



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 4 - Telecommunications

PNRR 118 TDA Research Field: **SENSOR PLANTS: PAVING THE WAY TOWARDS A
GREENER AND MORE SUSTAINABLE CITY**

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**

Molecular communication is a bio-inspired communication method where molecules are used for encoding, transmitting, and receiving information, in the same way that living cells communicate by exchanging signals. Plants use different signals to transfer intercellular information. These signals have a significant role in various functionalities. For example, they allow plants to adapt to changes in the environment, grow, and develop in compliance with the surrounding environment. With no option to run away, plants survival builds on their capacity to respond to challenges from their environment. External stress signals such as light, temperature or pressure result in action potentials (AP) electrochemical signals in the leaf cells of plants. AP can trigger the release of information carrying molecules that propagate to the neighboring cells and result in a collective action taken by the plant such as increase or decrease in growth. Potentially, the MC system has a direct impact on this action of the plant in response to external stress. Likewise, on a much larger scale (compared to leaves), the MC phenomena plays an important role in the everyday functions of plants. As vegetation is part of our lives, plants are good candidates to be used as sensors of pollutants or toxic chemicals. Considering this aspect, there is a need to improve the understanding of the



	<p>physical and chemical modifications that occur due to exposure to external agents. It is therefore essential to define and characterize these changes and develop methods to achieve new modalities of detection by using the plant itself as an indicator.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The dissection of processes inside plants requires an interdisciplinary approach that brings together expertise from the fields of plant biology, cellular topology, gene regulatory networks, system modelling, microfluidics. The availability of a functional model can help in answering to critical challenges such as how plants adapt to climate changes or which crop varieties do better under different climate scenarios. Notwithstanding great effort from scientific society on MC, this paradigm is greatly suffering from lack of validated implementation with respect to the advanced theoretical background already investigated. With this PhD research proposal, we aim to develop a first functional model based on ideas from MC to understand the extent at which plants can act as transducers to monitor the concentrations of pollutants in the air, thus providing a local measure of the quality of air. The collection of measured data is the first step to protect clean air in our cities. Researchers have always looked for practical methods that can be used in real case, but no matter how rich the theory behind the work is, there exists demand for experimental validation to guarantee the theory and then apply the system in real scenario. Thanks to this study we aim to fill this gap and get results that include the effect of many hidden effective variables in the process like time, temperature, pollutant type and concentration, etc.</p>
<p>Educational objectives</p>	<p>The research will benefit from the application of information and communication theory to environmental sciences. The aim is to achieve a more in-depth knowledge of the mechanisms underpinning the transport of information in plants to understand how they can act as sensors to measure concentration of pollutants in the air. In particular, MC is seeking to leverage biological phenomena at molecular level such as inter-cell communication and interplay to build models to describe</p>



	transport mechanisms that can be deployed to coordinate sophisticated biological operations such as those happening in the plants. Within this highly multidisciplinary area, disparate islands of research are emerging with little coordination.
Job opportunities	Enterprises that are a part of agricultural supply chains and provide technology to boost agriculture production or cut pollution. Precision agriculture companies.
Composition of the research group	0 Full Professors 3 Associated Professors 3 Assistant Professors 5 PhD Students
Name of the research directors	Maurizio Magarini

Contacts

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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	700.0 €
By number of months	6

National Operational Program for Research and Innovation

Company where the candidate will attend the stage (name and brief description)	Vivent SA
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Vivent SA
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, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student.



TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student 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 AVAILABILITY: individual use.

DESK AVAILABILITY: individual use.