5120.

[22] **U. Rosolia**, X. Zhang, and F. Borrelli, "Robust learning model predictive control for iterative tasks: Learning from experience", in *2017 IEEE 56th Annual Conference on Decision and Control (CDC)*, URL: https://ieeexplore.ieee.org/document/8263812, IEEE, 2017, pp. 1157–1162.

Selected Invited Talks

Learning Model Predictive Control for Iterative Tasks: Theory and Applications *ETH – Autonomy Talks,* 🌐*Link*	February 2022
Learning Model Predictive Control for Iterative Tasks: Theory and Applications *NeurIPS 2021 – Workshop on Safe and Robust Control of Uncertain Systems,* 🌐	December 2021
Learning Model Predictive Control for Iterative Tasks: Theory and Applications *MINES ParisTech CAS - Centre automatique et systèmes,* 🌐*link*	June 2021
A Multi-Layer Approach to Safety-Critical Dynamic CPS *2021 CPS-IoT Week Workshop: Verification of Autonomous & Robotic Systems (VARS),* 🌐*VARS2021*	May 2021
Learning how to autonomously race a car: a predictive control approach *Workshop on Opportunities and Challenges on Autonomous Racing (ICRA),* 🌐*linklab-uva.github.io*	May 2021
Learning Predictive Control and Dynamic Programming *IMT Lucca*	February 2021
Learning Predictive Control and Dynamic Programming *Mechanical and Civil Engineering (MCE) Seminar Series, Caltech*	October 2020
Learning Predictive Control and Dynamic Programming *Yisong Yue Lab, Caltech*	September 2020
Learning Predictive Control and Dynamic Programming *IFAC 2020 Workshop "Machine Learning meets Model-based Control", Berlin*	August 2020
Learning Predictive Control and Dynamic Programming *Semiautonomous Seminar, Berkeley*	May 2020
Learning Model Predictive Control and its Application in Robotics *Dependable Control and Decision (DECODE) group, EPFL*	November 2019
Learning Model Predictive Control and its Application in Robotics *Dynamic Design Lab, Stanford*	May 2019
Learning Model Predictive Control and its Application in Robotics *AMBER Lab, Caltech*	May 2019
Learning Model Predictive Control and its Application in Robotics *Robot Locomotion Group, MIT*	May 2019
Learning Model Predictive Control and its Application in Robotics *CITRIS/CPAR Control Theory and Automation Symposium, UC Berkeley*	April 2019
Learning Model Predictive Control for Iterative task *Optimization methods in dynamical systems, SIAM Conf. on Applications of Dynamical Systems*	May 2017
Learning Model Predictive Control for Autonomous Racing *Baidu*	December 2017