



PhD Course in ROBOTICS AND INTELLIGENT MACHINES

Curriculum: Robotics and Intelligent Machines for Mobility and autonomous vehicles

Research themes

1. PERCEPTION, PLANNING, AND CONTROL OF MULTI-ROBOT RESILIENT SYSTEMS WITH AUTONOMY, ADAPTABILITY, ROBUSTNESS, AND SAFETY REQUIREMENTS, WITH APPLICATIONS TO INSPECTION, MAPPING, MONITORING REALISTIC SCENARIOS – UNIVERSITY OF PADOVA..... 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 on land, water or air. Specific areas of research may include:


1. Development of control algorithms to allow, starting from sensory data, to plan and control vehicle dynamics, also in relation to the assignment of vehicles to transport service requests.
2. Development of sensors and sensor data processing algorithms for an accurate perception of the vehicle's surrounding environment, both fixed and dynamic.
3. Integration and coordination of human and artificial intelligence to facilitate coexistence both between driverless and human-guided vehicles, and between driverless vehicles and other users in the shared environment.
4. Development of a reference regulatory framework regarding the objectives to be optimized in emergency situations where the possibility of a complete solution without harm to people, animals or things does not eventually exist.
5. Study of how to ensure the safety of the vehicle, of its passengers (if any) and of the people, animals or things around it, in all conditions.
6. Development of technologies for autonomous freight, off-highway, unmanned vehicles for last-mile delivery and for agriculture.

The ideal candidates are students with a Master (or equivalent/higher) STEM (Science, Technology, Engineering, and Mathematics) degree and possibly a specific background in Robotics.

The students will perform 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 PI for clarifications before submitting their application.

International applications are encouraged and applicants will receive logistic support with visa issues, relocation, etc.

1. Perception, planning, and control of multi-robot resilient systems with autonomy, adaptability, robustness, and safety requirements, with applications to inspection, mapping, monitoring realistic scenarios – University of Padova

<p>Curriculum:</p> <p>Robotics and Intelligent Machines for Mobility and autonomous vehicles</p>	 <p>UNIVERSITÀ DEGLI STUDI DI PADOVA</p>
<p>Hosting Institution:</p> <p>University of Padova</p>	
<p>Department:</p> <p>Department of Information Engineering</p>	
<p>Tutor(s):</p> <p>Prof. Angelo Cenedese Dr.ssa Giulia Michieletto</p>	
<p>Description:</p> <p>The research activity will address the development of approaches for resilient multi-robot systems (MRSs), with applications to inspection, mapping, and monitoring tasks in realistic scenarios.</p> <p>The methodologies will encompass different phases of the MRS operation, namely the perception (of the environment and of the other robots), the planning (of the trajectory to perform a specific task safely and efficiently), the control (of the dynamics to also actively mitigate and compensate for disturbances, unmodeled dynamics, failures). In this sense, the resilience requirement for the MRSs takes the multi-faceted features of autonomy, adaptability, robustness, and safety.</p> <p>In detail, the objective of the PhD is to develop and integrate cutting-edge paradigms and architectures for autonomous aerial and ground vehicles, enabling the design of algorithms for MRSs to operate securely and proficiently in uncertain, unstructured, and dynamic environments. Aiming to effectively combine the unique sensing and actuation capabilities of heterogeneous MRSs, both model-based and data-driven control methodologies and suitable estimation schemes will be considered in hierarchical or parallel architectures with proven feasibility and performance measures.</p> <p>Experimental tests will be conducted to evaluate the performance of the designed solutions in setups simulating the real-world scenarios of interest. These scenarios include outdoor monitoring for urban mobility and environmental surveillance, as well as indoor remote sensing inspection of large-scale facilities potentially dangerous or hazardous. By addressing these diverse situations, the outcomes of the research activity aim to advance and widely disseminate MRS technology across civil, rural, and industrial contexts.</p>	
<p>Requirements:</p> <p>The ideal candidate would have a degree in Control Engineering with a background in Robotics and Computer Science. Applicants are expected to be highly motivated to pursue a PhD program and have strong programming skills (including, e.g. Matlab/Simulink, Python, C/C++), knowledge of embedded systems, simulator tools, middleware for robotics, laboratory experience. In addition, the candidate should possess a genuine interest for</p>	

research and a strong desire to acquire new knowledge and competences, and the attitude to work in group.

References:

- Parker, Lynne E., Daniela Rus, and Gaurav S. Sukhatme. "Multiple mobile robot systems." Springer handbook of robotics (2016): 1335-1384.
- Prorok, Amanda, et al. "Beyond robustness: A taxonomy of approaches towards resilient multi-robot systems." arXiv preprint arXiv:2109.12343 (2021).
- Garg, Kunal, et al. "Learning sage control for multi-robot systems: Methods, verification, and open challenges." Annual Reviews in Control 57 (2024):100984.

Company name and link (for industrial projects):

N.A.

Number of positions available:

1

Main Research Site

Department of Information Engineering, University of Padova

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Fascia 1: 16,500 €/year