POLITECNICO DI MILANO

PhD in FISICA / PHYSICS - 41st cycle

THEMATIC Research Field: MACHINE LEARNING-ENHANCED MINIATURIZED SENSORS FOR ENVIRONMENTAL MONITORING

Monthly net income of PhDscholarship (max 36 months)
1400.0 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	Currently, 2.2 billion people lack access to safe drinking water, and 80% of wastewater is released untreated into the environment. At the same time, emerging and persistent water pollutants such as micro and nanoplastics, perfluoroalkyl substances (PFAS), heavy metals and bacteria, are threatening ecosystems and human health. Urgent global action is needed to address this crisis. Although there are scientific efforts to develop integrated, cost-effective and environmentally sustainable water treatment approaches, these are often fragmented and narrowly focused. The Istituto Italiano di Tecnologia (IIT) aims to address water-related challenges through sustainable, holistic approaches thanks to its multidisciplinary team and integrated research infrastructure. These include, in addition to water remediation, monitoring pollutants and studying their impact on life - from cells to organisms - using expertise in materials science, engineering, devices miniaturisation (lab-on-a-chip) and machine learning. The main objective is innovation, exploiting new knowledge in the development of intelligent devices concepts.http://cnst.iit.it/
Methods and techniques that will be developed and used to carry out the research	This project focuses on the development of a new, sustainable, state-of-the-art sensor platform supported by machine learning methods. The total analysis system purpose is to provide continuous and ultra-sensitive information on environmental parameters and to identify pollutants in aqueous solutions. Using advanced

	computational methods, we intend to boost pollutant detection based on concentration or minimum particle size. The final goal is to develop cost-effective and sustainable sensors with improved analytical performance that can compete with commercial ones.The methodology involves exploiting of photonic analysis capabilities and fabricating of organic field-effect transistors with functionalised gates and biodegradable sensors using eco-friendly conductive ink electrodes. All these sensors will be miniaturised and integrated into a multi-parameter analysis platform using laser-assisted fabrication techniques. This intelligent device network will advance the automation of measurements and on-line data processing after being subjected to rigorous testing to assess its diagnostic potential and environmental sensing capabilities. Machine learning skills will be exploited to improve detection sensitivity, enabling the real-time detection of low concentrations of biomarkers and environmental pollutants.
Educational objectives	The main outcomes will be to strengthen participants' background knowledge in physics, optics, microfluidic, materials engineering and machine learning, while providing them with useful skills and tools for teamwork and problem solving.
Job opportunities	Academic, Research institutes. Sustainability Manager and ESG (Environment, Social, Governance) framework, Engineers, Physics, research or technical managers in high-tech industry: Optics and Photonics, Bio Photonic Companies, Opto-fluidic devices manufacturing, green technology Research and Development, Electronics devices.
Composition of the research group	1 Full Professors 2 Associated Professors 5 Assistant Professors 5 PhD Students
Name of the research directors	L. Criante, S. Decherchi, D. Fragouli, G. Lanzani

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)			
Housing - Foreign Students	**1st year**	**2nd year**	**3rd year**
	1000.0 € per student	1000.0 € per student	1000.0 € per student
	max number of financial aid available: 1, given in order of merit (only for students with scholarship)..		
Housing - Out-of-town residents	**1st year**	**2nd year**	**3rd year**
	500.0 € per student	500.0 € per student	500.0 € per student
	max number of financial aid available: 1, given in order of merit (only for students with scholarship)..		

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Educational activities:Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences). Financial aid per PhD student per 3 years: max 5.707,20 euros per student.

Teaching assistantship:There are various forms of financial aid for activities of support to the teaching practice.The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

Computer and desk availability: individual or shared use computer and desk