UNIVERSITÀ DI TRENTO
Dipartimento di Matematica

DOTTORATO

CYCLE 37th
ORAL DEFENCE OF THE PHD THESIS

Friday 25th July 2025 – 10.00 am
Department of Mathematics
Seminars Room - Povo 0
The event will take place in presence and online through the ZOOM platform.
To get the access codes, please contact the secretary office

Giulia Lombardi

PhD Student in Mathematics

Probabilistic Ecosystems Assessment with Reinforcement Learning

Shaping Explainable AI for Marine Biodiversity Monitoring

Abstract:
Preserving marine biodiversity is one of the greatest challenges of our century—crucial to maintaining planetary health under the escalating impacts of climate change. Despite technological advances, monitoring marine ecosystems remains constrained by limited coverage, high operational costs, and the complexity of dynamic and often remote environments. To address this, the PEARL framework has been developed to integrate reinforcement learning with probabilistic assessment for adaptive and explainable biodiversity monitoring using autonomous underwater vehicles (AUVs). At its core lies HexaWorld, a simulation environment based on hexagonal grids, partial observability, and a multi-objective reward function that guides exploration toward ecologically relevant areas while balancing energy efficiency. In parallel, this work introduces novel analytical tools for the systematic treatment of Generalized Gaussian Mixtures (GGMs), expanding the space of probability density functions for modeling complex, multimodal, and irregular data—such as those generated by environmental sensors and machine learning classifiers. Together, these contributions seek to establish the foundation for next-generation biodiversity monitoring systems that combine robustness with explainability, enabling the transformation of raw data streams into actionable ecological insights for guiding conservation strategies and shaping environmental policy.

Supervisor: Luigi Amedeo Bianchi

CONTATTI
Staff di Dipartimento - Matematica
tel. 0461 281508-1625-1701-3786
phd.maths@unitn.it
www.maths.unitn.it