POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 38th cycle

Research Area n. 1 - Advanced Materials and Smart Structures

INTERDISCIPLINARY Research Field: SMART TECHNOLOGIES FOR VERTICAL AND PRECISION FARMING

Monthly net income of PhDscholarship (max 36 months)
€ 1325.0
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	Interdisciplinary PhD Grant The PhD research will be carried out in collaboration with research groups of the PhD programme in "**MATERIALS ENGINEERING**". See https://www.dottorato.polimi.it/?id=422&L=1 for further information. The evolution of engineering disciplines and their implementation in agriculture has led, in recent years, to the development of systems and techniques for food production that could help solve some of the main problems in this sector. In this scenario, the birth of the concepts of vertical and precision farming was favored by the need to find a solution to the problems related to the exploitation of natural resources (soil and water), to have products at km0, to minimize the use of pesticides and to optimize production. However, the development in this sector is far from scientific and lacks a systematic approach that allows to consolidate the methods and techniques, thus favoring a real advancement of knowledge and a real implementation with results capable of justifying the use of these new technologies. The final goal of the research is therefore to formalize the problem associated with vertical farming techniques, propose and develop specific technologies for the sector, optimize

	processes and create a living lab in which experimentation can be carried out for the validation of the defined models.
Methods and techniques that will be developed and used to carry out the research	The methods implemented in the research will be theoretical (numerical and analytical) and experimental. The research will develop along 3 main research lines closely related to each other and which will concern: the design and implementation of a sensorized and automated modular layout for vertical and precision farming; the development and optimization of automation and product handling systems (e.g. soft picking) and control of the environment during the growth phases, also through the development of machine learning algorithms for the analysis of data relating to the conditions of plant growth and their properties; the optimization of substrate and growth support materials (e.g. for the controlled release of H_2O and nutrients). The strong interdependence of the research lines is evident, which will be adequately supported by experimental activities at the basis of the validation procedures of the models created and will allow a robust development of the identified technical solutions. The main result of the PhD activity will consist in the creation of a study platform and a small-scale laboratory in which to test innovative plant cultivation techniques, support the formalization of agronomic techniques for vertical farming and definition of optimal requirements. for plant engineering and materials associated with cultivation.
Educational objectives	PhD graduate will be able to have an interdisciplinary knowledge of technologies and processes related to new paradigms in agriculture, with a focus on automation, robotics for soft picking and new materials.
Job opportunities	Skills and competences in the field are extremely interesting for all the companies involved in vertical farming and new technologies for Agriculture. Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to Master of Science holders in the

	same field.
Composition of the research group	1 Full Professors 2 Associated Professors 4 Assistant Professors 6 PhD Students
Name of the research directors	Prof. Simone Cinquemani, Prof. Luigi De Nardo

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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	662.5 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of 5401,42 euro. Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 662,50 euro/month- net amount). Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. 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.