POLITECNICO DI MILANO

PhD in INGEGNERIA ELETTRICA / ELECTRICAL ENGINEERING - 41st cycle

THEMATIC Research Field: DEVELOPMENT OF ELECTROMAGNETIC SENSING AND LEARNING FRAMEWORK FOR NEXT-GENERATION OPTIMIZED MONITORING SYSTEMS - PROGETTO SMARTEYE-CUP B49J25000950005

Monthly net income of PhDscholarship (max 36 months)
1600.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	In recent years, the protection of critical infrastructures has become a matter of growing concern for both public and private institutions. Ensuring the security of such strategic assets requires not only continuous monitoring but also the capability for fast and effective intervention in the case of potential threats. Moreover, the need to reduce the reliance on human personnel in hazardous or complex environments is becoming more urgent, both for economic reasons and for the safety of operators. In this context, the use of autonomous systems such as Unmanned Aerial Vehicles (UAVs), equipped with advanced sensing technologies and intelligent decision-making capabilities, presents a highly promising solution. The main objectives of this PhD project are the following: Design and development of radar and sonar systems for UAV platforms, with the goal of enabling reliable perception and mapping in diverse operational scenarios, including low-visibility conditions; Exploitation and optimization of wireless sensor networks (WSNs) for situational awareness, data fusion, and cooperative surveillance tasks; Integration and application of artificial intelligence techniques, in order to enhance autonomous decision-making, threat detection, and system adaptability in real time. The proposed research aims to contribute to the creation of innovative and robust technological frameworks for autonomous monitoring systems, capable

	of operating efficiently in critical infrastructure protection scenarios. Agevolazione a valere sul D.M. MiSE 31/12/2021 CUP B49J25000950005 - COR: 24363643 SMARTEYE - Prog n. F/310276/03/X56 - WHM4RIST01
Methods and techniques that will be developed and used to carry out the research	To achieve the aforementioned objectives, the PhD candidate will make use of a multidisciplinary set of advanced methodologies, combining both theoretical and applied approaches. In particular, the research will involve: Neural networks and deep learning architectures, for the processing and interpretation of complex data acquired from sensors, including radar and sonar signals, with the aim to enable autonomous recognition and classification of objects and events; Evolutionary optimization algorithms, to support system design choices and improve the performance of sensor deployment, path planning, and signal processing parameters under dynamic and uncertain conditions; Electromagnetic simulations, for the accurate modelling and validation of radar systems and their interaction with the environment, which is fundamental for system integration on UAV platforms; Monitoring systems and control frameworks, to coordinate data acquisition, real-time analysis, and autonomous response across distributed sensor networks and UAV-based platforms. These techniques will be explored both through simulation environments and through experimental activities, possibly in collaboration with industrial or institutional partners involved in infrastructure security.
Educational objectives	The PhD program aims to provide a solid and interdisciplinary education in key areas relevant to modern autonomous monitoring systems and critical infrastructure protection, such as neural networks, sensor systems, electromagnetic simulations, and evolutionary algorithms.
Job opportunities	Successful fulfilment of the research programs associated

	with these Scholarships will provide PhD candidates with the qualifications required to seek employment in diversified industry and university sectors in the EE field, such as Aerospace, Transportation (Automotive, Aeronautics, and Railway), Energy, Environment, etc.
Composition of the research group	4 Full Professors 3 Associated Professors 1 Assistant Professors 10 PhD Students
Name of the research directors	Riccardo Zich

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents	--

Scholarship Increase for a period abroad	
Amount monthly	800.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Increase in the scholarship for stays abroad: euro 800 per month, for up to 6 months. Educational activities:Financial aid per PhD student is available for purchase of study books and material, funding forparticipation in courses, summer schools, workshops and conferences, instrumentations andcomputer, etc. This amount is equal to 10% of the annual gross amount, for 3 years. Teaching assistantship:Availability of funding in recognition of supporting teaching activities by the PhD student. There arevarious forms of financial aid for activities of support to the teaching practice. The PhD student isencouraged to take part in these activities, within the limits allowed by the regulations. Computer availability: individual use. Desk availability: individual use.