POLITECNICO DI MILANO

PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 39th cycle

PNRR 118 PA Research Field: TOWARDS ECOLOGICAL AND DIGITAL TRANSITION IN AGRIVOLTAICS: ARTIFICIAL INTELLIGENCE & SENSING SYSTEMS FOR SMART AGRICULTURE

Monthly net income of PhDscholarship (max 36 months)
€ 1195.5 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	Agrivoltaics is the integration of energy production and crop production and quality in smart farming, hopefully in accordance with landscape design for the countryside. This integration does not look simple, since crops and photovoltaics sometimes have competing requirements in relation to solar radiation. Structural solutions need to be optimized in their shapes and data need to be continuously collected and processed with powerful data analytics methodologies, so that detrimental effects of climate change could be limited. In accordance with DM 118, the goal of the research activity is to provide guidelines and understand how to move towards the digital and ecological transition in this research field, to help public administration understand how to foreseen some of the issues linked to climate change.
Methods and techniques that will be developed and used to carry out the research	Recent events linked to the climate change have caused a huge loss of money in relation to vinery and, more generally, fruit farms. For instance, due to hailstorms and spring frosts it has been reported that, only in 2021 and in Lombardia, around 20M Euros were lost in the revenues linked to local production. Recent hailstorms in northern Italy have also shown how exposed we are to extreme events. Solutions giving benefits in case of such events, in

	events. Solutions giving benefits in case of such events, in accordance e.g. to a structural design which has been filed as a patent by people in the research group, can substantially help in making our agriculture, not only in the Pianura Padana, more resilient against such possible events. By means of Agro-Photovoltaics or Agrivoltaics, the integration of photovoltaic panels in the farms would provide a benefit in terms of decarbonization, as power would be locally produced and made at disposal for a continuous monitoring of the health conditions of the structure carrying the panels and the entire energy production system, and also of the crops, if not to be sold to the network. Since data brought from satellite observations are not time-continuous and might be affected by temporary cloudy conditions at the time they are collected, a local network of sensors, together with agro-hydrological models to monitor the health of plants would provide a means to increase by a large amount the crop production, if possible, or at least the quality and, therefore, the revenues for farmers. In this way, as a side effect in the global situation we are living, we do expect that also irrigation procedures can be improved to make attractive some cultivations currently not remunerative in Italy, so to make our agriculture a bit more independent of the import from other Countries. Overall, an impact to our Country is expected thanks to the decarbonization and green transformation linked to the smart use of a renewable energy. The use of collected information, together with methods of artificial intelligence (like machine and deep learning), will be investigated to lead to a digital platform for decision making that public administration can take advantage of in order to reduce or anticipate the risks related to extreme events.
Educational objectives	Besides the interaction with international researchers in the field and with the public administration, to understand in detail their needs, activities can be classified to have a clear interdisciplinary approach in this project. The PhD student will learn how extreme events and climate change can affect crop production, the response of smart

	structures and the simultaneous energy production in case of photovoltaics is also deployed in the fields.
Job opportunities	Through the possible interaction with companies leader in renewable energies, and with a number of research centres and universities in Europe the research team is already in contact with, job opportunities are going to be at the international level, to possibly build landmarks as policy makers.
Composition of the research group	1 Full Professors 2 Associated Professors 1 Assistant Professors 3 PhD Students
Name of the research directors	Stefano Mariani and Chiara Corbari

Contacts
Stefano Mariani stefano.mariani@polimi.it +39-0223994279 Chiara Corbari chiara.corbari@polimi.it +39-0223996231

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	597.75 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Regione Lombardia, Direzione Generale Agricoltura, Sovranità Alimentare e Foreste - https://www.regione.lombardia.it/wps/portal/istituzionale/HP/istituzione/direzioni-generali/direzione-generale-agricoltura-sovranita-alimentare-e-foreste
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Laboratory of Mechanics Paris-Saclay, CentraleSupélec
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): The Ph.D. course supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year. **Teaching assistanship** (availability of funding in recognition of support to teaching activities by the PhD student): Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undegraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them devoted to teaching and classroom activities and the rest to support classworks and exams. **Computer availability and desk availability**: Each Ph.D. student has his/her own computer for individual use. Each Ph.D. student has his/her own desk, cabinet and locker.