

Frederico Fernandes Afonso Silva

Dual nationality: Brazilian and Portuguese

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University of Manchester

Department of Electrical and Electronic Engineering

Nancy Rothwell Building, Booth Street East

Manchester M13, United Kingdom

Education and Employment

Marie Curie Postdoctoral Fellow, University of Manchester, United Kingdom

10/2023–present

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

- Developed parallelized algorithms for the modular dynamic modeling of branched robots
- Designed 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

- Developed MPC strategies for robotic manipulators 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

- Developed dynamic models for tiltrotor UAVs based on dual quaternion algebra
- Validated the models comparing them with the group's previous, and more computationally expensive, 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

- Developed a dual quaternion Newton-Euler formalism for serial robots
- Proposed a systematic strategy for the dynamic modeling of branched robots
- Developed 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

- Developed a whole-body control strategy for nonholonomic mobile manipulators
- Applied feedback linearization and dual quaternion algebra
- 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

Fellowships and Funding Received

Marie Curie Postdoctoral Fellowship

10/2023–10/2025

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 enable 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)

Teaching and Mentoring Experience

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, considering internal forces

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

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

Publications

Peer-reviewed international journals

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. 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).

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>.

Peer-reviewed national and Latin American conference papers

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)

Workshop papers

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 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)

Editorial and review activities

Journal and conference reviews: 11

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

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://dqrobotics.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