Gennaro Raiola

Curriculum Vitae

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Fields of interest

Robotics, programming, human-robot interaction, motion control, force control, inverse kinematics and dynamics, whole-body control, hardware integration, embedded, DevOps, ROS.

Profession

09/2019–10/2020 **Post-Doc**, *Jet Propulsion Laboratory (NASA-JPL)* , Pasadena, CA, United States.

At JPL I worked on demonstration of autonomous berthing, assembly and installation of scientific payloads using a robotic platform mounted on a testbed simulating a scientific space station.

- Autonomous berthing:
  - created a state estimator to track the full pose and velocity of an incoming payload using Kalman filtering via a fiducial detector,
  - developed a new software module for the testbed to generate coordinated motions of the robotic arm in order to intercept and dock the incoming payload by means of inverse kinematics and force control,
  - performed experiments in preparation for the paper *Validating an Architecture for Robotic Assembly and Servicing of Hosted Payloads on a Persistent Platform*,
  - gained experience with the JPL testbed software architecture and the m3tk simulation software,
  - integrated some of the functionalities of the testbed with the robotic operating system (ROS).
- Autonomous assembly:
  - developed code to perform assembly of instruments using fiducial movements for localization and positioning of the instrument and force control for interaction,
  - performed two demos in which the robot is able to autonomously assemble a starshade and a satellite dish,
  - created new modules and autonomous behaviors for the testbed.

09/2017–06/2019 **Post-Doc**, *Istituto Italiano di Tecnologia (IIT)*, Genoa, Italy.

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.

- Developed a real-time control framework and communication system with EtherCAT,
- 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,
- developed the low level safety software layer to protect the robot hardware and human operators.
- DevOps processes, including:
  - creating and maintaining fully automated CI/CD pipelines for code testing and deployment using GitLab-CI,
  - deploying apt servers to track the software dependencies,
  - developing Docker containers for code testing and development.
- Sensor integration and calibration for the HyQReal robot.
- Research work 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*.
- Collaboration 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.

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.

- 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.

During the last year of my PhD, I had the opportunity to transfer my research results to a startup at CEA-List (ISybot).

- 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.

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.).

- implemented via ROS-Control an inverse kinematics controller with task optimization for REEM-H and REEM-C robots in collaboration with LAAS-CNRS in France.

09/2012–02/2013 **Intern**, *ENSTA-ParisTech and UPMC-ISIR*, Paris, France.

I developed a library in Matlab and C++ to generate motion primitives and perform skill optimization for humanoid robots (MEKA, NAO, ICub and Pepper). This library has been successfully used with the SoftBank robot Pepper to learn and play the "ball in the cup" dexterous game.

Education

2014–2016 **Ph.D. student in Robotics**, *Université Paris-Saclay*, Palaiseau, France.

2009–2012 **Master's Degree (M.Sc) cum laude in Automation and Control Engineering**, *University of Naples "Federico II"*, Naples, Italy.

2006–2009 **Bachelor's Degree (B.Sc) in Computer Engineering**, *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 **RTOS** (RTAI, Xenomai, RT-PREEMPT), Kernel configuration and **EtherCAT**.

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".
Frontiers in Robotics and AI, special issue on "Bridging the Gap Between the Lab and the Real World: Future Perspectives for Legged Robots".

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