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

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 January 2026

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 smother 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 smother 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

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

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.

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

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

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://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