David Rodríguez Martínez

Research Scientist | Planetary Robotics

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Date of birth: October 3, 1990
Nationality: Spanish

10-SEC SUMMARY

I am a Research Scientist (postdoc) at EPFL's Advanced Quantum Architecture Lab (AQUA) in Lausanne, Switzerland, where my group currently conducts research at the intersection of robotics, quantum imaging, and space. My research revolves around the study of innovative quantum-driven autonomous navigation pipelines and robotic mobility solutions based on the use of single-photon detectors. Our goal is to enable mobile robotic systems to be faster, more efficient, reliable, and robust when deployed in extreme environments, on and off-Earth. Over the past decade I have founded initiatives and led research projects in academic institutions and public organizations based in Europe, USA, and Japan. I currently teach and direct master's level courses on Concurrent Engineering of Space Missions (ENG411) and Spacecraft Design and Systems Engineering (EE584) at EPFL.

EDUCATION

PhD in Planetary Robotics | April '17 - September '20
Tohoku University Sendai, Japan
Advisor: Prof. Kazuya Yoshida
Co-Advisor: Michel Van Winnendael (ESA/ESTEC)

MSc. in Space Studies | September '15 - September '16
International Space University, Strasbourg, France
Graduated *cum laude* (highest grade of the 2016 class)

MSc & BSc in Mechanical and Structural Engineering | September '08 - May '15
Carlos III University, Madrid Spain
Graduated *summa cum laude* in final master's thesis.

PROFESSIONAL EXPERIENCE

Research Scientist (postdoc) @Advanced Quantum Architecture (AQUA) Lab, EPFL
Lausanne, Switzerland | April '23 - Present

- Leading the Quantum Vision for Extreme Robotics group.

Principal Scientist @eSpace - EPFL Space Center
Lausanne, Switzerland | September '22 - April '23

- Founder and Director of the Lunar Hub.
- Responsible for the hub's R&D strategy and implementation

Research Scientist & Engineer @eSpace - EPFL Space Center
Lausanne, Switzerland | October '20 - September '22

- Support to the center's lunar research Initiative strategy & implementation.
- Project Manager for EPFL of the Active Debris Removal/ In-Orbit Servicing – ADRIOS ESA-ClearSpace Project.
- Support to a variety of projects in space sustainability, robotics, space transportation technologies, atmospheric science, AgriTech, and radio astronomy.
- Coordinator of students' interdisciplinary projects (>200 students)
- Supervision of >15 master's student projects.

Research Group Lead @Space Robotics Lab, Tohoku University
Sendai, Japan | April '18 - September '20

- Founder and principal investigator of the High-Speed Exploration Rover Group made up of 2 PhD students, 4 Master's students, and 2 exchange students.
- PI: High-speed lunar exploration.
- Development of Explorer-1 (EX1), the lab's first fast-moving lunar rover prototype.

PhD Candidate @Space Robotics Lab, Tohoku University
Sendai, Japan | April '17 - September '20

- Study of the effects associated with faster (> 1m/s) ground mobility in reduced-gravity, unstructured, and dynamic environments.
- Locomotion, terramechanics and motion control architecture for lunar rovers.

NPI Researcher (PhD) @European Space Agency (ESTC/ESA)
Katwijk, The Netherlands | April '18 - September '20
Planetary Robotics Lab | Automation and Robotics Section | TEC-MMA
Mechatronics & Optics Division

Visiting Scientist (PhD) @German Aerospace Center (DLR)
Munich, Germany | October '18 - November '18
Robotics and Mechatronics Center (RMC) | Institute of Systems Dynamics and Control

- Test campaign director: effects of speed on the locomotor performance of mobile robots over planetary simulants (olivine sands and calcite silts).

Mechanical Engineer Trainee @European Space Agency (ESTEC/ESA)
Katwijk, The Netherlands | June '16 - September '16
Mechanical Engineering Department

- Static and dynamic finite element analysis and topology optimization of E/O satellites and nanosatellite structures

Research Scholar (MSc) @West Virginia University
WV, United States | September '14 - March '15

- Application to a pre-design tool of analytical models for the impact of composite panels.

OTHER ACADEMIC ACTIVITIES

- Founder and current chair of the HERMES International Working Group ("Heterogeneous MultiRobot Cooperation for Exploration and Science in Extreme Environments") currently formed by 15 members from 8 different institutions.
- See Teaching Activities.
- Coordinator of EPFL's student interdisciplinary team Xplore (2020 - 2023)[>100 students]
- Overall Coordinator of student initiatives at EPFL Space Center (2020 - 2023) [>200 students]

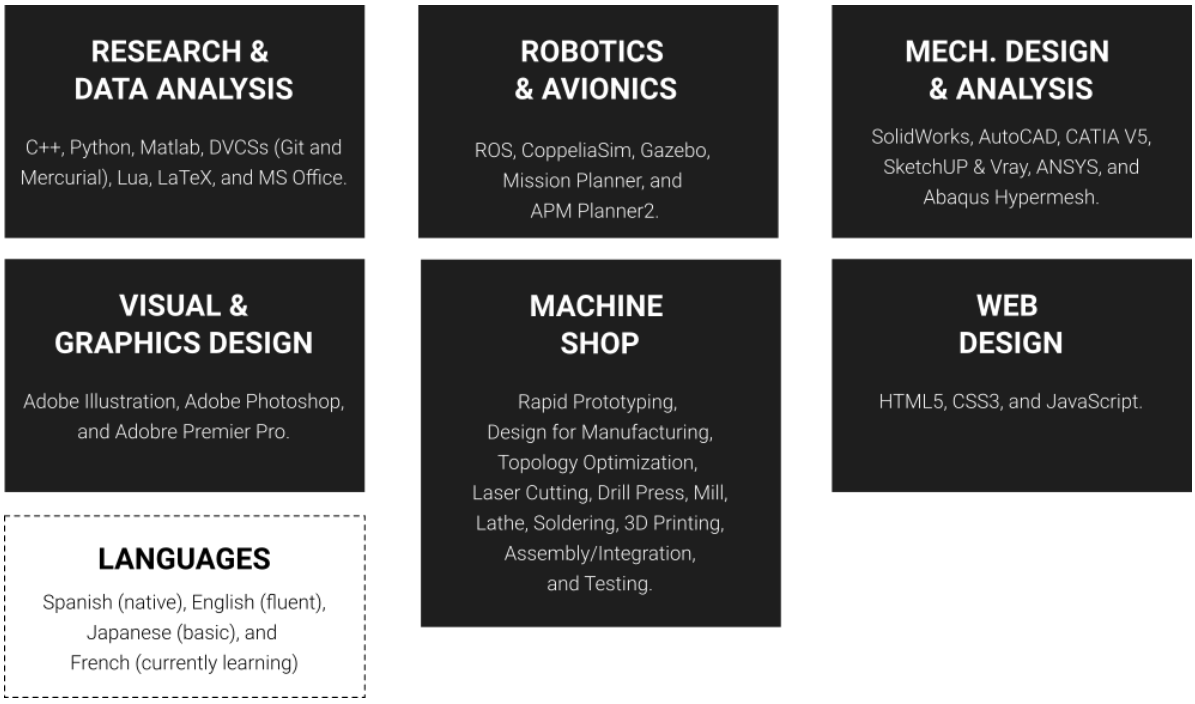
TEACHING ACTIVITIES

2023 - today EPFL | Director & Main Lecturer of ENG-411 **"Concurrent Engineering of Space Missions"** part of the Master's Minor in Space Technologies (15 students)

2023 - today EPFL | Director & Main Lecturer of EE-584 **"Spacecraft Design & Systems Engineering"** part of the Master's Major in Electrical and Electronics Engineering, Minor in Space Technologies, and Minor in Systems Engineering (40 students)

2022 Spaceonova | Invited instructor to the Space Robotics Training Programme, **"Introduction to lunar rovers mobility"**

TECHNICAL SKILLS



ACADEMIC HONORS, GRANTS AND AWARDS

2024 **Armasuisse Science & Technology (S+T) Program Grant, Federal Department of Defense, Civil Protection and Sport (DDPS)** (PI) "Monocular SPAD camera for enhanced vision in complex and uncertain environments" 01/04/2024 - 31/12/2024 [96k CHF, ~100k EUR]

2024 **Armasuisse Science & Technology (S+T) Program Grant, Federal Department of Defense, Civil Protection and Sport (DDPS)** (PI) "Quantum LiDAR for NLOS applications" 01/03/2024 - 15/11/2024 [82k CHF, ~86k EUR]

2023 **Armasuisse Science & Technology (S+T) Program Grant, Federal Department of Defense, Civil Protection and Sport (DDPS)** (Project Coordinator) "Pre-study on SPAD-based LiDAR Direct Time-of-flight (DTOF) for occluded perception." 01/04/2023 - 31/12/2023 [35k CHF, ~37k EUR]

2022 **Armasuisse Science & Technology (S+T) Program Grant, Federal Department of Defense, Civil Protection and Sport (DDPS)** (PI) "DRAGONFLY - A 1 Mpx SPAD camera with real-time on-chip computation for space applications." 1/11/2022 - 31/12/2023 [131k CHF; ~140k EUR]

2021 **European Space Agency (ESA) FLPP ITT** (PM) "Fund New European Space Transportation Solutions (NESTS)" granted as part of a consortium led by Ariane Group.

2019 **Best paper award** in the mobile robotics for ground applications track at the 15th ISTVS Conference held in Prague, Czech Republic, for the paper "The effects of increasing velocity on the tractive performance of planetary rovers."

2018 **ESA's Networking-Partnering Initiative (NPI) Research Programme Grant** (PI) "Study, analysis and development of a high-speed locomotive system for an improved-mobility lunar prospecting rover," first ever NPI association between ESA and a non-member state university.

2018 **Tohoku University Graduate School of Engineering GPMech Funding Award (機械科学技術国際共同大学院プログラム)** for the promotion of international research collaborations. [600k JPY/year + international mobility expenses; ~12.5k EUR]

2017 **Monbukagakusho ("MEXT") Scholarship Recipient (文部科学省奨学金)** given by Ministry of Education, Culture, Sports, Science, and Technology of Japan. Embassy recommendation. [1.8M JPY/year for the whole duration of doctoral studies; ~50k EUR]

2016 **European Space Agency Sponsorship** to attend the International Space University Master's in Space Studies. [16k EUR]

2008 **National Scholarship from the Ministry of Education, Culture and Sport of Spain.**
Full payment of the first-year university tuition.

TECHNOLOGY TRANSFER / INNOVATION PROJECTS

2022 EPFL | Project Manager | Funded by ESA [4000131315120/DILG] **"ADRIOS ClearSpace Service Phase 1B/2"** in collaboration with ClearSpace SA

2021 EPFL | Project Manager | Funded by Innosuisse [44145.1 IP-ICT] **"Capture system concept validation"** in collaboration with ClearSpace SA

2020 EPFL | Project Manager | Funded by Innosuisse [38398.1 IP-ICT] **"Relative navigation technologies for Failed Satellite Removal"** in collaboration with ClearSpace SA

SEMINARS, INVITED TALKS AND OUTREACH

2024 Mar 13 Speaker at the European Robotics Forum (ERF'24) Workshop on Pushing the limits for Space Robotics. Organized by the euRobotics TC on Space Robotics.

2024 Jan 15 Seminar at the University of Zurich: "Quantum vision for extreme robotics." Invited by the Robotics Perception Group of Prof. Davide Scaramuzza.

2023 Jun 02 Keynote speaker at the ICRA '23 Workshop on Heterogeneous Multi-Robot Cooperation for Exploration and Science in Extreme Environments (HERMES), "Efficient exploration: exploring farther and faster," London, UK

2023 Apr 20 Invited speaker at the Space Resources Week: "Design of a lunar reconnaissance drone for exploration and mapping of extreme, hardly accessible locations," Luxembourg.

2022 Dec 15 Invited speaker at the "Italy and Switzerland: Together in Space" event organized by the Embassy of Italy in Bern

2022 Dec 12 Invited speaker eSpace Seminars: "Lunar Hub: a venture to explore the extreme and the uncharted"

2022 Nov 30 Seminar at the University of Luxembourg: "eSpace Lunar Hub: a venture to explore the extreme and the uncharted." Invited by the SnT's SpaceR group of Prof. Miguel A. Olivares-Mendez

2021 Sep 08 Invited speaker at eSpace Seminars: "EPFL involvement in MVA Payload Project first mission to the Moon"

2018 Jan 01 Digital speaker part of the "50 Global Innovators" track at the Space Tech Summit held in San Mateo, CA.

CONFERENCE/WORKSHOP ORGANIZER

[1] Special session on Space Autonomy, Member of the Organization Committee, 2024 IEEE International Conference on Automation Science and Engineerings (CASE), Aug. 28 - Sep. 1, 2024, Bari, Italy.

[2] 1st International Conference on Space Robotics (iSpaRo'24), Conference Co-chair & Member of the Organization Committee, July 24 - 26, 2024, Luxembourg

[3] 2nd International HERMES Workshop: Multi-robot Sensing & Perception, Chair of the Organization Committee, 2024 IEEE International Conference on Robotics and Automation (ICRA). May 13 - 17, 2024, Yokohama, Japan

[4] Pushing the Limits of Space Robotics Workshop, Member of the Organization Committee, ERF 2024 | European Robotics Forum 2024, March 13 - 15, 2024, Rimini, Italy

[5] 1st International Workshop on Heterogeneous Multi-Robot Cooperation for Exploration and Science in Extreme Environments (HERMES), Member of the Organization Committee, 2023 IEEE International Conference on Robotics and Automation (ICRA), May 29 - June 2, 2023 London, UK.

ASSOCIATE/GUEST EDITOR AND REVIEWER

2024 Associate editor for the 1st International Conference on Space Robotics (iSpaRo) 2024

2023 Guest editor for the Journal of Intelligent & Robotic Systems (JINT) special issue on "Robotics for exploration and science in extreme environments"

I am actively reviewing papers for the following journals: Journal of Terramechanics (since 2019), Journal of Intelligent & Robotics Systems (since 2023).

STUDENT SUPERVISION

Master's Theses

Spring 2024 Noah Lugon-Moulin, "Optimization of VIPER Navigation System Performance and Reliability through System-Level Integrated Navigation Testing," co-supervised by Prof. Jean-Paul Kneib (EPFL Space Center) and Arno Rogg (NASA Ames).

Spring 2023 Iacopo Sprenger (*now Embedded Android Engineer at Almer Technologies*), "Realtime on-chip computing for space applications," co-supervised by Prof. Andrea Guerrieri and Prof. Theo Kluter (Processor Architecture Lab, EPFL)

Spring 2023 Thomas Manteaux (*now System Engineer at ONWARD*), "Path planning for lunar rovers: An Artificial Potential Field-based algorithm for the path planning of a walking lunar rover," co-supervised with Prof. Raj Thilak Rajan (SensorAI Lab, Delft University of Technology)

Fall 2022 Romeo Tonasso (*now Space System Engineer at OHB*), "Feasibility analysis & preliminary design of a Lunar Reconnaissance Drone Service Station," co-supervised with Prof. Jean-Paul Kneib, Prof. Colin Jones, and invited Prof. Hiroyuki Koizumi (Space Propulsion Laboratory, University of Tokyo)

Spring 2022 Vincent Pozsgay (*now Space Propulsion Engineer at Exotrail*), "Feasibility analysis and preliminary design of a Lunar Reconnaissance Drone," co-supervised with Prof. Jean-Paul Kneib, Prof. Colin Jones, and invited Prof. Hiroyuki Koizumi (Space Propulsion Laboratory, University of Tokyo)

Fall 2019 Kazuki Nakagoshi, "Testbed development for high-speed single-wheel performance testing on uneven terrains," co-supervised with Prof. Kazuya Yoshida (Space Robotics Lab, Tohoku University)

Fall 2019 Takato Kawada, "High-level strategies for high-speed lunar navigation," co-supervised with Prof. Kazuya Yoshida (Space Robotics Lab, Tohoku University)

Master's Semester Projects

Spring 2024 Joachim Despature, "Camera egomotion estimation under complex visual fields," Semester Project at EPFL AQUA Lab

Spring 2024 Marie Ethvignot, "Peering behind dust storms on Mars with single photon cameras," Semester Project at EPFL AQUA Lab

Spring 2024	Sylvain Beuret, “Monocular visual inertial odometry of a fast-moving planetary rover,” Semester Project at EPFL AQUA Lab
Spring 2024	Tom Rathjens, “Single-photon camera integration on a 2-wheel self-balancing mobile robot,” Minor in Space Technologies Project at EPFL AQUA Lab
Spring 2024	Théodore Allegre, “Single-photon camera integration with Single Board Computer,” Semester Project at EPFL AQUA Lab
Spring 2024	Nathan Benavides, “Learning agile navigation across lunar-like environments with a 2-wheel self-balancing robot,” Minor in Space Technologies Project at EPFL AQUA Lab
Spring 2024	Matthias Kockisch, “Single-photon imaging simulator in NVIDIA Omniverse,” Semester project at EPFL AQUA Lab
Fall 2022	Daniel Tataru (*now Simulation Engineer at Dufour Aerospace*), “Control of the Lunar Reconnaissance Drone flight profile in Gazebo,” Semester Project at EPFL Space Center (eSpace)
Fall 2022	Hippolyte Rauch, “Simulation of the Lunar Reconnaissance Drone flight profile in Gazebo,” Semester Project at EPFL Space Center (eSpace)
Fall 2022	Koki Kimura, “Rover locomotion subsystem design for fast extraterrestrial mobility,” Semester Project at EPFL Space Center (eSpace)
Fall 2022	Robin Bonny (*now PhD in Space Research & Physics at the University of Bern*), “Development of the on-board computer for a lunar payload,” Semester Project at EPFL Space Center (eSpace) co-supervised with Minglo Wu and Prof. Edoardo Charbon (EPFL AQUA - Advanced Quantum Architecture Laboratory)
Spring 2022	Julien Moreau, “Mechanical design of the optical unit and structural subsystem for a lunar camera,” Semester Project at EPFL Space Center (eSpace)
Spring 2022	Arion Zimmermann, “Space Localisation,” Semester Project at EPFL Space Center (eSpace) co-supervised with Sitian Li and Prof. Andreas Peter Burg (EPFL TCL - Telecommunications Circuits Laboratory)
Fall 2021	Clément Vincent (*now Mechanical Design Engineer at Flyability*), “Lunar Payload Design : Definition of a lunar camera payload system architecture,” Semester Project at EPFL Space Center (eSpace)
Fall 2021	Vincent Dor (*now Test Engineer at Space Research & Planetary Sciences, University of Bern*), “EL3 Polar Explorer: Radio Antenna Payload Pre-phase A Study,” Minor in Space Technologies Project at EPFL Space Center (eSpace)
Fall 2021	Erik Uythoven (*now Mechanical Engineer at APCO*), “Preliminary design of a lunar reconnaissance drone,” Semester Project at EPFL Space Center (eSpace)
Fall 2021	Thomas Pfeiffer (*now Engineer at Airbus D&S*), “Preliminary design of a lunar reconnaissance drone,” Semester Project at EPFL Space Center (eSpace)

Spring 2021	Aurelien Balice-Debbas (*now Data Scientist at Cartier*), "GrowBotHub: Organization & Systems Engineering," Semester Project at EPFL Space Center (eSpace)
Spring 2021	Thomas Manteaux (*now System Engineer at ONWARD*), "Critical analysis of the Systems Engineering approach for a short-term space project," Semester Project at EPFL Space Center (eSpace)
Spring 2021	Dimitri Hollosi (*now Project Manager at KSAT*), "System Engineering of a Small Radio Telescope," Minor in Space Technologies Project at EPFL Space Center (eSpace)
Spring 2021	Hadrien Sprumont (*now Robotics Research Engineer at Soft Kinetic Group*), "Polar rover mission: Preliminary concept study." Semester Project at EPFL Space Center (eSpace)

Exchange Students

Fall 2019	Alan Allart (*now Aerospace Guidance & Control Engineer at ArianeGroup*), "Development of Embedded Systems for a High-Speed Lunar Exploration Rover Prototype," co-supervised by Prof. Kazuya Yoshida at Tohoku University

MEDIA COVERAGE

[1] *"A leading expert in space robotics tests a lunar rover in the Tottori Sand Dunes,"* (Original title: **宇宙ロボット工学の第一人者 鳥取砂丘で月面探査車の走行実験**) NHK News Web, 14/Nov/2023 [article, in Japanese]

[2] *"Students design lunar water-prospecting missions for the Concurrent Engineering Challenge 2022!,"* European Space Agency (ESA) Academy, 23/May/2022 [article]

[3] *"Ocho españoles investigarán en Japón desastres, alimentación y robótica."* La Vanguardia, 30/03/2017 [newspaper article]

LICENSES AND CERTIFICATIONS

Concurrent Design Study Facilitator
ESA Concurrent Engineering Challenge 2021

Agile Project Management Foundation Certification
APMG International, Oct 2021, Credential ID: 09795868-01-LBYK

STK Certified Foundation Certification
Ansys [previously Analytical Graphics Inc (AGI)], Nov 2015

MEMBERSHIP NETWORKS

IEEE Robotics and Automation Society
Member since 2023
Member of the TC on Space Robotics

Member of the TC on Computer & Robot Vision
Member of the TC on Multi-Robot Systems

euRobotics Topic Groups
Member of the TG on Space Robotics since 2023
Member of the TG on Perception since 2023
Member of the TG on Autonomous Navigation since 2023
Member of the TG on Marine Robotics since 2024

PUBLICATIONS

Phd Thesis

[1] **Rodríguez-Martínez, D.**, *High-Speed Lunar Exploration: Design and Evaluation of Wheeled Locomotion System for a Fast-Moving Rover*, Tohoku University, ID No. B7TD9113. Advisor: Prof. Kazuya Yoshida; Co-Advisor: Michel Van Winnendael (ESA/ESTEC); Reviewers: Prof. Yasuhida Hirata and Prof. Hiroshi Takahashi; July 15, 2020.

Journals

[2] **Rodríguez-Martínez, D.**, Yoshida, K., *High-speed lunar rovers.* ROOM: The Space Journal, 2(12), 54-56, 2017.

[3] **Rodríguez-Martínez, D.**, Van Winnendael, M., Yoshida, K., *High-speed mobility in planetary surfaces: a technical review.* Journal of Field Robotics, 36(8), 1436-1455, 2019.

[4] **Rodríguez-Martínez, D.**, Uno, K., Sawa, K., Uda, M., Kudo, G., Hernan Diaz, G., Umemura, A., Santra, S., Yoshida, K., *Enabling Faster Locomotion of Planetary Rovers with a Mechanically-Hybrid Suspension.* IEEE Robotics and Automation Letters (RA-L), 9(1), 619-626, Jan 2024 (also presented at ICRA 2024)

[5] Romeo, T., Tataru, D., Rauch, H., Pozsgay, V., Pfeiffer, T., Uythoven, E., **Rodríguez-Martínez, D.**, *A lunar reconnaissance drone for cooperative exploration and high-resolution mapping of extreme locations*, Acta Astronautica, 218, 1-17, May 2024.

Conferences

[6] Iliffe, P., Kaethler, S., Xu, E., Jonathan, S., **Rodríguez-Martínez, D.**, Jones, W., Christensen, J., Rocha de Oliveira, M., King, A., Vikner, M., Punch, O., Bartos, A., Chagas, M., Russitano Lanza, M., Shanthini, K., Medepalli, A., Kaspar, K., Hedima, R., Ochanda, N., Zhang, W., *Planetary protection and the search for life on the icy moons of the Solar System: A technology roadmap*. 67th IAC, Guadalajara, Mexico, 2016.

[7] **Rodríguez-Martínez, D.**, Buse, F.,Van Winnendael, M., Yoshida, K., *The effects of increasing velocity on the tractive performance of planetary rovers* (best conference paper award). 15th ISTVS Conference, Prague, Czech Republic, 2019.

[8] Nakagoshi, K., **Rodríguez-Martínez, D.**, Yoshida, K., *A new single-wheel test bed for fast-moving planetary robots.* Aerospace Europe Conference, Bordeaux, France, 2020.

[9] Pfeiffer, T., Uythoven, K., **Rodríguez-Martínez, D.**, Koizumi, H., Kneib, J-P., *Feasibility study and preliminary design of a lunar reconnaissance drone*. Lunar Surface Innovation Consortium (LSIC) Spring Meeting, Laurel, MD, 2022. (virtual)

[10] Pozsgay, V., **Rodríguez-Martínez, D.**, Kneib, J-P., *A lunar reconnaissance drone mission concept for mapping and characterizing polar regions*. Lunar Polar Volatiles Conference (LPVC) Boulder, CO, 2022. (virtual)

[11] **Rodríguez-Martínez, D.**, Pfeiffer, T., Uythoven, E., Pozsgay, V., Tonasso, R., David, E., Kneib, J-P., *Design of a lunar reconnaissance drone for exploration and mapping of extreme, hardly accessible locations*. Space Resources Week, Luxembourg, 2023.

[12] Sawa, K., Uno, K., Kudo, G., Yoshida, K., **Rodríguez-Martínez, D.**, *Development and experimental evaluation of a suspension mechanism for a high-speed lunar rover*, The Robotics and Mechatronics Conference (ROBOMECH), Nagoya, Japan, 2023.

Technical Reports

[13] Abdullah, F., Entrena-Utrilla, C.M.,Husseyin, S., Iiffe, P., **Rodríguez-Martínez, D.**, Xu, E., *Cubesat Atmospheric Re-entry Experiment (CARE) Mission Design Report*, Cubesat Mission Design, International Space University MSS'16.

[14] Iiffe, P., Kaethler, S., Xu, E., Jonathan, S., **Rodríguez-Martínez, D.**, Jones, W., Christensen, J., Rocha de Oliveira, M., King, A., Vikner, M., Punch, O., Bartos, A., Chagas, M., Russitano Lanza, M., Shanthini, K., Medepalli, A., Kaspar, K., Hedima, R., Ochanda, N., Zhang, W., *SEDNA: Planetary Protection in Missions to Icy Moons, Analysis and Technology Roadmap.* Team Project, International Space University MSS'16.

[15] **Rodríguez-Martínez, D.**, *Explorer 1 (EX1) High Speed Exploration Rover: User Manual*, Tohoku University's Space Robotics Lab, 1(0), 2020

Master Theses

[16] **Rodríguez-Martínez, D.**, *Applicability to a pre-design tool of analytical models on the impact of composite laminates*, Universidad Carlos III de Madrid. Advisor: Prof. Carlos Navarro Ugena; Co-Advisor: Prof. Ever J. Barbero (WVU); Graded *summa cum laude,* 2015.

[17] **Rodríguez-Martínez, D.**, *Development of a UAV system to augment remote observation via spatial immersion*, International Space University. Advisor: Prof. Hugh Hill and Joshua Nelson; Graded *cum laude*, 2016.

Further information and references are available upon request
For any future correspondence, emails can be sent to david.rodriguez@epfl.ch