Bernardo Hummes Flores

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Summary

I'm a PhD candidate working on the mathematical foundations of distributed multi-robot systems. My interests lie at the intersection of mathematics and computer science, where logics, topology and category theory shed light on the principles of distributed computing and mobile robotics for guaranteed behavior.

Education

2022 – now **Ph.D.** in computer science at École Polytechnique, France
Formal methods in mobile robotics
In preparation of an European Doctorate.
Advisors: Eric Goubault, Luc Jaulin and Sylvie Putot

2020 – 2022 **Dipl.Ing.** in robotics at École Nationale Supérieure de Techniques Avancées Bretagne, France

2021 – 2022 **M.Sc.** in complex systems at Université d'Angers, France

2017 – 2022 **B.Sc.** in computer science at Universidade Federal do Rio Grande do Sul, Brazil

Experience

08/2024 – 11/2024 **Visiting Researcher** ECS, TU Wien, Austria
Work on a sheaf-theoretic characterization distributed tasks and a temporal epistemic logic formalization of multi-robot tasks.

03/2022 – 09/2022 **Research Intern** LIX, École Polytechnique, France
Work on the solvability of distributed mobile robot tasks.

04/2021 – 08/2021 **Research Intern** Lab-STICC, ENSTA Bretagne, France
Work on a visual localization method for ground robots using interval analysis on environments with tiled floors.

03/2019 – 03/2021 **Research Assistant** Phi Robotics, UFRGS, Brazil
Work on a hybrid interval-probabilistic self-localization method for robots and a visual self-localization method for robots with procedural learning.

03/2018 – 03/2020 **Member** PET Computação, UFRGS, Brazil
Worked on the implementation of deep and reinforcement learning models as a part of a study group on artificial intelligence, oriented by a senior researcher at DeepMind, and the investigation of data-centric information gathered from the institute's students to help solve drop-out ratio.

Publications

Conference proceedings

SIROCCO 2025 **A Sheaf-Theoretic Characterization of Tasks in Distributed Systems** (short paper)
with Stephan Felber and Hugo Rincon Galeana
32nd International Colloquium On Structural Information and Communication Complexity
10.1007/978-3-031-91736-3_26

Journals

Algorithms 2022 **Experimental Validation of Ellipsoidal Techniques for State Estimation in Marine Applications**
with with Andreas Rauh, Yohann Gourret, Katell Lagattu, Luc Jaulin, Johannes Reuter, Stefan Wirtensohn and Patrick Hoher
Algorithms (15)
10.3390/a15050162

IJUFKS 2021 **Robust Hybrid Interval-Probabilistic Approach for the Kidnapped Robot Problem**
with Renata Neuland, Mathias Mantelli, Luc Jaulin, Renan Maffei, Edson Prestes and Mariana Luderitz Kolberg
International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems (29)
10.1142/S0218488521500141

Preprints

2025 **A categorical and logical framework for iterated protocols**
with Eric Goubault, Roman Kniazev, Jeremy Ledent and Sergio Rajsbaum
10.48550/arXiv.2505.10071

2025 **Knowledge in multi-robot systems: an interplay of dynamics, computation and communication**
with Giorgio Cignarale, Stephan Felber, Eric Goubault and Hugo Rincon Galeana
10.48550/arXiv.2501.18309

Teaching

École Polytechnique

2024, 2023 Concurrent and Distributed Computing

2024, 2023, 2022 Introduction to Object Oriented Programming

2024, 2022 Introduction to Algorithms

2023 Advanced Algorithms

2022 Formal Languages

2022 Computer Graphics

Funding

2022 – 2025 **Funding for doctoral project** from Intitut Polytechnique de Paris, France

2020 – 2021 **Scholarship for Undergraduate Research** from CNPq, Brazil

2018 – 2019 **Scholarship for Undergraduate Research** from CAPES, Brazil

Academic Service

Reviewer

2024 SIROCCO 2025

2023 Special issue GETCO 2022 of Journal of Applied and Computational Topology

Organizer

2024 **Doctoral Meeting of LIX**, LIX, École Polytechnique

A seminar for PhD candidates and post-doctoral researchers to share the work done in different areas of computer science within LIX.

2023 – 2025 **Theoretical Cosynus Seminar**, LIX, École Polytechnique

A local seminar for young researchers on theoretical computer science at École Polytechnique.

2023 – 2025 **Proofs and Algorithms Pole Seminar**, LIX, École Polytechnique

A seminar shared across the three teams composing the proofs and algorithms pole of LIX.

Miscellaneous

Programming languages: C, C++, Python, Julia, Rust

Technical skills: Git, GNU/Linux, OpenCV, ROS, NumPy, Pandas, CODAC, Org, LaTeX

Languages: Portuguese, English (fluent), French (advanced) and Italian (beginner)