

# Frederico Fernandes Afonso Silva

Dual nationality: Brazilian and Portuguese

Website: <https://ffasilva.github.io/>

ORCID: [0000-0003-2130-3636](https://orcid.org/0000-0003-2130-3636)

Phone: +44 07570 248303

Email: [frederico.silva@ieee.org](mailto:frederico.silva@ieee.org)

University of Manchester

Department of Electrical and Electronic Engineering

Nancy Rothwell Building, Booth Street East

Manchester M13, United Kingdom

## Education and Employment

### Postdoctoral Research Associate, University of Manchester, United Kingdom

09/2025–present

- Developing a robotic laser cutting strategy using geometric description of the environment to impose safety constraints at task level
- Aiming to have a demonstration ready by the end of November 2025

Supervisor: Dr. Bruno Vilhena Adorno

### Marie Curie Postdoctoral Fellow, University of Manchester, United Kingdom

10/2023–09/2025

EU's flagship Postdoctoral Fellowship of two years, awarded by the Horizon Europe and founded by the UKRI (due to UK non-associated country status at the time)

- Obtained faster computational times by developing parallelized algorithms for the modular dynamic modeling of branched robots
- Ensured easier task description and safer execution through the design of control strategies for branched robots based on vector fields
- Mentored Ph.D. and M.Sc. students on bi-manual manipulation and motion planning of legged robots
- Collaborated to the group's integration by organizing bi-weekly research seminars where the PDRAs and Ph.D. students present the recent advances on their works
- Increased the robotics group visibility by organizing demonstrations on two high-profile events with attendance of over 100 people each, including donors, policymakers, and the general public
- Assisted teaching a module to M.Sc. students on kinematic and dynamic modeling and control
- Submitted the work to one of the most prestigious journals in robotics

Supervisor: Dr. Bruno Vilhena Adorno

### Postdoctoral Research Associate, Technical University of Munich, Germany

02/2023–09/2023

- Obtained smoother trajectories for the motion of robot manipulators by developing MPC strategies using dual quaternion algebra
- Enabled a Ph.D. student research and attended a thematic conference where they presented the work
- Supported a colleague during their absence by temporarily organizing regular research seminars amongst the group's PDRAs and Ph.D. students

Supervisors: Dr. Luis Figueredo and Dr. Sami Haddadin

### Postdoctoral Research Associate, Federal University of Minas Gerais, Brazil

08/2022–02/2023

- Achieved descriptive and computationally efficient models through the development of dynamic models for tiltrotor UAVs based on dual quaternion algebra
- Validated the models comparing them with the group's previously available models

Supervisor: Guilherme Vianna Raffo

### Ph.D. in Electrical Engineering with focus on Robotics, Federal University of Minas Gerais, Brazil

08/2017–06/2022

Dynamic Modeling of Robotic Systems: A Dual Quaternion Formulation

- Achieved a unified formulation within dual quaternion algebra through a Newton-Euler formalism for serial robots
- Proposed a systematic strategy for the dynamic modeling of branched robots
- Facilitated the assemble of complex mechanisms by developing a modular composition approach to integrate models of heterogeneous robots
- Published a journal paper and presented at a workshop in an international conference

Supervisor: Dr. Bruno Vilhena Adorno

**M.Sc. in Electrical Engineering with focus on Robotics, Federal University of Minas Gerais, Brazil** 07/2015–06/2017

Whole-Body Control of a Mobile Manipulator Using Feedback Linearization and Dual Quaternion Algebra

- Obtained smoother robot movements and a lesser control effort by developing a whole-body control strategy for nonholonomic mobile manipulators using feedback linearization
- Published a journal paper and presented at a Latin American conference

Supervisor: Dr. Bruno Vilhena Adorno

**B.Sc. in Control and Automation Engineering, Federal University of Minas Gerais, Brazil** 06/2009–07/2015

Implementation of a Machine Vision Algorithm for Electrical Outlet Recognition

- Implemented machine vision algorithms for self-charging robots
- Taught computer programming to undergraduate students and coordinated a team of around ten teaching assistants

Supervisor: Dr. Bruno Vilhena Adorno

### Supervision of students

**Mentor/Co-supervisor of a Ph.D. student, University of Manchester, United Kingdom** 04/2025–present

Bi-manual manipulation using two independent underwater robots

- Assisted the student in developing a formalism for bi-manual manipulation including internal forces and a control strategy considering load distribution and safety constraints
- Currently working on two journal papers about nonlinear control of underwater robots and bi-manual manipulation, which we will submit in the foreseeable future

Supervisor: Dr. Bruno Vilhena Adorno

**Mentor/Co-supervisor of three M.Sc. students, University of Manchester, United Kingdom** 06/2024–08/2024

Topics: Real-time gait planning and collision-free motion planning for biped robots; gait control of quadruped robots; motion control for humanoid robots

- Had regular one-to-one meetings with the students and supported them on theoretical questions

Supervisor: Dr. Bruno Vilhena Adorno

### Fellowships and Funding Received

**Marie Curie Postdoctoral Fellowship** 10/2023–09/2025

Awarded £187k by the UKRI as part of the Horizon Europe Guarantee to research dynamic modeling and control of complex robots using modular formulations

- The developed models enabled the group's research on quadruped robots by easing the modeling process with computationally efficient algorithms

Funding Agency: UK Research and Innovation (UKRI) – EP/Y024508/1

Awarding programme: Horizon Europe

**Ph.D. Study Fellowship** 08/2018–01/2022

Competitive Ph.D. stipend awarded by the Graduate Program of Electrical Engineering of the Federal University of Minas Gerais (UFMG)

Funding Agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

**M.Sc. Study Fellowship** 08/2015–06/2017

Competitive M.Sc. stipend awarded by the Graduate Program of Electrical Engineering of the Federal University of Minas Gerais (UFMG)

Funding Agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

### Publications

#### Peer-reviewed journal and conferences

A. Teimoorzadeh, **F. F. A. Silva**, L. F. C. Figueredo, and S. Haddadin. 2023. "Smooth real-time motion planning based on a cascade dual-quaternion screw-geometry MPC." In International Workshop on Human-Friendly Robotics, 164–180. DOI: [10.1007/978-3-031-55000-3\\_12](https://doi.org/10.1007/978-3-031-55000-3_12)

**F. F. A. Silva**, J. J. Quiroz-Omaña, and B. V. Adorno. 2022. "Dynamics of Mobile Manipulators Using Dual Quaternion Algebra." *Journal of Mechanisms and Robotics*, pp. 1–24. ISSN: 1942-4302. DOI: 10.1115/1.4054320. arXiv: 2007.08444. URL: <https://arxiv.org/abs/2007.08444>.

**F. F. A. Silva** and B. V. Adorno. 2019. "Wrench Control based on Dual Quaternion Algebra." In *Workshop on Applications of Dual Quaternion Algebra to Robotics, International Conference on Advanced Robotics (ICAR)*. DOI: [10.5281/zenodo.3566650](https://doi.org/10.5281/zenodo.3566650)

**F. F. A. Silva** and B. V. Adorno. 2018. "Whole-Body Control of a Mobile Manipulator Using Feedback Linearization and Dual Quaternion Algebra." *Journal of Intelligent & Robotic Systems* 91 (2): 249–62. DOI: [10.1007/s10846-017-0686-3](https://doi.org/10.1007/s10846-017-0686-3).

**F. F. A. Silva** and B. V. Adorno. 2016. "Whole-Body Control of a Mobile Manipulator Using Feedback Linearization Based on Dual Quaternions." In *2016 XIII Latin American Robotics Symposium and IV Brazilian Robotics Symposium (LARS/SBR)*, 293–98. IEEE. DOI: [10.1109/LARS-SBR.2016.56](https://doi.org/10.1109/LARS-SBR.2016.56)

## Journal preprints

**F. F. A. Silva** and B. V. Adorno, "Dynamic Modeling of Branched Robots using Modular Composition," Jul. 2024. [Online]. Available: <http://arxiv.org/abs/2208.01795>.

## Teaching Experience

### Graduate teaching

**Teaching Assistant of Robotic Manipulators, University of Manchester, United Kingdom** 01/2024–04/2024  
Mentored M.Sc. students on practical programming classes about forward and inverse kinematics, differential kinematics, kinematic control, dynamic modeling, and basic dynamic control  
Supervisor: Dr. Murilo M. Marinho and Dr. Xiaoxiao Cheng

### Undergraduate teaching

**Teaching Assistant of Robotic Manipulators, Federal University of Minas Gerais, Brazil** 02/2019–07/2019  
Mentored B.Sc. students on theoretical classes about forward and inverse kinematics, differential kinematics, kinematic control, dynamic modeling, and basic dynamic control and invigilated the course tests  
Supervisor: Dr. Bruno Vilhena Adorno

**Teaching Assistant of Laboratory of Projects III, Federal University of Minas Gerais, Brazil** 08/2018–12/2018  
Mentored B.Sc. students on software and hardware development 02/2016–07/2016  
Supervisor: Dr. Bruno Vilhena Adorno

**Coordinator of the Teaching Assistant team of Computer Programming, Federal University of Minas Gerais, Brazil** 06/2013–06/2015

- Coordinated a team of around ten teaching assistants by organizing regular meetings and establishing mentoring criteria
- Taught B.Sc. students theoretical introductory classes to computer programming
- Mentored B.Sc. students on practical programming classes using Scilab and invigilated the course tests

Supervisor: Dr. Osvaldo Sérgio Farhat de Carvalho

**Teaching Assistant of Computer Programming, Federal University of Minas Gerais, Brazil** 11/2012–06/2013

- Taught B.Sc. students theoretical introductory classes to computer programming
- Mentored B.Sc. students on practical programming classes using Scilab and invigilated the course tests

Supervisor: Dr. Osvaldo Sérgio Farhat de Carvalho

## Editorial and review activities

**Journal and conference reviews:** 12

Selected journals and conferences: IEEE Robotics and Automation Letters, Nonlinear Dynamics; International Journal of Advanced Robotic Systems; IEEE International Conference on Intelligent Robots and Systems; IEEE International Conference on Robotics and Automation

## Grant reviews: 1

EPSRC standard research grant

Web of Science profile: <https://www.webofscience.com/wos/author/record/364088>

## Outreach activities

### **Celebrations for the renaming of the Nancy Rothwell Building, University of Manchester, United Kingdom**

07/2024

Organized the robot demonstration using three quadruped robots and a wheeled humanoid

- Attended by over 100 people, including donors, the general public, industrialists, and policymakers
- Provided outstanding visibility of the work at the University of Manchester, being covered by university-wide outlets, such as webpages, newsletters, and videos advertised through social media

### **Rosenbrock Lecture Series, University of Manchester, United Kingdom**

03/2024

Organized the robot demonstrations using mobile robots, robotic manipulators, underwater robots, and humanoids

- Attended by over 100 people, including academics and industry sponsors
- Provided outstanding visibility of the work at the University of Manchester, encouraging external partners to reach out for further collaborations and increasing the University's international profile as a centre of excellence in robotics

## Boards, committees and positions of trust

- Board member of the Graduate Program in Electrical Engineering as Student Representative (Federal University of Minas Gerais, 05/2016–05/2017 and 10/2017–03/2020)
- Participation in the evaluation board for one M.Sc. thesis and one B.Sc. thesis

## Programming languages, simulators and academic skills

**Advanced level:** C/C++; MATLAB; CoppeliaSim

**Intermediate level:** ROS; Scilab

**Basic level:** LUA; Gazebo

- Extensive experience in kinematic modeling (direct and inverse kinematics, differential kinematics), dynamic modeling (Newton-Euler formalism, Euler-Lagrange approach), control (Jacobian-based control, nonlinear control, force control, strategies based on vector fields), and manipulation
- Practical experience with robotic manipulators, mobile manipulators, and quadrupeds
- Significant leadership, project management, grant application, mentoring, and teaching experiences

## Open-source libraries

### **DQ Robotics Developer**

03/2023–present

A standalone open-source library for dual quaternion algebra, robot modelling, and control

Available at: <https://dgrobotics.github.io/>

## Non-academic Experience

### **Internship on Control and Automation Engineering, Nucletrans UFMG, Brazil**

09/2014–09/2015

Implemented machine vision algorithms for maintenance of railway lines

Line manager: Marcelo Franco Porto

### **Internship on Mechatronics Vocational and Technical Education, Destec, Brazil**

04/2009–10/2009

Assembled electronic components, installed overhead crane load measuring systems, and simulated industrial process for process optimization

## Languages

Portuguese: Mother language

English: Advanced level

French: Basic level