CARLOS MASTALLI   ROBOTICS RESEARCHER

https://cmastalli.github.io/, carlos.mastalli@gmail.com, (+44) 7782 447706
University of Edinburgh - Alan Turing Institute, Citizenship: Italian & Venezuelan

PROFILE

Researcher associate at The University of Edinburgh and Alan Turing fellow.
Strong background in numerical optimization and control, and significant hands-on experience on legged robots.

RESEARCH INTERESTS

Robotics planning and control in legged robots, rigid-body dynamics and perception (watch results on legged locomotion).
Artificial Intelligence optimal control, numerical optimization, and machine learning. (watch results of optimal control solvers).

EDUCATION

Ph.D. in Bioengineering and Robotics   January 2014 - April 2017
Istituto Italiano di Tecnologia & Università degli Studi di Genova.
- Thesis: Planning and Execution of Dynamic Whole-Body Locomotion on Challenging Terrain.
- Advisor: Dr. Ioannis Havoutis, Dr. Claudio Semini and Prof. Darwin G. Caldwell

M.Sc. in Mechatronic Engineering GPA 4.85/5   September 2009 - June 2013
Mechatronic Group at Simón Bolívar University, Venezuela (2-year program)
- Thesis: Learning from Demonstration using Dynamic Movement Primitives in Excavator Robots (Outstanding Mention).
- Advisor: Prof. Gerardo Fernández-López

WORK EXPERIENCE

University of Edinburgh - Alan Turing Institute
Research Associate   October 2019 - to date
- Multi-contact optimal control for loco-manipulation tasks.
- Model predictive control on legged robots.
- Project manager of Crocoddyl team (University of Edinburgh, LAAS-CNR, INRIA and MPI Tuebingen).
- Working on EU MEMMO and OrcaHub projects.
- Machine learning in legged locomotion

LAAS - CNRS
Postdoc Researcher   November 2017 - October 2019
- Efficient differential dynamic programming algorithm for multi-contact motion control in humanoid robots [4].
- Using memory of motion for real-time multi-contact motion control.
- Developing of the fastest optimal control toolbox for legged robots called Crocoddyl [1].
- Force feedback in optimal control [3].
- Working on EU MEMMO project.

Istituto Italiano di Tecnologia
Research Fellow   January 2014 - November 2017
- Novel motion planning and control methods for legged locomotion on challenging terrain [2,5-11].
- Envisioning the software framework for perception, planning and control for quadrupedal robots [2].
- Developing of a software toolbox (called DWL) for easy prototyping (c++ with Python bindings) optimization, robotics, planning, control and visualization.

Simon Bolivar University
Lecturer
April 2012 - March 2014

- Teaching control system for undergraduate students.
- Developing of a general purpose software for Model Predictive Control.

Academic Assistant
September 2009 - April 2012

- Teaching and preparation activities in control system lab for undergraduate engineering students.
- A learning from demonstration approach for backhoe operations [12,15-16].

SKILLS

Robotics and Computer Science
- Motion planning, trajectory optimization and optimal control.
- Whole-body control, rigid-body dynamics and torque-control.
- Numerical optimization: nonlinear, stochastic, convex and mixed-integer optimization.
- State estimation, terrain mapping and computer vision.

Mechatronics and Software
- C++, Python and Matlab (more than 8 years of experience).
- Robot middle-wares (ROS, LCM, YARP) and real-time systems (Xenomai).
- Open-source (OpenCV, PCL, Octomap, Pinocchio, Gazebo, Bullet, etc).
- Revision control tools (GIT, SVN and HG).
- Linux and OSX development environment.

Soft-skills
- Self-motivation, self-confidence, optimism and divergent thinking.
- Questioning, introspection and organization.
- Open to feedback, idea exchange and persuasion.
- Mentoring, public speaking and humour.

LANGUAGES

English (fluent), Spanish (native), Italian (fluent), French (beginer)

PROJECT PORTFOLIO

MPC for robotics
2013 - to date

- Contact RObot COntrol by Differential DYnamic programming Library (Crocoddyl) (read this article).
- Open-source library for Model Predictive Control (MPC) over ROS.

Legged locomotion
2014 - 2017

- Motion planning for legged locomotion on challenging terrain.
- Terrain mapping for legged motion planning and control.

Software framework for robotics
2014 - 2018

- Envisioned DLS lab software framework: simulation, control, planning, perception and communication.
- Legged locomotion toolbox: "Dynamic Whole-body Locomotion (DWL)" library.
- Real-time control interface with ROS and Xenomai.
- Visualization tools (e.g. whole-body state plugin).

Autonomous backhoe machines
2010 - 2012

- Lerning from Demonstration for autonomous execution of backhoe tasks.
- Control and state estimator.
- 3D terrain mapping and perception.

ACADEMIC VISITS

Visiting researcher
2016

Agile and Dexterous Robotics Lab (ADRL), ETH Zurich, Switzerland.

INVITED TALKS	**RSS'19 workshop**	December 1st 2017

Workshop on Numerical optimization for Online multi-contact Motion Planning and control, Freiburg, Germany
- Title: Highly dynamic maneuvers computed by feasible-prone.

Oxford Research Institute   December 1st 2017

University of Oxford, Oxford, UK
- Title: Motion planning for legged locomotion on challenging terrain.

Gepetto Team   April 28th 2017

LAAS, CNRS, Toulouse, France
- Title: Planning and execution of dynamic whole-body locomotion on challenging terrain.

AWARDS
- Master thesis with Outstanding Mention. Simón Bolívar University. 2013.

PUBLICATIONS

[1] **C. Mastalli**, R. Budhiraja, W. Merkt, G. Saurel, B. Hammoud, M. Naveau, J. Carpentier, S. Vijayakumar and N. Mansard, Crocoddyl: An Efficient and Versatile Framework for Multi-Contact Optimal Control. IEEE International Conference on Robotics and Automation (ICRA), 2020.

[2] T.S. Tembono, **C. Mastalli**, P. Fernbach, N. Mansard and S. Calinon, Learning How to Walk: Warm-starting Optimal Control Solver with Memory of Motion. International Conference on Robotics and Automation (ICRA), 2020.

[3] K. Giraud, P. Fernbach, **C. Mastalli** and O. Stasse, Motion Planning with Multi-Contact and Visual Servoing on Humanoid Robots. International Symposium on System Integration (SII), 2020.

[4] **C. Mastalli**, I. Havoutis, M. Focchi, D. G. Caldwell and C. Semini, Motion planning for quadrupedal locomotion: coupled planning, terrain mapping and whole-body control. (under-review).

[5] **C. Mastalli***, S Fahmi*, M. Focchi, C. Semini, Passivity Based Whole-body Control for Quadruped Robots: Experimental Validation over Challenging Terrain. IEEE Robotics and Automation Letters (RAL), 2018.

[6] R. Budhijara, J. Carpentier, **C. Mastalli**, N. Mansard, Differential Dynamic Programming for Multi-Phase Rigid Contact Dynamics. IEEE International Conference on Humanoid Robots (ICHR), 2018.

[7] M. Focchi, R. Orsolino, V. Barasuol, **C. Mastalli**, D. G. Caldwell and C. Semini, Heuristic Planning for Rough Terrain Locomotion in Presence of External Disturbances and Variable Perception Quality. Springer Tracts in Advanced Robotics (STAR), 2018.

[8] **C. Mastalli**, M. Focchi, I. Havoutis, Buchli, Jonas D. G. Caldwell and C. Semini, Trajectory and Foothold Optimization using Low-Dimensional Models for Rough Terrain Locomotion. IEEE International Conference on Robotics and Automation (ICRA), 2017.

[9] B. Aceituno-Cabezas, **C. Mastalli**, H. Dai, M. Focchi, A. Radulescu, D. G. Caldwell, J. Cappelletto, J. C. Grieco, G. Fernandez-Lopez and C. Semini, Simultaneous Contact, Gait and Motion Planning for Robust Multi-Legged Locomotion via Mixed-Integer Convex Optimization. IEEE Robotics and Automation Letters (RAL), 2017.

[10] R. Orsolino, M. Focchi, **C. Mastalli**, H. Dai, D. G. Caldwell, and C. Semini, Application of Wrench based Feasibility Analysis to the Online Trajectory Optimization of Legged Robots. IEEE Robotics and Automation Letters (RAL), 2018.

[11] **C. Mastalli**, I. Havoutis, M. Focchi, D. G. Caldwell and C. Semini, Hierarchical Planning of Dynamic Movements without Scheduled Contact Sequences. IEEE International Conference on Robotics and Automation (ICRA), 2016.

[12] **C. Mastalli**, I. Havoutis, A. W. Winkler, D. G. Caldwell and C. Semini, Online and On-board Planning and Perception for Quadrupedal Locomotion. IEEE International Conference on Technologies for Practical Robot Applications (TE-PRA), 2015.

[13] A. W. Winkler, **C. Mastalli**, I. Havoutis, M. Focchi, D. G. Caldwell and C. Semini, Planning and Execution of Dynamic Whole-Body Locomotion for a Hydraulic Quadruped Robot on Challenging Terrain. IEEE International Conference on Robotics and Automation (ICRA), 2015.

[14] **C. Mastalli** and G. Fernandez-Lopez, A Proposed Architecture for Autonomous Operations in Backhoe Machines. International Conference on Intelligent Autonomous Systems (IAS), 2015.

[15] R. Jamisola and **C. Mastalli**, Bio-inspired holistic control through modular relative Jacobian for combined four-arm robots. International Conference on Advanced Robotics (ICAR), 2017.

[16] N. Certad, **C. Mastalli**, J. Cappelletto and J. C. Grieco, Extracting Points Features from Laser Rangefinder Data Based on Hough Transform. IEEE Andean Regional Conference (ANDESCON), 2014.

[17] **C. Mastalli**, D. Ralev, N. Certad and G. Fernández-López, Asymptotic Stability Method for PID Controller Tuning in a Backhoe Machine. Dynamic and System Conference, 2013.

[18] **C. Mastalli**, J. Cappelletto, R. Acuña, A. Terrones and G. Fernández-López, An Imitation Learning Approach for Truck-Loading Operations in Backhoe Machines. International Conference on Climbing and Walking Robots and The Support Technologies for Mobile Machines (CLAWAR), 2012.

PEER-REVIEW ACTIVITIES TMECH, RAL, ICRA, IROS, Humanoids, ASME Dynamic and System Conference.

WORKSHOP ORG. **Robotics: Science and Systems 2019**
R. Orsolino, **C. Mastalli**, M. Focchi and N. Mansard. Workshop on Numerical optimization for Online multi-contact Motion Planning and control