

Juan David Gamba Camacho

Personal Information

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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

- 2022–Present **Postdoctoral Researcher - Advanced Robotics & Dynamic Legged Systems Lab**, *Istituto Italiano di Tecnologia*, Genova, Italy.
- Improve the current perception and manipulation modules to increase the performance of correctly recognizing pruning points and precise manipulation planning and control to reach them.
 - Supervise students and fellows for the grapevine winter pruning projects.
 - VINUM Project website: <https://vinum-robot.eu/>
- 2021–2022 **Research Fellow - Advanced Robotics**, *Istituto Italiano di Tecnologia*, Genova, Italy.
- Provide support to areas involving 3D semantic segmentation, data collection, system architecture, and manipulation control.
 - VINUM Project website: <https://vinum-robot.eu/>
- 2018–2021 **Researcher PhD Student**, *Istituto Italiano di Tecnologia*, Genova, Italy.
- 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, Bosch BNO055, LORD MicroStrain 3DM-GX5-15) 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: <http://www.royfeatherstone.org/skippy/index.html>

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

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

- 2022 **Hopping, Landing and Balancing with Springs**, *PhD Thesis, Italian Institute of Technology and University of Genova, Advance Robotics Department*, 2022, Italy.
- 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 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

Java, HTML

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

Soft skills

Problem Solving.

Adaptability.

Good ability in sharing and/or presenting ideas.

Very good team-work skills.

Friendly, sociable.
Versatile

Research Interests

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

Computer Vision: RGB-D Cameras, Stereo Cameras, 3D localization.

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

Real-Time Embedded Programming.

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

Languages

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

Interests

- Music
- Documentaries
- Sports
- Social Activities

References

Dr. Roy Featherstone, *Lead researcher on the Skippy project, Advanced Robotics, Istituto Italiano di Tecnologia, roy.featherstone@iit.it.*

Dr. Antonio Candea Leite, *Associate Professor, Faculty of Science and Technology, Norwegian University of Life Sciences, antonio.candea.leite@nmbu.no.*