

# Curriculum: Inspection and Maintenance of Infrastructure

# **Research Themes**

1.	COORDINATION AND CONTROL OF A TEAM OF UAV – UNIVERSITY OF GENOA
2.	Robotized Underwater Inspection and Maintenance Operations – Università di Genova 4
3.	COMPUTER VISION AND AI APPLICATIONS FOR REMOTE SENSING OF PHOTOVOLTAIC PLANTS –

The main goal of the Robotics and Intelligent Machines for Inspection and Maintenance of Infrastructures curriculum is to train scientists and researchers capable of working in multidisciplinary teams on topics related to state-of-the-art solutions for infrastructure inspection and maintenance tasks. Robotics holds significant potential to drive technological innovation in inspection and maintenance processes by reducing costs, improving service quality, and enhancing safety while minimizing environmental impact.

The inability to adapt existing plants and infrastructures to the capabilities of standard industrial robots—combined with the increasing autonomy of cutting-edge technological solutions—has created favorable conditions for the development of specialized service robotics designed for civil and industrial inspection and maintenance applications.

The research theme offered by the University of Genoa and Wesii S.r.l will be awarded to the top applicants selected for this theme.

Ideal candidates are students with a strong background in robotics and intelligent machines, from various perspectives including control and artificial intelligence. Please consult the individual requirements for each research theme.

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

International applications are welcome, and participants will receive logistical support for visa issues, relocation, and related matters.

# 1. Coordination and control of a team of UAV – University of Genoa

#### **Curriculum:**

Inspection and Maintenance of Infrastructures

#### **Hosting Institution:**

University of Genoa (Università degli Studi di Genova)

#### Department:

DIBRIS, Department of Informatics, Bioengineering, Robotics and Systems Engineering (https://dibris.unige.it/)

#### Tutor(s):

Prof. Marco Baglietto

## Description:

The deployment of multiple Unmanned Aerial Vehicles (UAVs) enables advanced capabilities for tasks such as persistent area monitoring [1], target tracking [2], and environmental surveillance in dynamic and uncertain environments [3]. To achieve these objectives effectively, robust and adaptable formation control strategies are essential, allowing UAVs to maintain desired relative positions while responding to changing mission goals and environmental conditions. These strategies must consider constraints such as limited communication ranges, onboard sensing capabilities, and external disturbances. Moreover, scenarios involving reconfiguration due to agent failures or obstacle avoidance demand decentralized, scalable solutions that ensure reliable performance. Developing such control frameworks remains a critical challenge in cooperative autonomous systems.

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#### **Requirements:**

The ideal candidate would have a degree in Robotics/Mechatronics/Control Engineering/Computer Engineering/Mechanical Engineering. Applicants are expected to have a strong background in Systems Theory, Automatic Control and modelling of UAVs.

#### **References:**

[1] Zhang, M., Wu, X., Li, J., Wang, X., & Shen, L. (2023). Integrated design of cooperative area coverage and target tracking with multi-UAV system. Journal of Intelligent & Robotic Systems, 108(4), 77.

[2] Wang, W., Chen, X., Li, L., & Zhang, M. (2023). Cooperative target search and tracking for multi-UAVs based on control barrier functions. Transactions of the Institute of Measurement and Control, 45(13), 2582-2589.

[3] Yu, B., Fan, S., Cui, W., Xia, K., & Wang, L. (2024). A Multi-UAV cooperative mission planning method based on SA-WOA algorithm for three-dimensional space atmospheric environment detection. Robotica, 42(7), 2243-2280.

Number of positions available:

1

#### Main Research Site

DIBRIS Department, University di Genoa, Via All'Opera Pia,13 - 16145 Genova, Italy.

#### Contacts:

Email: marco.baglietto@unige.it

Funding Scheme: This doctorate grant is funded by the University of Genova.

#### Scholarship Amount:

• Fascia 4: 19,500 €/year

## 2. Robotized Underwater Inspection and Maintenance Operations – Università di Genova

#### **Curriculum:**

Inspection and Maintenance of Infrastructures

#### **Hosting Institution:**

University of Genoa (Università degli Studi di Genova)

#### **Department:**

DIBRIS, Department of Informatics, Bioengineering, Robotics and Systems Engineering (https://dibris.unige.it/)

#### Tutor(s):

Prof. Enrico Simetti

# Description:

The research will target the development of robotic systems capable of performing intervention tasks in challenging and often unstructured underwater environments, with a particular emphasis on inspection and maintenance of submerged infrastructures.

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One of the core research lines is the development of an innovative, electrically actuated manipulator integrated on an underwater vehicle-manipulator system (UVMS), capable of operating in various configurations (free-flying, tethered, autonomous, and remotely operated) [1]. These systems will be employed for complex underwater intervention tasks, such as manipulation of small objects and the execution of repair operations at different depths — from coastal areas to deep-sea environments.

The contributions of the PhD candidate may also be applied to a modular robotic platform composed of an autonomous surface vehicle (ASV) and a tethered ROV equipped with a manipulator [2]. This system is designed for automatic deployment and retrieval and aims to provide a flexible solution for underwater inspection and light-duty maintenance, further expanding the scope and impact of the PhD work.

#### **Requirements:**

Applicants are expected to have strong programming skills (including Python, C/C++), a good background in control systems and software development. ROS2 expertise is a plus.

#### **References:**

- 1. Simetti, E., Casalino, G., Wanderlingh, F., & Aicardi, M. (2018). Task priority control of underwater intervention systems: Theory and applications. Ocean Engineering, 164, 40-54.
- Khanmeh, J., Wanderlingh, F., Indiveri, G., & Simetti, E. (2024, September). Design and control of a cooperative system of an autonomous surface vehicle and a remotely operated vehicle (ASV-ROV). In 2024 20th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications (MESA) (pp. 1-7). IEEE.

#### Number of positions available: 1

#### Main Research Sites

GRAAL laboratory (<u>https://graal.dibris.unige.it/</u>), DIBRIS Department, University of Genoa, Via all'Opera Pia 13, Genova, Italy.

#### Contacts:

Email: Enrico Simetti : <u>enrico.simetti@unige.it</u>

Funding Scheme: This doctorate grant is funded by Università di Genova.

#### Scholarship Amount:

• Fascia 4: 19,500 €/year

## 3. Computer Vision and AI Applications for Remote Sensing of Photovoltaic Plants – Wesii S.r.l., University of Genoa

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#### Curriculum:

Inspection and maintenance of infrastructures

#### **Hosting Institution:**

Wesii S.r.l,

University of Genoa (Università degli Studi di Genova)

#### Department:

Wesii S.r.l R&D Department

DIBRIS, Department of Informatics, Bioengineering, Robotics, and Systems Engineeering

#### Tutor(s):

Dr. Mauro Migliazzi (Wesii), Prof. Luca Oneto (UNIGE)



Remote sensing technologies, empowered by computer vision and artificial intelligence (AI), are revolutionizing the way we monitor, inspect, and optimize photovoltaic (PV) plants. Wesii S.r.l., a global leader in multispectral aerial inspection, is at the forefront of this transformation by integrating information coming from drones, aircrafts, multispectral sensors, satellite data, and proprietary AI/ML algorithms to provide high-accuracy insights for asset management in the renewable energy sector. This PhD project focuses on the development of next-generation vision-based algorithms and analytics for PV plants through advanced advanced image processing, deep learning-based approaches (e.g. SAR image super-resolution), and sensor fusion techniques.

The research will explore how multispectral and thermal imaging data acquired by drones, aircrafts, and satellites can be automatically interpreted to identify mechanical anomalies, monitor thermal behaviour, and assess degradation of PV plants over time.

Scientific activities will be addressed in a high-level industrial application context, as addressed by Terna and Duferco, companies that are partners in Wesii

#### **Requirements:**

Applicants are expected to have strong programming skills in Python. Experience with computer vision frameworks (e.g., OpenCV, PyTorch), a solid background in AI/ML techniques, and familiarity with geospatial data, will be positively evaluated.

#### **References:**

1. Tanda G., Migliazzi M. Infrared thermography monitoring of solar photovoltaic systems: A comparison between UAV and aircraft remote sensing platforms (2024) Thermal Science and Engineering Progress, 48 2. Madeti S.R., Singh S.N. Monitoring system for photovoltaic plants: A review (2017) Renewable and Sustainable Energy Reviews, 67, pp. 1180 - 120

#### Company name and link (for industrial projects):

Wesii S.r.l. (https://www.wesii.com/)

#### Number of positions available:

1

#### Main Research Site

Wesii S.r.l., P.zza Nostra Signora dell'Orto, 8, 16043 Chiavari (GE), Italy.

**Contacts:** 

Email: Mauro Migliazzi: mauro.migliazzi@wesii.com

Funding Scheme: This doctorate grant is funded by Wesii S.r.l.

#### Scholarship Amount:

• Fascia 1: 16,500 €/year