

Juan David Gamba Camacho

Personal Information

Address Via Chiabrera 3/8, Genova Italy 16123.
Phone (39) 351 881 4705
Email juandavid212@hotmail.com
Website juandavid212.github.io
Linked-in Juan David Gamba Camacho

Education

- 2018–2021 **Doctor of Philosophy - PhD in Advanced Robotics**, *Dipartimento di Informatica, Bioingegneria, Robotica e Ingegneria dei Sistemi*, Università degli Studi di Genova, Italy.
- 2016–2018 **Master's Degree, Electrical Engineering**, *Departamento de Engenharia Eletrica*, Pontificia Universidade Catolica do Rio de Janeiro, Brazil.
- 2012–2015 **Bachelor's Degree, Automation and Control**, *Escuela de Ingenieria Electronica*, Universidad Latina de Costa Rica, Costa Rica.
- 2010–2012 **Associate's Degree, Electronics and Communications Engineering**, *Escuela de Ingenieria Electronica*, Universidad Latina de Costa Rica, Costa Rica.

Achievements & Honors

- 11/2015 **Winner of The National Award of Electronic Engineering, Professional Category - ASOELECTRONICA ITCR**, *Nationwide SCADA, Energy Quality*, Instituto Costarricense de Electricidad, Costa Rica. **News story.**

Experience

- 2018–2021 **Researcher PhD Student**, *Istituto Italiano di Tecnologia*, Genova, Italy.
- o Design of a balance controller for spring-loaded legged robots. The strategy enables the robot to accurately perform high-performance motions and acrobatics.
 - o Design of an optimization strategy using casADI with orthogonal collocation methods to efficiently solve nonlinear programming (NLP) problems. This method is capable of solving the NLP problem three times faster than multiple shooting methods.
 - o Design of a Non-linear observer to estimate the spring model of a spring-loaded legged robot. The strategy helps the robot to keep the balance and perform high-performance tasks using an unknown spring.
 - o Electronics diagram design and implementation with embedded real-time controllers for performing experiments related to the project.

- o Design and implement the real-time embedded software for a test rig to explore the capabilities of IMU's (Vectornav VN-100) working on bouncing applications, which are very common on legged robot applications. The software runs on the sbRIO-9637 development board from NI using the software LabVIEW, which has analog and digital inputs/outputs, a dual-core CPU, and a programmable FPGA. The FPGA oversees performing: (i) the SPI communication; (ii) the PWM low-level logic; (iii) the necessary signal conditioning. The board's CPU uses these measurements to control a solenoid and sends them to a host computer using network streams. Finally, this host runs a Human-Machine-Interface (HMI) to monitor online the acquired data.
- o Project website: royfeatherstone.org/skippy/index.html

2016–2018 **Master's Student**, *Pontificia Universidade Catolica do Rio de Janeiro*, Rio de Janeiro, Brazil.

During my Master's program, I worked in different eye-in-hand visual servoing control schemes applied to a robotic harvesting task of soft fruits in the presence of parametric uncertainties in the system models.

- o Combination of position-based visual servoing (PBVS) to approach the end-effector to the fruit, and an image-based visual servoing (IBVS) to control the gripper to harvest.
- o Develop a hybrid visual servoing (HVS) approach to fulfill the complete harvesting task by designing a suitable control law that combines error vectors defined in the image and task spaces.

For detecting the fruit I used:

- o An algorithm based on the OHTA color space and Otsu's threshold method for fast detection of mature fruits.
- o A pre-trained deep encoder-decoder algorithm based on a minimized Segnet version for a fast and cheap inference during the task execution.

I also used the algorithms speeded-up-robust-features (SURF) and the-random-sample-consensus (RANSAC) or the Oriented FAST and Rotated BRIEF and the Brute-Force Matcher (BF-Matcher) to extract features from images and match them from to different scenes (obtained from a stereo camera) to do a 3D reconstruction of the target.

The software was implemented using ROS, a robot arm RV-2AJ, and a mini ZED stereo camera.

I also explore the application of robust control techniques based on sliding mode to improve the system's robustness.

2015–2016 **Project Engineer - Security Solutions**, *Emerson Process Management*, Costa Rica.

- o Designing and implementing scripts for different application involving embedded devices; for the Security US Team and provide support for different Power Water Solutions area projects.

2014–2015 **Project Engineer**, *Emerson Process Management*, Costa Rica.

- o Implementation, testing, and commissioning of different projects developed with Ovation (company software), also provide technical support and troubleshooting on-site activities. Responsibilities included: Field Service Support; Project Engineering.

Projects:

- o Enertek, Mexico: Design and implementation of the control logic for Air Condensers and a Vacuum System for the full functionality with the Steam Turbine. Debug and configure the Modbus communication between the Alstom and SCADA systems.

- o Promissao and COG (Centro de Operação da Geração), Brazil: Field support for the maintenance of GU (Generation Unit) one and three. Configuration of WIN-911 (notifications, alarms, and events software). Configuration of EDS (platform for network-security).

2013–2014 **Intern Engineer, Instituto Costarricense de Electricidad, Costa Rica.**

- o Design and implementation of a nationwide SCADA on energy quality. The system has around fifty thousand variables using LabVIEW and the Data Logging and Supervisory Control module. The application consists of logging information via Modbus and other communications protocols from several sites distributed along with the country and storing it to be accessed by everyone through a public server.
- o The system was previously priced at approximately two hundred and fifty thousand dollars and it ended up being developed by two engineering students in seven months.

Scientific Publications

- 2021 **Balancing on a Springy Leg**, *IEEE International Conference on Robotics and Automation, June 2021, Xi'an, China.*
- 2021 **Robust Balancing Control of a Spring-legged Robot based on a High-order Sliding Mode Observer**, *IEEE-RAS International Conference on Humanoid Robots, July 2021, Munich, Germany.*
- 2018 **A Robust Visual Servoing Approach for Robotic Fruit Harvesting**, *Master Thesis, Departamento de Engenharia Elétrica, Pontifícia Universidade Católica do Rio de Janeiro, 2018, Brazil.*
- 2018 **A Robust Vision-based Control for Robotic Fruit Harvesting using Deep Learning**, *IEEE LARS 2018 - 15th Latin American Robotics Symposium, Brazil.*
- 2018 **A Visual Servoing Approach For Robotic Fruit Harvesting in the Presence of Parametric Uncertainties**, *CBA Proceedings Volumes, 2018. XXII Congresso Brasileiro de Automatica, Brazil.*

Skills & Background Knowledge

Computer skills

- Basic Java, HTML
- Intermediate VHDL, Assembler, C++, LabVIEW, Solid Works, Power Shell, VBA, V-REP, ROS, CasADi, L^AT_EX.
- Advanced Python, Matlab, Linux, Windows, Microsoft Office.

Communication skills

- Problem Solving.
- Adaptability.
- Good ability in sharing and/or presenting ideas.
- Very good team-work skills.
- Friendly, sociable.
- Ability to bear under high pressure of tasks.

Research Interests

Control Theory: Linear and Non-linear Control, High Order Sliding Mode Observers and Dynamic Control.

Computer Vision: SLAM, Stereo Cameras, 3D reconstruction.

Machine Learning: Reinforcement Learning, Deep Learning and Deep Reinforcement Learning.

Optimal Control: Linear, Quadratic and Non-linear Programming.

Real-Time Embedded Programming.

Languages

Spanish	Mothertongue	
English	Advanced	<i>Fluent in communicative and academic aspect</i>
Portuguese	Intermediate	<i>Fluent in communicative</i>
Italian	Intermediate	<i>B2 Level</i>

Interests

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| - Music | - Sports |
| - Documentaries | - Social Activities |