

Iacopo Catalano

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Research Interests

My research focuses on scene understanding and environment modelling for autonomous robots. I work on representations that let robots reason about space, objects, and dynamics. In particular, I am interested in hierarchical 3D scene graphs that capture both the geometry and the temporal behaviour of an environment. A central thread in my work is bridging perception and prediction: building models that not only describe where things are, but how they move and change over time. Applications include multi-robot coordination, autonomous navigation in dynamic environments, and long-term autonomy.

3D scene graphs · dynamic environment modelling · spatial perception · motion forecasting · SLAM

Education

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| 2020–2022 | Master of Engineering , Toyohashi University of Technology, Toyohashi, Japan.
<i>Completed under the Erasmus Mundus IMLEX programme.</i> |
| 2020–2022 | M.Sc. Optics, Image, Vision, Multimedia (OIVM) , University Jean Monnet, Saint-Étienne, France.
<i>Completed under the Erasmus Mundus IMLEX programme.</i> |
| 2020–2022 | M.Sc. Computer Science (XR specialisation) , University of Eastern Finland, Joensuu, Finland.
<i>Completed under the Erasmus Mundus IMLEX programme.</i> |
| 2010–2018 | B.Sc. Physics , Sapienza University of Rome, Rome, Italy. |

Positions

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| 3/2026–present | Visiting Researcher , Aalto University, Espoo, Finland. <ul style="list-style-type: none">▪ Hosted by Dr. Francesco Verdoja and Prof. Ville Kyrki.▪ 3D scene understanding and dynamic environment modelling. |
| 9/2022–present | Doctoral Candidate , University of Turku, Faculty of Technology, Turku, Finland. <ul style="list-style-type: none">▪ Supervised by Dr. Jorge Peña Queraltá.▪ Research focus: scene understanding, 3D scene graphs, and temporal environment modelling. |
| 3/2025–2/2026 | Visiting Researcher , University of Zaragoza, Spain. <ul style="list-style-type: none">▪ Hosted by Prof. Eduardo Montijano and Prof. Javier Civera.▪ Motion forecasting in dynamic environments and its integration in 3D scene graphs. |
| 8/2024–2/2025 | Research Software Engineer Intern , DAAV. <ul style="list-style-type: none">▪ Autonomous ground robotics: mapping and on-device state estimation.▪ Integration of proprietary and open-source software in C++/Python. |

- 2/2022–8/2022 **Research Intern**, KU Leuven, Belgium.
 ▪ 3D mapping framework for an RGB-D SLAM pipeline (master’s thesis).
- 4/2021–7/2021 **Research Intern**, Laboratoire Hubert Curien, Saint-Étienne, France.
 ▪ Siamese-CNN multi-object tracking for visually similar small electronic parts.
- 2018–2020 **Junior Data Scientist / Front-end Web Developer**, Accenture, Italy.

Grants and Awards

- 2025 **Finnish Cultural Foundation Grant**, Finnish Cultural Foundation.
 Personal working grant supporting scientific work in Finland. PI: applicant.
- 2024 **Researchers Abroad Grant**, Technology and Trade Foundations Research Exchange.
 Walter Ahlström Foundation, Finnish Business Education Fund, Nokia Foundation, KAUTE Foundation.
 International research visit grant.
- 2023 **ENRICH Challenge**, Zwentendorf Nuclear Power Plant, Austria.
 Best drone 3D map and autonomous exploration (drone track)
- 2022 **EMJMD Erasmus Mundus Scholarship (IMLEX)**, European Commission.
 Two-year full scholarship for joint master’s studies across three universities.

Publications

Peer-Reviewed Conference Papers

- [C5] **I. Catalano**, E. Montijano, J. Civera, J. A. Placed, J. Peña-Queralta, “*Aion: Towards Hierarchical 4D Scene Graphs with Temporal Flow Dynamics*,” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2026 [arXiv] [Code]
- [C4] **I. Catalano**, H. Sier, X. Yu, T. Westerlund, J. Peña-Queralta, “*UAV Tracking with Solid-State Lidars: Dynamic Multi-Frequency Scan Integration*,” in *IEEE International Conference on Advanced Robotics (ICAR)*, 2023. [arXiv] [Code]
- [C3] **I. Catalano**, X. Yu, J. Peña-Queralta, “*Towards Robust UAV Tracking in GNSS-Denied Environments: A Multi-LiDAR Multi-UAV Dataset*,” in *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2023. [arXiv] [Dataset]
- [C2] H. Sier, X. Yu, **I. Catalano**, J. Peña-Queralta, Z. Zou, T. Westerlund, “*UAV Tracking with Lidar as a Camera Sensor in GNSS-Denied Environments*,” in *International Conference on Localization and GNSS (ICL-GNSS)*, 2023. [arXiv]
- [C1] **I. Catalano**, J. Peña-Queralta, T. Westerlund, “*Evaluating the Performance of Multi-scan Integration for UAV LiDAR-Based Tracking*,” in *New Developments and Environmental Applications of Drones: Proceedings of FinDrones 2023*, Springer, 2024. [DOI] [arXiv]

Journal Articles

- [J1] C. R. Cueto Zumaya, **I. Catalano**, J. Peña-Queralta, “*Building Better Models: Benchmarking Feature Extraction and Matching for Structure from Motion at Construction Sites*,” *Remote Sensing*, 2024. [Journal]

Preprints

- [P4] **I. Catalano**, F. Verdoja, J. Civera, J. Peña-Queralta, J. A. Placed, “*Rheos: Modelling Continuous Motion Dynamics in Hierarchical 3D Scene Graphs*,” *arXiv preprint*, 2026. [arXiv]
- [P3] **I. Catalano**, D. Morilla-Cabello, J. Peña-Queralta, E. Montijano, “*EgoMod: Predicting Global Maps of Dynamics from Local Egocentric Observations*,” *arXiv preprint*, 2026. [arXiv]

[P2] I. Catalano, C. R. Cueto Zumaya, J. A. Placed, J. Civera, W. M. Bessa, J. Peña-Queralta, “3D Scene Graphs in Robotics: A Unified Representation Bridging Geometry, Semantics, and Action,” *Authorea Preprints*, 2025. [PDF]

[P1] X. Yu, I. Catalano, P. Torrico Morón, S. Salimpour, T. Westerlund, J. Peña-Queralta, “Fusing Odometry, UWB Ranging, and Spatial Detections for Multi-Robot Relative Localization,” *arXiv preprint*, 2024. [arXiv]

Software and Datasets

- **Aion.** Framework for constructing hierarchical 4D scene graphs that couple spatial structure with temporal flow dynamics, letting robots reason about how dynamic environments evolve over time. [Code]
- **Dynamic Scan Tracking.** Real-time UAV tracking pipeline for solid-state LiDARs that adaptively integrates scans at multiple frequencies to stay robust across a target’s changing range and velocity. [Code]
- **Multi-LiDAR Multi-UAV Dataset.** Public benchmark for UAV tracking and relative localization in GNSS-denied environments, with synchronized recordings from multiple LiDARs observing several UAVs and ground-truth trajectories. [Dataset]

Teaching

Fall 2023	Instructor , Introduction to Mobile Robotics, University of Turku.
Spring 2023	Teaching Assistant , Aerial Robotics and Multi-Robot Systems, University of Turku.
Spring 2023	Teaching Assistant , Hardware Acceleration for AI, University of Turku.
Spring 2024	Co-supervisor , master’s thesis of Carlos Cueto Zumaya Title: “Building Better Models: A Benchmark on Feature Extractors and Matchers for Structure from Motion in Construction Sites”, University of Turku.
2010–2015	Private Tutor , mathematics and physics. Tutored 20+ high-school and undergraduate students during university studies.

Professional Service

Reviewer

- IEEE Robotics and Automation Letters (RA-L), 2026.
- IEEE International Conference on Robotics and Automation (ICRA), 2024-2026.
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024-2026.
- IEEE International Conference on Advanced Robotics (ICAR), 2023.
- IEEE International Conference on Robotics and Biomimetics (ROBIO), 2023.

Memberships

- Member, IEEE Robotics and Automation Society (RAS), 2022–present.

Skills and Languages

Programming	Python, C++, ROS, MATLAB
ML / DL	TensorFlow, OpenCV, PyTorch
Languages	Italian (native) · English (C1) · Spanish (B1) · French (A2)

Interests

Long-time member of the scouting movement, with experience in outdoor leadership, team organization, and mentoring younger members.