Alonso Marco, Ph.D.

CONTACT	amarco@berkeley.edu	LINKEDIN	linkedin.com/in/amarcovalle	GITHUB	github.com/alonrot
	+1 (341) 766-8473	WEBPAGE	www.alonsomarco.me	YOUTUBE	A. Marco Robotics
RESIDENCE	Berkeley, CA	SCHOLAR	Alonso Marco		

Experienced research scientist with seven years specializing in algorithms for robot control and machine learning, including motion planning, predictive modeling, and probabilistic inference. My passion lies in achieving rapid societal impact through applied industrial research in robotics and autonomous driving.

Experience

2021 - Present | **Postdoctoral Fellow**, University of California, Berkeley, with *Prof. Claire Tomlin*
- Architected control, motion planning and behavior software stacks for a real quadrupedal robot to navigate in unseen environments, which led to two scientific publications in top tier conferences.

Sep-Dec 2019 | **Robotics Internship**, Meta AI, California, with *Prof. Roberto Calandra*
- Deployed a deep reinforcement learning algorithm on a real hexapod robot that learns to walk from scratch in under 100 trials by integrating neural network control with perception.
- Implemented a proprietary robot-computer wireless communication infrastructure that became part of Meta AI's codebase.

Aug 2012 - Jul 2013 | **Internship** at Continental Automotive GmbH (Germany)
- Patented an algorithm deployed on a commercial car for automatically estimating tire tread depth via sensor fusion. Designed and executed data collection experiments on a real car.
- Earned trust of world-renowned automobile manufacturer with a live car demonstration.

Technical skills

Solid background on real-time programming, polymorphism, data structures, multithreading and unit testing. Extensive experience collaborating in large software teams, developing continuous integration, code reviews, version control, profiling and documentation.

Languages	C++, Python, Matlab, Bash, XML, HTML, CSS.
Python Libraries	TensorFlow, CUDA, JAX, Keras, PyTorch, Numpy, Scipy, Matplotlib, BoTorch.
C++ Libraries	NLopt, STD, Boost, Eigen, LCM, Control Toolbox (ADRL), Xenomai.
Robots	Hydraulic humanoid (SARCOS), Quadrupeds (SOLO8 and Go1, Unitree), Hexapod (HEBI), Robotic arm (Kuka LBR), Robot hand (SARCOS), Turtlebot.
Hardware	VICON, RealSense, Kinect 2.0, Raspberry PI, IMU, DC motors, IR sensor.
Machine learning	Bayesian optimization, deep RL, sim-to-real transfer, probabilistic inference (variational/sampling), Markdov decision processes, classification, nonlinear regression, Monte Carlo methods, predictive modeling, NN compression. Gaussian processes, LSTMs, Bayesian NNs, k-means, NN classification, Bayesian linear models.
Control	Model-based predictive control (MPC), robust control, nonlinear and optimal control, classical control, feedback linearization, real-time control.
Perception	RANSAC, stereo matching.
State Estimation	Kalman filter (extended/unscented), Luenberger observers.
Optimization	Quadratic programming, Simplex, backpropagation.
Simulators	CARLA, OpenAI Gym, MuJoCo, Pybullet, Raisim, Isaac Gym, Simulink.
OS	Linux (Ubuntu), macOS, Windows.
Middleware	ROS, ROS2, TCP/UDP, Git.
Databases	MongoDB, JSON, YAML, CSV, Hydra.
Virtual machine	Docker, VirtualBox, MultiPass.

Education

2016 - 2020 | **Ph.D. in Computer Science**, Max Planck Institute for Intelligent Systems (Germany), with *Prof. Sebastian Trimpe* and *Prof. Stefan Schaal*
- Developed AI algorithms to automatically tune controller parameters of real robots, which outperform human tuning by 30-50% and reduce human costs to zero.
- Led over 10 robotics projects from start to completion that were published in top-tier robotics and machine learning international conferences. Responsible for (i) conceiving and prototyping ideas, (ii) planning and experimenting on real robots, (iii) writing, publishing and presenting results.
- Deployed real-time control architectures and cutting-edge deep learning algorithms on real (physical) robots, such as *quadrupeds, hydraulic humanoids, hexapods and manipulators*, in both C++ and Python.

2013 - 2015 | **M.Sc. in Robotics and Automation**, Polytechnical University of Catalonia (Spain)
- Master Thesis (*Summa cum laude*, top 1 %)
- Exchange student at the Max Planck Institute for Intelligent Systems, Tübingen, Germany.

2007 - 2013 | **BSc. in Industrial Engineering**, University of Castilla-La Mancha (Spain)
Major in control theory and mechatronics.
- Bachelor Thesis (*Summa cum laude*, top 1 %) at Continental Automotive GmbH, Germany.
- Exchange student (1 year) at Technical University of Darmstadt, Germany.

Research projects with real robots (2/6)

- A **walking quadruped** learns to safely navigate a room by automatically detecting hazardous environments, previously unseen at training time. This is achieved via out-of-distribution (OoD) runtime monitors, which compare observations with future state predictions using a simulation-informed probabilistic dynamics model.
- A **humanoid robot** manipulator (Kuka arms) learns to balance an inverted pole by automatically tuning its own LQR controller using Bayesian optimization, outperforming human efforts by 32%. Developed a C++ control-perception-action loop that included pose estimation and real-time programming. [Paper] [Video]

Selected publications (2/17, 550 citations)

Complete list at Alonso Marco's google scholar. Published at RA-L, TCST, ICRA, CoRL, CDC, IROS.

A. Marco, E. Morley, C.J. Tomlin, "Out of Distribution Detection via Domain-Informed Gaussian Process State Space Models", IEEE 62nd Conference on Decision and Control (CDC), Dec, 2023 *(to appear)*.

A. Marco, D. Baumann, M. Khadiv, P. Hennig, L. Righetti, and S. Trimpe, "Robot Learning with Crash Constraints", IEEE Robotics and Automation Letters (RA-L), Jan, 2021.

Awards and achievements (selection)

- **Postdoctoral Fellowship Rafael del Pino ($60,000)** awarded to Spanish researchers with an outstanding academic path (1% acceptance rate).
- **NASA University Leadership Initiative Grant** to fund my research at UC Berkeley.
- **Excellence Grant: Catalunya-La Pedrera Foundation ($15,000)** awarded to the most outstanding student among 50 candidates, covering tuition for the master's degree and living expenses for two years.

Outreach

- Boosted MPI-IS' public outreach by designing and conducting **over 20 live robot learning demonstrations** for CEOs/CTOs of the largest automobile manufacturers (BMW, Porsche, Mercedes), politicians (including Mr. Van der Bellen, president of Austria) and world-renowned professors (Carnegie Mellon University, University of Cambridge).
- Ph.D. Thesis results published by *Die Zeit*, the **most impactful German weekly newspaper**. [Article]
- Elected democratically as *person of trust* by the Robotics Department at MPI-IS to provide victims of harassment with institutional help.

Publications

2023 | **A. Marco**, E. Morley, C.J. Tomlin, "Out of Distribution Detection via Domain-Informed Gaussian Process State Space Models", IEEE 62nd Conference on Decision and Control (CDC), Dec, 2023 *(to appear)*

2022 | S.A. Deka, **A. Marco**, C.J. Tomlin, "Koopman-based Neural Lyapunov functions for general attractors", IEEE 61st Conference on Decision and Control (CDC), Dec, 2022

2021 | D. Baumann, **A. Marco**, M. Turchetta, S. Trimpe, "Gosafe: Globally optimal safe robot learning", IEEE International Conference on Robotics and Automation (ICRA), May, 2021

2021 | **A. Marco**, D. Baumann, M. Khadiv, P. Hennig, L. Righetti, and S. Trimpe, "Robot Learning with Crash Constraints", IEEE Robotics and Automation Letters (RA-L), Jan, 2021

2020 | **A. Marco**, "Bayesian Optimization in Robot Learning - Automatic Controller Tuning and Sample-Efficient Methods", Ph.D. Thesis, University of Tübingen, Jul. 2020

2020 | **A. Marco**, A. von Rohr, D. Baumann, J.M. Hernández-Lobato, and S. Trimpe, "Excursion Search for Constrained Bayesian Optimization under a Limited Budget of Failures", arXiv:2005.07443

2019 | M. Neumann-Brosig, **A. Marco**, D. Schwarzmann, and S. Trimpe,"Data-efficient Auto-tuning with Bayesian Optimization: An Industrial Control Study", IEEE Transactions on Control Systems Technology, vol. 28, no. 3, pp. 730–740, Jan 2019

2018 | A. von Rohr, S. Trimpe, **A. Marco**, P. Fischer, and S. Palagi ,"Gait learning for soft microrobots controlled by light fields", International Conference on Intelligent Robots and Systems (IROS), Oct. 2018, pp. 6199–6206

2017 | **A. Marco**, P. Hennig, S. Schaal, and S. Trimpe, "On the Design of LQR Kernels for Efficient Controller Learning", Proceedings of the 56th IEEE Annual Conference on Decision and Control (CDC), Dec. 2017, pp. 5193–5200

2017 | A. Doerr, C. Daniel, D. Nguyen-Tuong, **A. Marco**, S. Schaal, M. Toussaint, and S. Trimpe, "Optimizing Long-term Predictions for Model-based Policy Search", Proceedings of 1st Annual Conference on Robot Learning (CoRL), Nov. 2017, pp. 227–238

2017 | A. Doerr, D. Nguyen-Tuong, **A. Marco**, S. Schaal, and S. Trimpe , "Model-Based Policy Search for Automatic Tuning of Multivariate PID Controllers", Proceedings of the IEEE International Conference on Robotics and Automation (ICRA), May 2017, pp. 5295–5301

2017 | **A. Marco**, F. Berkenkamp, P. Hennig, A.P. Schoellig, A. Krause, S. Schaal, and S. Trimpe, "Virtual vs. Real: Trading Off Simulations and Physical Experiments in Reinforcement Learning with Bayesian Optimization", Proceedings of the IEEE International Conference on Robotics and Automation (ICRA), May 2017, pp. 1557–1563

2016 | **A. Marco**, P. Hennig, J. Bohg, S. Schaal, and S. Trimpe, "Automatic LQR Tuning Based on Gaussian Process Global Optimization", Proceedings of the IEEE International Conference on Robotics and Automation (ICRA), May 2016, pp. 270–277

2015 | **A. Marco**, P. Hennig, J. Bohg, S. Schaal, and S. Trimpe, "Automatic LQR Tuning Based on Gaussian Process Optimization: Early Experimental Results", Machine Learning in Planning and Control of Robot Motion Workshop at the IEEE/RSJ International Conference on Intelligent Robots and Systems (iROS), Oct. 2015

2015 | **A. Marco**, "Gaussian Process Optimization for Self-Tuning Control", M.Sc. Thesis, Polytechnic University of Catalonia, Barcelona, Oct. 2015

Awards and Fellowships

2021-2023 | **Postdoctoral Fellowship Rafael del Pino ($60,000)** awarded to Spanish researchers with an outstanding academic path (1% acceptance rate).

2021-2023 | **NASA University Leadership Initiative Grant** to fund my research at UC Berkeley.

2018-2020 | **Ph.D. candidate** at the International Max Planck Research School for Intelligent Systems (IMPRS-IS) (10 % acceptance rate).

2016-2020 | **Associate fellow** at the Max Planck ETH Center for Learning Systems.

2013-2014 | **Excellence Grant: Catalunya-La Pedrera Foundation ($15,000)** awarded to the most outstanding student among 50 candidates, covering tuition for the master's degree and living expenses for two years.

2013 | **Bachelor's Degree Extraordinary Award** (top 1%) awarded to the student with the best GPA, University of Castilla-La Mancha, Spain.

2011 | **Mobile Robotics contest (finalist)**, University of Castilla-La Mancha, Spain. Design and implementation of a strategy to solve labyrinths with real mobile line-follower robots.

2011 | **Tuition exemption** in 2 courses for being awarded *summa cum laude* in 2 courses in the previous academic year, University of Castilla-La Mancha, Spain.

2010 | **Tuition exemption** in 5 courses for being awarded *summa cum laude* in 5 courses in the previous academic year, University of Castilla-La Mancha, Spain.

2009 | **Tuition exemption** in 5 courses for being awarded *summa cum laude* in 5 courses in the previous academic year, University of Castilla-La Mancha, Spain.

2008 | **Excellence scholarship** for initiation to research, University of Castilla-La Mancha, Spain. Design and implementation of a motion planning strategy for two mobile line-follower robots to avoid collision. The grant covered tuition fees and dormitory costs.

2008 | **Tuition exemption** in 1 course for being awarded *summa cum laude* in 1 course in the previous academic year, University of Castilla-La Mancha, Spain.

2007 | **Excellence scholarship** for initiation to research, University of Castilla-La Mancha, Spain. Efficient implementation in Java of a Sudoku solver with few initial numbers. The grant covered tuition fees and dormitory costs.

2007 | **"Becas Europa" (II edition)"** to visit to the oldest Universities of Europe together with high-profile University professors, Universidad Francisco de Vitoria, Spain. Selection at national level among 3000+ applications.

Scientific collaborations abroad

Feb-May 2019 | **Research stay** at Computational and Biological Learning Lab (CBL), University of Cambridge, UK, "Leveraging constraint violation for efficient Bayesian optimization".
Advisor: Prof. José Miguel Hernández-Lobato

Sep-Nov 2017 | **Research stay** at Computational Learning and Motor Control Lab (CLMC), University of Southern California, Los Angeles, USA, "Automatic LQR tuning of a humanoid biped real robot using Bayesian optimization".
Advisor: Prof. Sebastian Trimpe & Prof. Ludovic Righetti

Invited talks and posters

2023 | **Invited Talk**, "Online out-of-distribution detection via simulation-informed deep Gaussian process state-space models", at Prof. Jeannette Bohg's group, the Interactive Perception and Robot Learning Lab (IPRL), Stanford, California, USA, Jul 2023.

2023 | **Poster**, "On-line out-of-distribution detection using simulation-informed deep Gaussian process state-space models", Safe Aviation Autonomy Annual Meeting, NASA University Leadership Initiative (ULI), Stanford, California, USA, Jun 2023.

2023 | **Talk**, "Online out-of-distribution detection via simulation-informed deep Gaussian process state-space models", DARPA Assured Neuro Symbolic Learning and Reasoning (ANSR) campus visit, Berkeley, California, USA, Jun 2023.

2022 | **Poster**, "Model-based continual learning for quadruped locomotion", Safe Aviation Autonomy NASA ULI annual meeting, Stanford, California, USA, Jun 2022.

2021 | **Seminar Talk**, "Bayesian Optimization in Robot Learning - Improving efficiency and Safety", biweekly joint meeting with the research groups from Prof. Koushil Sreenathat, Prof. Ben Recht and Prof. Francesco Borrelli, UC Berkeley, California, USA, Feb 2021 (virtual meeting).

2020 | **Invited Talk**, "Bayesian Optimization in Robot Learning", at the Hybrid Systems Laboratory, UC Berkeley, California, USA, Jul 2020 (virtual meeting).

2019 | **Research Talk**, "Towards learning robot locomotion using model-based reinforcement learning", at Facebook Artificial Intelligence Research (FAIR), Menlo Park, California, USA, Dec 2019.

2019 | **Research Talk**, "Learning Robot Controllers using Bayesian optimization", at Computational and Biological Learning Lab, University of Cambridge, UK, April 2019.

2019 | **Poster**, "Learning Robot Controllers using Bayesian optimization", at Computational and Biological Learning Lab, Div-f Conference, University of Cambridge, UK, March 2019.

2018 | **Poster**, "Learning Robot Controllers under Unknown Failure Penalties using Bayesian Optimization", in Workshop Automating Robot Experiments: Manipulation and Learning, in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Madrid, Spain, Oct 2018.

2018 | **Invited Talk**, "Robot controller learning using data-efficient Bayesian optimization", at Bosch Center for Artificial Intelligence, Renningen, Germany, Feb 2018.

2018 | **Poster**, "LQR Kernels for Efficient Controller Learning", at Second Max Planck ETH Workshop on Learning Control, Zürich, Switzerland, Feb 2018.

2016 | **Poster**, "Bayesian Optimization for Learning Robot Control", at Google Zürich, Switzerland, Oct 2016.

2016 | **Invited Talk**, "Automatic Controller tuning based on Gaussian process global optimization", at Learning and Adaptive Systems Group, ETH Zürich, Switzerland, Sep 2016.

2015 | **Invited Talk**, "Automatic LQR tuning based on Gaussian process global optimization", at First Max Planck ETH Workshop on Learning Control, ETH Zürich, Tübingen, Germany, Nov 2015.

Talks at international conferences

2021 | **Oral presentation**, "Robot Learning with Crash Constraints" at the International Conference on Robotics and Automation (ICRA), May, 2021

2018 | **Spotlight presentation**, "Learning Robot Controllers under Unknown Failure Penalties using Bayesian Optimization", in Workshop Automating Robot Experiments: Manipulation and Learning, in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Madrid, Spain, Oct 2018.

2017 | **Oral presentation**, "On the Design of LQR Kernels for Efficient Controller Learning", at 56th IEEE Annual Conference on Decision and Control (CDC), Melbourne, Australia, Dec 2017.

2017 | **Spotlight presentation**, "Virtual vs. Real: Trading Off Simulations and Physical Experiments in Reinforcement Learning with Bayesian Optimization", at IEEE International Conference on Robotics and Automation (ICRA), Singapore, May 2017.

2016 | **Spotlight presentation**, "Automatic LQR Tuning Based on Gaussian Process Global Optimization", at IEEE International Conference on Robotics and Automation (ICRA), Stockholm, Sweden, May 2016.

2016 | **Oral presentation**, "Automatic LQR Tuning Based on Gaussian Process Optimization: Early Experimental Results", at Machine Learning in Planning and Control of Robot Motion Workshop at the IEEE/RSJ International Conference on Intelligent Robots and Systems (iROS), Hamburg, Germany, Oct 2015.

Review activity (2016-present)

JMLR	The Journal of Machine Learning Research: Member of the editorial board
L4DC	Learning for Dynamics and Control Conference: Best paper award committee (2022 and 2023)
ICML	International Conference on Machine Learning
T-RO	IEEE Transactions on Robotics
RA-L	IEEE Robotics and Automation Letters
IROS	IEEE International Conference on Intelligent Robots and Systems
ICRA	IEEE International Conference on Robotics and Automation
CDC	IEEE International Conference on Decision and Control
CoRL	Conference on Robot Learning

Undergraduate projects

2014 | **Mean shift-based object tracking algorithm** at Polytechnical University of Catalonia, *Computer Vision*, final project. Design and implementation of a tracking algorithm using mean-shift and background segmentation, validated in user videos available online.

2014 | **Exploration frontiers: SLAM-based exploration with a Turtlebot** at Polytechnical University of Catalonia, *Mobile Robots and Navigation* final project. Design and implementation of a motion planning exploration algorithm using SLAM to navigate around the corridors of the school, using a real Turtlebot robot.

2014 | **Ball catcher: A DMP-based trajectory learning method for quadrotors** at Polytechnical University of Catalonia, *Robot Learning*, final project. Implementation of a learning algorithm using Dynamic Movement primitives for a simulated quadrotor to learn to intercept a ball in mid-air, using on-line goal estimation and minimum jerk trajectories.

2012 | **Modeling and control of an inverted pendulum** at Technical University of Darmstadt, *"Projektseminar" Mecatronics*. Design and implementation of a PID controller for stabilizing an real inverted pendulum.

Leadership

2021-Present | **Mentorship**: Directed an interdisciplinary study group composed of eight Ph.D. students to discuss the latest literature on "Perception in Closed-loop with Guarantees" at University of California Berkeley.

2016-2019 | **Mentorship**: Supervised two master students and one intern during their research projects.

2008 | **University Leadership School**, at Universidad Francisco de Vitoria, Madrid, Spain. Acquisition of leadership skills through an interactive online program of excellence organized by experts.

2010 | **University Debate League G9** (first winner), at University of Castilla-La Mancha, Madrid, Spain. Public debate in teams of five people about controversial political issues.

2018-2020 | **Person of trust**, Autonomous Motion Department, at the Max Planck Institute for Intelligent Systems, Tübingen, Germany. Elected democratically by the Robotics Department at MPI-IS to provide victims of harassment with institutional help.

2018-2020 | **Spokesman**, Autonomous Motion Department, at the Max Planck Institute for Intelligent Systems, Tübingen, Germany. Representative of co-workers from the department to defend our rights and demand necessary action to the Worker's Council.

Exchange programs and Summer schools

2015 | **Machine Learning Summer School (MLSS)**, Tübingen, Germany, 2015. Participant and co-organizer.

2014 | **ARCAS Summer School Eurathlon**, at CATEC, University of Seville, Spain. Programming of UAVs and UGVs to cooperatively navigate in unforeseen environments.

2011 | **Erasmus exchange program**, Technical University of Darmstadt, Germany. Coursed lectures within the *Electrical Engineering and Information Technology M.Sc.* program, with focus on Automation Systems.

Other interests

1997-2007 | Conservatory of Music, Ciudad Real, Spain. Main instrument: Classical Guitar. Second instrument: Piano. Main focus: Composition. Author of several chamber music and piano pieces, including and a quintet for strings and clarinet, performed by conservatory professors.

2022-present | Leader of Bay area salsa band "Los Salsabrosos", cuban tres player and music scores arranger.

2007-present | Salsa dancer. Self-trained pop/rock songwriter, amateur theater actor (4 plays), blogger (poetry and opinion essay), amateur videographer, and semi-professional photographer.