

Gennaro Raiola

Curriculum Vitae

✉ gennaro.raiola@gmail.com
📄 <https://github.com/graiola>

Fields of interest

Robotics, programming, human-robot interaction, motion control, force control, impedance/admittance control, inverse kinematics, DevOps.

Profession

09/2019-present *Post-Doc @ Jet Propulsion Laboratory (NASA-JPL), Pasadena (CA), United States* 🌐 [www](http://www.nasa.gov) – Demonstration of autonomous berthing, assembly and installation of scientific payloads using the robotic platform PROPS: for this project, I am working on the state estimation and docking procedure for the incoming payload, which is performed using Kalman filtering via pose measurements of the payload extracted from an AprilTag detector. Once the payload is on an interception course with the robot, docking is performed by means of inverse kinematics and force control. This work has been conducted in preparation of a paper with the title *Validating an Architecture for Robotic Assembly and Servicing of Hosted Payloads on a Persistent Platform*. Previously I was working with the same platform on two other projects in the context of robotics space assembly: autonomous assembly of a starshade and of a satellite dish, and assembly of instruments using fiducials and force control. During my work at JPL I have gained experience with the casah2 software architecture, realize software modules for it, and integrate some of its functionalities with the robotic operating system (ROS).

- 09/2017-06/2019 *Post-Doc @ Istituto Italiano di Tecnologia (IIT), Genoa, Italy* 🌐 [www](#) – During my work at IIT, I had the opportunity to work on several aspects of the development and maintenance of software and electronics for the quadruped robots HyQ and HyQReal. I was responsible for the development of a real-time control framework and communication system with EtherCAT for the robots. I developed the software control architecture with ROS-Control, in order to make the robot capable of executing different types of gaits (e.g. crawl, trot, etc.) in complex and changing terrains. I also developed the low level safety software layer to protect the robot hardware and human operators. I was also responsible for the DevOps processes, which included: creating and maintaining fully automated CI/CD pipelines for code testing and deployment using GitLab-CI, deploying apt servers to track the software dependencies, and developing Docker containers for code testing and development. For the design of HyQReal, I was responsible for the electronics and low level software, with a focus on sensor integration and calibration. I also completed research to create a novel whole-body locomotion framework for quadrupedal robots using inverse dynamics and task optimization which led to the publication of the journal paper *A simple yet effective whole-body locomotion framework for quadruped robots* (currently under review). With this work, my team and I cooperated with external work groups such as Moog and Vodafone to define the requirements and functionalities of the robots for various real-world scenarios.
- 03/2017-07/2017 *Post-Doc @ Robotics and Mechatronics group, University of Twente, Enschede, The Netherlands.* 🌐 [www](#) – At the University of Twente, I worked on the development of a safety- and energy-aware impedance controller for the KUKA LWR 4+ robotic arm. This led to the publication of the journal paper *Development of a Safety and Energy Aware Impedance Controller for Collaborative Robots* on IEEE Robotics and Automation Letters which was selected for presentation at ICRA 2018.
- 01/2016-12/2016 *Ph.D. student in Robotics @ CEA-List (French Alternative Energies and Atomic Energy Commission - Laboratory for Integration of Systems and Technology), Gif-sur-Yvette, France.* 🌐 [www](#) – During the last year of my PhD, I had the opportunity to transfer my research results to a startup at CEA-List (ISybot). This led to the development of a force controller to generate virtual guides through kinesthetic teaching to be used within the software framework of the startup's collaborative robot.
- 05/2013-12/2013 *Research Engineer in Motion Control of Humanoid Robots @ PAL Robotics S.L., Barcelona, Spain.* 🌐 [www](#) – At PAL Robotics, I worked on a team to design and test the ROS-Control package. The aim of ROS-Control is to implement a Hardware Abstraction Layer for different kinds of robots (e.g. humanoids, manipulators, mobile robots, etc...). Via ROS-Control I implemented an inverse kinematics controller with task optimization for REEM-H and REEM-C robots in collaboration with LAAS-CNRS in France.

09/2012- *Internship* @ ENSTA-ParisTech and UPMC-ISIR, Paris, France. 🌐 [www](#)
02/2013 - I developed a library in Matlab and C++ to generate motion primitives and perform skill optimization for humanoid robots (MEKA, NAO, ICub and Pepper).

Education

2014-2016 *Ph.D. student in Robotics* @ Université Paris-Saclay, Palaiseau, France. 🌐 [www](#).
2009-2012 *Master's Degree (M.Sc) with honor in Automation and Control Engineering* given by the University of Naples "Federico II", Naples, Italy.
2006-2009 *Bachelor's Degree (B.Sc) in Computer Engineering* given by the University of Naples "Federico II", Naples, Italy.

Technical skills



- Proficient in the following programming languages: C, C++ and Matlab
- Competent with Python and Bash scripting.
- Competent with Qt, Eigen and ROS
- Excellent knowledge of GIT.
- Excellent knowledge of CMake and Makefile for managing the build process of software and Doxygen for code documentation.
- Competent with Docker and Virtual Machines deployment for testing and development.
- Deep knowledge of Linux-based operating systems (Ubuntu, Kali, Debian).
- Experienced with real time operating systems (RTAI Linux, Xenomai Linux, RT-PREEMPT), Kernel configuration and EtherCAT.

Selected open-source software projects

- "ros-control" 🌐
Ros packages to make controllers generic to all robots.
- "Stack-of-Task" 🌐 🎮
Integration of the stack of tasks inverse kinematics solver on the REEM-H and REEM-C robots at PAL Robotics.
- "DmpBbo" 🌐 🎮 🎮 🎮
C++ framework for motion primitives and black-box optimization.
- "m3ros-control" 🌐
C++ bridge to integrate the control layer of the Meka robot into a ROS environment.
- "virtual-fixtures" 🌐 🎮 🎮
Library of virtual guides for co-manipulation.

Publications

Journals

- 2020 **G. Raiola**, E. Mingo Hoffman, M. Focchi, N. Tsagarakis, C. Semini.
"A simple yet effective whole-body locomotion framework for quadruped robots".
Under review at Frontiers in Robotics.
- 2019 R. Orsolino, M. Focchi, S. Caron, **G. Raiola**, V. Barasuol, C. Semini.
"Feasible Region: an Actuation-Aware Extension of the Support Region". 
IEEE Transactions on Robotics.
- 2019 F. Stulp, **G. Raiola**.
"DmpBbo: A versatile Python/C++ library for Function Approximation, Dynamical Movement Primitives, and Black-Box Optimization". 
The Journal of Open Source Software.
- 2018 Susana Sánchez Restrepo, **Gennaro Raiola**, Joris Guerry, Evelyn D'Elia, Xavier Lamy and Daniel Sidobre.
"Towards an Intuitive and Iterative 6D Virtual Guides Programming Framework for Human-Robot Comanipulation".
Robotica.
- 2017 **Gennaro Raiola**, Carlos Cardenas Alberto, Tadele Shiferaw Tadele, Theo De Vries, Stefano Stramigioli.
"Development of a Safety and Energy Aware Impedance Controller for Collaborative Robots". 
In *IEEE Robotics and Automation Letters*.
The contents of this paper were also selected by ICRA'18 Program Committee for presentation at the Conference.
- 2017 S. Chitta, E. Marder-Eppstein, W. Meeussen, V. Pradeep, A. Rodriguez Tsouroukdissian, J. Bohren, D. Coleman, B. Magyar, **G. Raiola**, M. Ludtke and E. Perdomo Fernandez.
"ros_control: A generic and simple control framework for ROS". 
The Journal of Open Source Software.
- 2017 **Gennaro Raiola**, Susana Sanchez Restrepo, Pauline Chevalier, et al.
"Co-manipulation with a Library of Virtual Guiding Fixtures". 
Autonomous Robots, Special Issue on Learning for Human-Robot Collaboration.

Conferences

- 2017 Pauline Chevalier, **Gennaro Raiola**, Brice Isableu, Jean-Claude Martin, Christophe Bazile and Adriana Tapus.
"Do Sensory Preferences of Children with Autism Impact an Imitation Task with a Robot?".
Conference on Human-Robot Interaction (HRI).

- 2017 Susana Sanchez Restrepo, **Gennaro Raiola**, Pauline Chevalier, Xavier Lamy, and Daniel Sidobre.
 "Iterative Virtual Guides Programming for Human-Robot Comanipulation". 
IEEE International Conference on Advanced Intelligent Mechatronics (AIM).
- 2015 **Gennaro Raiola**, Xavier Lamy, and Freek Stulp.
 "Co-manipulation with Multiple Probabilistic Virtual Guides". 
International Conference on Intelligent Robots and Systems (IROS).
- 2015 **Gennaro Raiola**, Pedro Rodriguez-Ayerbe, Xavier Lamy, Sami Tliba, and Freek Stulp.
 "Parallel Guiding Virtual Fixtures: Control and Stability". 
IEEE Multi-Conference on Systems and Control (MSC).
- 2014 Freek Stulp, Laura Herlant, Antoine Hoarau, and **Gennaro Raiola**.
 "Simultaneous On-line Discovery and Improvement of Robotic Skill". 
International Conference on Intelligent Robots and Systems (IROS).
- 2013 Freek Stulp, **Gennaro Raiola**, Antoine Hoarau, Serena Ivaldi, and Olivier Sigaud.
 "Learning Compact Parameterized Skills with a Single Regression". 
IEEE-RAS International Conference on Humanoid Robots.

Languages

italian native proficiency
 english professional working proficiency
 french limited working proficiency