Matías Mattamala

Curriculum Vitae

Contact Information

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Research Overview

I aim to make robots that help us understand and solve problems of the real world. To achieve this, my research focuses on the foundations and systems for autonomy: representations and algorithms that leverage perception, planning, learning, and simulation, with experience and data acquired through robot experiences in the field.

Current Positions

University of Oxford, Oxford, UK
Postdoctoral Researcher — Sep 2023 – present

- Research on robot navigation and mapping using vision, geometry, and language.
- Supervision of PhD, visitors, and undergraduate students.
- Support on management, grant application writing, dissemination, field trials.

Education

University of Oxford, Oxford, UK
DPhil in Engineering Science, — Oct 2019 – Nov 2023
Supervisor: Prof. Maurice Fallon
Thesis: *Vision-based Legged Robot Navigation: Localisation, Local Planning, Learning*

Universidad de Chile, Santiago, Chile
M.Sc in Electrical Engineering — Mar 2015 – Aug 2018
Thesis: *Visual Localization for Resource-constrained Robots*
Supervisor: Prof. Javier Ruiz-del-Solar

Ingeniería Civil Eléctrica — Mar 2009 – Aug 2018
B.Sc in Electrical Engineering — Mar 2009 – Mar 2014

Past Positions

ETH Zürich, Zürich, Switzerland
Visiting Researcher — Apr 2022 – Sep 2022

- Research visit at the Robot Systems Lab (RSL) under Prof. Marco Hutter.
- Project on learned visual traversability estimation for natural environments.
- Co-supervision of semester and master's thesis projects.

Universidad de Chile, Santiago, Chile
Project Manager — Jun 2018 – Aug 2019

- Coordination of the 'Beauchef Proyecta' unit to foster multidisciplinary activities across engineering degrees. Managed funds associated to the project (∼£90,000).

Undergraduate and M.Sc. researcher — Mar 2012 – Aug 2018

- Perception lead of the UChile Robotics RoboCup Soccer team. Joined competitions in Mexico (2012), The Netherlands (2013), Brazil (2014, 4th place), and China (2015, 4th place).

Knight Robotics, Santiago, Chile
Part-time Developer — Jan 2015 – Mar 2018

- Assembly of educational robot kits, graphic design, training for school teachers.

ALMA Observatory, San Pedro de Atacama, Chile
Engineering Intern — Jan 2013 – Mar 2013
- Implementation of graphical user interfaces for monitoring the radiotelescope's antennas.

Teaching

University of Oxford, Oxford, UK
Teaching Assistant — Mar 2021
- Lead TA of an AIMS CDT course on autonomous exploration. I co-designed a new online challenge (due to COVID-19 restrictions) to introduce advanced robotics methods and C++ programming.

Universidad de Chile, Santiago, Chile
Instructor — Mar 2017 – Sep 2019
- Designed and taught courses on mobile robotics (based on the Duckietown project), tech project development, battlebots, and data science for astronomy. Over 300 students taught.

Teaching Assistant — Mar 2012 – Dec 2016
- TA for mobile robotics, image processing, computational methods for science and engineering, introduction to engineering, and electromagnetism. Over 200 students taught.

Mustakis Foundation, Santiago, Chile
Instructor — Apr 2014 – Jun 2018
- Introductory robotics and programming courses for high school students using LEGO Mindstorms and Arduino. Over 200 high-school students taught.

Selected Publications
(*equal contribution)

[3] **Matías Mattamala**, Nived Chebrolu, Jonas Frey, Leonard Freißmuth, Haedam Oh, Benoit Casseau, Jonas Frey, Marco Hutter and Maurice Fallon. Nov. 2024. "Building Forest Inventories with Autonomous Legged Robots — System, Lessons, and Challenges Ahead". *IEEE Trans. Field Robotics.* **Invited paper, under review**.

[2] Christina Kassab, **Matías Mattamala**, Lintong Zhang and Maurice Fallon. May 2024. "Language-EXtended Indoor SLAM (LEXIS): A Versatile System for Real-time Visual Scene Understanding". *IEEE Int. Conf. Robot. Autom. (ICRA).*

[1] Jonas *Frey, **Matías** ***Mattamala**, Nived Chebrolu, Cesar Cadena, Maurice Fallon and Marco Hutter. July 2023. "Fast Traversability Estimation for Wild Visual Navigation". *Robotics: Science and Systems (RSS).*

Presentations

From Industrial Facilities to Forestry Applications: ANYmal Research at the University of Oxford
Institution of Engineering and Technology (IET) (Invited talk by ANYbotics AG), Sep 2024. video, slides

DigiForest: Developing robotic technologies for sustainable forestry
ForestryAI Webinar, Jul 2024. video, slides

Visual Navigation for Legged Robots in Challenging Environments
Qué hacemos en robótica? (Spanish), Universidad de Chile, Chile. Feb 2023.
Técnicas modernas de control y aprendizaje de máquina para robótica y locomoción (Spanish), Universidad Nacional de Colombia, Colombia. Feb 2023. slides
AIMS-WASP Event, University of Oxford, UK. Oct 2022. slides

On physical, algebraic, geometric, and probabilistic descriptions in robotics
RPL Robotics Seminar, University College London, UK. Oct 2021. slides

Visual Navigation for Quadrupedal Robots
Charlas en AI, Robótica, Tecnología y Aplicaciones (Spanish), Universidad de O'Higgins, Chile. Jul 2021. slides
IEEE UPAO Webinar (Spanish), Universidad Privada Antenor Orrego, Perú. Apr 2022. slides

Robot Soccer
Futuristas, el mundo cambia contigo (Spanish), National Congress of Chile, Chile. Nov 2016. slides

Supervision and Co-Supervision

University of Oxford

- Christina Kassab, PhD project (2022 – present). Topic: "Language-Extended Visual SLAM for Real-time Scene Understanding". *Co-supervisor*
- Jianeng Wang, PhD project (2023 – present). Topic: "Leveraging Multi-sensor Modalities to Facilitate 3D Scene Understanding". *Co-supervisor*
- Haedam Oh, 4th Year Project (2023). Topic: "Evaluation and Deployment of LiDAR-based Place Recognition in Dense Forests". *Co-supervisor*
- Leonard Freißmuth, Academic Visitor (2023). Topic: "Online Tree Reconstruction and Forest Inventory on a Mobile Robotic System". *Co-supervisor*

ETH Zürich

- Piotr Libera, Semester Project (2023). Topic: "Semantic Understanding of Outdoor Environments for Navigation". *Co-supervisor*
- Giacomo Manzoni, Semester Project (2022). Topic: "Motion-primitives Planning for Legged Robots". *Co-supervisor*
- Pascal Lieberherr, M.Sc Thesis (2022). Topic: "Local Path Planning in Orchards and Vineyards". *Co-supervisor*
- Timo Schönegg, M.Sc Thesis (2022). Topic: "Global Planning in Orchards and Vineyards". *Co-supervisor*

Universidad de Chile

- Andrés Astudillo, B.Sc Thesis (2020). Topic: "Design and Construction of a Multi-purpose SCARA robot". *Co-supervisor*
- Matías Zamora, B.Sc Thesis (2019). Topic: "IoT-enabled Vermicompost System". *Main supervisor.*

Awards and Grants

Excellence Award (2024). *Department of Engineering Science, University of Oxford.* In recognition of outstanding performance in 2023/2024.

PhD Exchange Fellowship (2022). *NCCR Robotics, Swiss National Science Foundation (SNSF).* 9,000 CHF to partially support research visit at ETH Zurich.

ANID Becas Chile Scholarship (2019 – 2023). *Government of Chile.* Full scholarship (£145,000) for PhD studies at the University of Oxford.

Graduate Students Project Grant (2016). *Universidad de Chile.* £2,500 to implement a Duckietown-based course for second-year engineering students.

Professional Activities

Reviewer

- Autonomous Robots (AuRo)
- Conference on Robot Learning (CoRL)
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Transaction on Robotics (T-RO)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE International Conference on Robotics and Biomimetics (ROBIO)
- International Conference on Advanced Robotics (ICAR)
- Journal of Intelligent and Robotic Systems (JINT)
- Robotics: Science and Systems (RSS)
- Scientific Reports

Workshop Co-organization

- *LocoLearn: From Bioinspired Gait Generation to Active Perception*, Conference on Robot Learning, Munich, Germany (2024). *Co-organizer*
- *Retrospective and Future of World Representations for Lifelong Robotics*, IEEE/RSJ International Conference on Intelligent Robots and Systems, Abu Dhabi, UAE (2024). *Program Committee Member*

Technical Memberships

- British Machine Vision Association (BMVA)
- Computer Vision Foundation (CVF)
- Institute of Electrical and Electronics Engineers (IEEE)

Scientific Advising

- Library of the Congress of Chile (2018–2021). Topic: Impact and State-of-development of Robotics in Chile. *Committee Member*
- Universidad de Chile (2018–2019). Topic: Innovation in Engineering Courses. *Committee Member*

Volunteering

- IEEE/RSJ International Conference on Intelligent Robots and Systems, Madrid, Spain (2018). *Organization support*
- International Symposium on Robotics Research 2017, Puerto Varas, Chile (2017). *Organization support*
- Singularity Summit Chile 2016, Santiago, Chile (2016). *Robotics Mentor*
- V Congress of the Future, National Congress of Chile, Santiago, Chile (2016). *Demonstrator*
- International Conference on Computer Vision, Santiago, Chile (2015). *Organization support*

Technical Skills

- **Languages** Spanish (Native), English (Professional Proficiency).
- **Programming** C++, Python, Arduino, ROS.
- **Development** Git, Docker.
- **Publishing** LaTeX, Inkscape, GIMP, Kdenlive.
- **Other software and technical skills** Fusion 360, 3D printing.

Matías Mattamala

Publications List

Journal Articles

(*equal contribution)

[J7] Michal Staniaszek, Tobit Flatscher, Joseph Rowell, Hanlin Niu, Wenxing Liu, Yang You, Matt Gadd, **Matías Mattamala**, Alex Schutz, Daniele De Martini, Luke Pitt, Robert Skilton, Maurice Fallon and Nick Hawes. Nov. 2024. "AutoInspect: Towards Long-Term Autonomous Industrial Inspection". *IEEE Trans. Field Robotics*. **Invited paper, under review**.

[J6] **Matías Mattamala**, Nived Chebrolu, Jonas Frey, Leonard Freißmuth, Haedam Oh, Benoit Casseau, Jonas Frey, Marco Hutter and Maurice Fallon. Nov. 2024. "Building Forest Inventories with Autonomous Legged Robots — System, Lessons, and Challenges Ahead". *IEEE Trans. Field Robotics*. **Invited paper, under review**.

[J5] Jianeng Wang, **Matías Mattamala**, Christina Kassab, Guillaume Burger, Fabio Elnecave, Lintong Zhang, Marine Petriaux and Maurice Fallon. Nov. 2024. "Exosense: A Vision-Based Scene Understanding System For Exoskeletons". *IEEE Robot. Autom. Lett. (RA-L)*. **Under review**.

[J4] **Matías *Mattamala**, Jonas *Frey, Piotr Libera, Nived Chebrolu, Georg Martius, Cesar Cadena, Marco Hutter and Maurice Fallon. Apr. 2024. "Wild Visual Navigation: Fast Traversability Learning via Pre-Trained Models and Online Self-Supervision". *Autonomous Robots*. **Invited paper, under review**. arXiv: 2404.07110.

[J3] Yiduo Wang, Milad Ramezani, **Matías Mattamala**, Sundara Tejaswi Digumarti and Maurice Fallon. Sept. 2022. "Strategies for Large Scale Elastic and Semantic LiDAR Reconstruction". *Robot. Auton. Syst.*

[J2] Milad Ramezani, **Matías Mattamala** and Maurice Fallon. Apr. 2022. "AEROS: AdaptivE RObust Least-Squares for Graph-Based SLAM". *Frontiers in Robotics and AI*.

[J1] **Matías Mattamala**, Nived Chebrolu and Maurice Fallon. Apr. 2022. "An Efficient Locally Reactive Controller for Safe Navigation in Visual Teach and Repeat Missions". *IEEE Robot. Autom. Lett. (RA-L)*.

Peer-Reviewed Conference Articles

[C19] Haedam Oh, Nived Chebrolu, **Matías Mattamala**, Leonard Freißmuth and Maurice Fallon. Oct. 2024. "Evaluation and Deployment of LiDAR-based Place Recognition in Dense Forests". *IEEE/RSJ Intl. Conf. Intell. Robots Syst. (IROS)*.

[C18] Benoit Casseau, Nived Chebrolu, **Matías Mattamala**, Leonard Freißmuth and Maurice Fallon. Oct. 2024. "Markerless Aerial-Terrestrial Co-Registration of Forest Point Clouds Using a Deformable Pose Graph". *IEEE/RSJ Intl. Conf. Intell. Robots Syst. (IROS)*.

[C17] Leonard Freißmuth, **Matías Mattamala**, Nived Chebrolu, Simon Schaefer, Stefan Leutenegger and Maurice Fallon. Oct. 2024. "Online Tree Reconstruction and Forest Inventory on a Mobile Robotic System". *IEEE/RSJ Intl. Conf. Intell. Robots Syst. (IROS)*.

[C16] Timo Schönegg, Turcan Tuna, Fan Yang, Gabriel Waibel, **Matías Mattamala** and Marco Hutter. July 2024. "Global Path Planning for Autonomous Vehicles in Orchards and Vineyards". *Intl. Work. on Robot Motion and Control (RoMoCo)*. **Best Conference Paper By a Young Author**.

[C15] Christina Kassab, **Matías Mattamala**, Lintong Zhang and Maurice Fallon. May 2024. "Language-EXtended Indoor SLAM (LEXIS): A Versatile System for Real-time Visual Scene Understanding". *IEEE Int. Conf. Robot. Autom. (ICRA)*.

[C14] Chong *Zhang, Jin *Jin, Jonas Frey, Nikita Rudin, **Matías Mattamala**, César Cadena and Marco Hutter. May 2024. "Resilient Legged Local Navigation: Learning to Traverse with Compromised Perception End-to-End". *IEEE Int. Conf. Robot. Autom. (ICRA)*. **Best Cognitive Robotics Paper Finalist**.

[C13] Yifu Tao, Yash Bhalgat, Lanke Frank Tarimo Fu, **Matías Mattamala**, Nived Chebrolu and Maurice Fallon. May 2024. "SiLVR: Scalable Lidar-Visual Reconstruction with Neural Radiance Fields for Robotic Inspection". *IEEE Int. Conf. Robot. Autom. (ICRA)*.

[C12] Meher V. R. Malladi, Tiziano Guadagnino, Luca Lobefaro, **Matías Mattamala**, Holger Griess, Janine Schweier, Nived Chebrolu, Maurice Fallon, Jens Behley and Cyrill Stachniss. May 2024. "Tree Instance Segmentation and Traits Estimation for Forestry Environments Exploiting LiDAR Data Collected by Mobile Robots". *IEEE Int. Conf. Robot. Autom. (ICRA)*.

[C11] Gian Erni, Jonas Frey, Takahiro Miki, **Matías Mattamala** and Marco Hutter. Oct. 2023. "MEM: Multi-Modal Elevation Mapping for Robotics and Learning". *IEEE/RSJ Intl. Conf. Intell. Robots Syst. (IROS)*.

[C10] Jonas *Frey, **Matías *Mattamala**, Nived Chebrolu, Cesar Cadena, Maurice Fallon and Marco Hutter. July 2023. "Fast Traversability Estimation for Wild Visual Navigation". *Robotics: Science and Systems (RSS)*.

[C9] Yiduo Wang, Milad Ramezani, **Matías Mattamala** and Maurice Fallon. Sept. 2021. "Scalable and Elastic LiDAR Reconstruction in Complex Environments Through Spatial Analysis". *European Conference on Mobile Robotics (ECMR)*.

[C8] **Matías Mattamala**, Milad Ramezani, Marco Camurri and Maurice Fallon. May 2021. "Learning Camera Performance Models for Active Multi-Camera Visual Teach and Repeat". *IEEE Int. Conf. Robot. Autom. (ICRA)*.

[C7] Milad Ramezani, Yiduo Wang, Marco Camurri, David Wisth, **Matías Mattamala** and Maurice Fallon. Oct. 2020. "The Newer College Dataset: Handheld LiDAR, Inertial and Vision with Ground Truth". *IEEE/RSJ Intl. Conf. Intell. Robots Syst. (IROS)*.

[C6] **Matías Mattamala**, María José Alfaro, Francisco Casado, Cristóbal Mesías, Gustavo Holmberg, Fernanda Sanchirico, Ramiro Insunza and Loreto Aguirre. 2019b. "Hackers, bandas y squads: Implementación de cursos flexibles para el desarrollo transversal de proyectos en la FCFM". *XXXII Congreso de la Sociedad Chilena de Educación en Ingeniería (SOCHEDI)*.

[C5] Cristopher *Gómez, **Matías *Mattamala**, Tim *Resink and Javier Ruiz-del-Solar. July 2018. "Visual SLAM-Based Localization and Navigation for Service Robots: The Pepper Case". *RoboCup 2018: Robot World Cup XXII*.

[C4] **Matías Mattamala**, Matías Lasen, Rodrigo Chi, Andrés Caba, Miguel Patiño, Javier Larrondo and Viviana Meruane. 2018c. "Beauchef Proyecta: Implementación Curricular de Proyectos Multidisciplinarios". *XXXI Congreso de la Sociedad Chilena de Educación en Ingeniería (SOCHEDI)*.

[C3] **Matías *Mattamala**, Gonzalo *Olave, Clayder González, Nicolás Hasbún and Javier Ruiz-del-Solar. July 2017. "The NAO Backpack: An Open-Hardware Add-on for Fast Software Development with the NAO Robot". *RoboCup 2017: Robot World Cup XXI*.

[C2] **Matías Mattamala**, Gonzalo Olave, Miguel Campusano, Cristopher Gómez, Luz Martínez, Pablo Estefó, Joakin Ugalde, Javier Urrutia, Felipe San Martín, Javier Carrasco, Pablo Villar and Rocío Gonzalez. 2017b. "Aprendizaje Interdisciplinario en Robótica: La Experiencia Innovadora de Duckietown Chile". *XXX Congreso de la Sociedad Chilena de Educación en Ingeniería (SOCHEDI)*.

[C1] **Matías Mattamala**, Constanza Villegas, José Miguel Yáñez, Pablo Cano and Javier Ruiz-del-Solar. July 2015. "A Dynamic and Efficient Active Vision System for Humanoid Soccer Robots". *RoboCup 2015: Robot World Cup XIX*.

Book Chapters

[BC3] Marco Camurri and **Matías Mattamala**. 2025. "Leg Odometry for SLAM". *SLAM Handbook — From Localization and Mapping to Spatial Intelligence*. Ed. by Luca Carlone, Ayoung Kim, Frank Dellaert, Timothy Barfoot and Daniel Cremers. **In preparation**. Cambridge University Press.

[BC2] **Matías Mattamala**. Nov. 2020. "La promesa de los robots en los tiempos del Covid-19: Desafíos y oportunidades para Chile". *La Robótica al Servicio de la Pandemia*. Ed. by Sofiía Calvo Foxley. (Spanish). Chile: Biblioteca del Congreso Nacional de Chile.

[BC1] **Matías Mattamala**. 2019a. "¿Qué es la inteligencia artificial?" *Inteligencia Artificial y Bienestar de las Juventudes en América Latina*. Ed. by Lionel Brossi, Tomás Dodds and Ezequiel Passeron. (Spanish). Chile: LOM Ediciones.

Pre-prints

[P3] Christina Kassab, **Matías Mattamala**, Sacha Morin, Martin Büchner, Abhinav Valada, Liam Paull and Maurice Fallon. Dec. 2024. "The Bare Necessities: Designing Simple, Effective Open-Vocabulary Scene Graphs". **Under review**. arXiv: 2412.01539 [cs.CV].

[P2] **Matías Mattamala**, Nived Chebrolu, Benoit Casseau, Leonard Freißmuth, Jonas Frey, Turcan Tuna, Marco Hutter and Maurice Fallon. May 2024. "Autonomous Forest Inventory with Legged Robots: System Design and Field Deployment". arXiv: 2404.14157.

[P1] Marco Tranzatto, [...], **Matías Mattamala** et al. July 2022. "Team CERBERUS Wins the DARPA Subterranean Challenge: Technical Overview and Lessons Learned". arXiv: 2207.04914.

Other Contributions

[O5] **Matías Mattamala** and Nived Chebrolu. Nov. 2023. *Tutorial on SLAM and factor graphs*. URL: https://github.com/ori-drs/slam_tutorial/ (visited on 31/10/2024).

[O4] **Matías Mattamala**. Oct. 2023. *Designing Graphics for Scientific Publications*. URL: https://github.com/mmattamala/paper-graphics (visited on 31/10/2024).

[O3] **Matías Mattamala**. Feb. 2021. *Reducing the uncertainty about the uncertainties, part 1: Linear and nonlinear*. URL: https://gtsam.org/2021/02/23/uncertainties-part1.html (visited on 16/09/2024).

[O2] **Matías Mattamala**. Feb. 2021. *Reducing the uncertainty about the uncertainties, part 2: Frames and manifolds*. URL: https://gtsam.org/2021/02/23/uncertainties-part2.html (visited on 16/09/2024).

[O1] **Matías Mattamala**. Feb. 2021. *Reducing the uncertainty about the uncertainties, part 3: Adjoints and covariances*. URL: https://gtsam.org/2021/02/23/uncertainties-part3.html (visited on 16/09/2024).