



PhD Course in ROBOTICS AND INTELLIGENT MACHINES

Curriculum: Mobility and Autonomous Vehicles (CODE 11662)

Research Themes

1. RESILIENT SEMANTIC-DRIVEN NAVIGATION FOR MOBILE ROBOTIC PLATFORMS.....3

The main goal of the Mobility and Autonomous Vehicles curriculum is to train scientists and researchers capable of working in multidisciplinary teams on topics related to state-of-the-art solutions for mobility and intelligent vehicles operating on land, water, or in the air. Specific areas of research may include:

1. Development of control algorithms that, starting from sensory data, enable planning and control of vehicle dynamics, including the assignment of vehicles to transport service requests.
2. Development of sensors and sensor data processing algorithms to ensure accurate perception of the vehicle's surrounding environment, both static and dynamic.
3. Integration and coordination of human and artificial intelligence to facilitate coexistence between driverless and human-operated vehicles, as well as between driverless vehicles and other users in shared environments.
4. Development of a regulatory framework addressing objectives to be optimized in emergency situations where a fully harm-free solution for people, animals, or property is not achievable.
5. Study of methods to ensure the safety of the vehicle, its passengers (if any), and people, animals, or property around it, under all conditions.
6. Development of technologies for autonomous freight transport, off-highway vehicles, unmanned vehicles for last-mile delivery, and agricultural applications.

The research theme offered by Italian Institute of Technology (IIT) will be awarded to the top applicants selected for this theme.

Ideal candidates are students holding a Master's degree (or equivalent/higher) in STEM (Science, Technology, Engineering, and Mathematics) disciplines, preferably with a background in Robotics.

Students will conduct their research project at the hosting institution (as described in the research project sheet). Interested applicants are encouraged to contact the tutors and/or the Unit's Principal Investigator (PI) for further information prior to submitting their application.

International applications are welcome, and applicants will receive logistical support with visa processing, relocation, and related matters.

1. Resilient Semantic-Driven Navigation for Mobile Robotic Platforms

Curriculum: Mobility and autonomous vehicles	 ISTITUTO ITALIANO DI TECNOLOGIA
Hosting Institution Istituto Italiano di Tecnologia	
Department: Humanoid and Human Centred Mechatronics Research line (https://hhcm.iit.it/)	
Tutor(s): Dr. Nikos Tsagarakis, nikos.tsagarakis@iit.it	
Description: This PhD research will focus on developing intelligent navigation systems for mobile and legged-wheeled robots capable of operating autonomously in unpredictable, dynamic environments. The goal is to endow robotic platforms with the ability to perceive, understand, and reason about their surroundings using semantic information, while maintaining robustness to environmental and system changes. The project will investigate resilience mechanisms that allow robots to adapt to sensor degradation, terrain variability, and changing conditions through self-assessment, active perception, and context-aware recovery strategies. By integrating semantic mapping, adaptive planning, and learning-based control, the robot will be able to navigate safely and efficiently across challenging terrains, leveraging knowledge about both geometric structure and environmental meaning. The focus will be on hybrid learning architectures that fuse physics-based reasoning with data-driven adaptation, ensuring reliable navigation performance. Real-world experiments will l’be carried out on advanced robotic platforms such as the CONCERT robot and the new CENTAURO quadruped robot at the HHCM Laboratory, validating the approach in realistic scenarios involving terrain changes, human interaction, and long-term operation. The developments within this PhD topic are linked to research projects obtained from the European commicion and industry.	
Requirements: This topic lies in the intersection of Robot model-based control and learning. Ideal applicants should have excellent C++ and Python programming competences. Strong competences in robot control and learning are required while robotic vision skills will a plus. Knowledge of motion planning tools and Robot Operating System (ROS/ROS2) is essential. The applicants should be fluent in English and team players.	
References: 1. Wellhausen, L., & Hutter, M. “Rough Terrain Navigation for Legged Robots Using Reachability Planning and Template Learning.” IEEE/RSJ IROS (2021). 2. Lee, J., Bjelonic, M., Reske, A., Wellhausen, L., Miki, T., & Hutter, M. “Learning Robust Autonomous Navigation and Locomotion for Wheeled-Legged Robots.” Science Robotics (2024).	
Number of positions available:	

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Main Research Site Center for Robotics and Intelligent Systems (CRIS), IIT, Genova
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