



PhD in CHIMICA INDUSTRIALE E INGEGNERIA

CHIMICA / INDUSTRIAL CHEMISTRY AND CHEMICAL ENGINEERING - 39th cycle

PNRR 117 Research Field: DEVELOPMENT OF SMART SENSING SYSTEMS FOR HOME APPLIANCES BASED ON THE ELECTRONIC NOSE TECHNOLOGY

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

M1. Technology evolution of the electronic nose.
 M2. Missing knowledge of the mixture of volatile compounds emitted in household environment, in particular in the kitchen or within cooking appliances due to cooking processes. Moreover, humans do have different sensitivity to each volatile compound. Final target is to develop a solution for "Odor sensing for domestic appliances" that could be associated to odor abatement and treatment systems inside household appliances (use cases include air purification, clothes treatment, on-need ventilation, assisted and automatic cooking). Working conditions are usually harsh (high and quickly varying humidity, low/high temperature and dirty flows). M3. In any of the use cases, given the industrial nature of the appliances, a robust methodology for calibration and compensation of the electronic nose is a dominant topic. Sensors, in fact, inherently have changing behaviors over time, sensitivity to environmental conditions and a certain dispersion of characteristics device to device. Possible objectives of the research in this field may include:
 O1. Characterize processes and identify dominant compounds and olfactory response for selected use cases.
 O2. Assess influence of environmental conditions to enable robust compensation strategies for selected use



	cases. O3. Development of consumer-centric models, the output of which is correlated with the user's response to odours (or user's experience, eg. of cooked item in case of control of cooking processes). O4. Selection of sensing components with an eye to industrial implementation (in collaboration with company's R&D and purchasing). O5. Calibration transfer techniques for the developed electronic nose to enable 1:n programming of systems embedded in appliances. O6. Compensation techniques for the developed electronic nose to guarantee performances despite variation of environmental conditions and aging of components for selected use cases.
Methods and techniques that will be developed and used to carry out the research	The research will be funded by the company Electrolux. The methods adopted will depend on the use-case to be developed, and may include: • Process/ use case characterization through the identification of VOCs of interest and study of process kinetics, the identification of specific interferents and the study of possible strategies for their compensation, and the study and selection of the sensors and other necessary equipment to be tested • Realization of a preliminary experimental setup for lab-scale testing and the implementation of preliminary classification models • Scale-up of the experimental setup to work in effective operating conditions; this phase may include olfactometric characterization and definition of acceptability thresholds • System training, which may involve a preliminary calibration and development of a classification model on one case, the possible extension of the calibration/ classification model on other cases or interferents, the optimization of the classification model, and the study of drift effects or possible calibration transfer techniques



Educational objectives	The student will increase his/her autonomy in conducting a research project, thereby also interacting with other people from the research team and coordinating the activity of possible Master Degree students. The student will also improve his/her programming skills for developing machine learning algorithms
Job opportunities	Job opportunities may be related to R&D activities mainly – but not only – in the field of chemical sensing. The skills developed during the research activity in the field of machine learning could be applied also to a lot of different sectors including food, biomedical, chemical, pharmaceutical industries, etc.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 3 PhD Students
Name of the research directors	Prof.ssa Laura Capelli

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)	Electrolux
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	da definire
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
Confidentiality (Agreement with company): since this is a thematic scholarship, the



management of Confidential Information, Results and their publication is subordinate to the restrictions agreed upon with the funding company. Upon acceptance of the scholarship, the beneficiary must sign a specific commitment.

Individual budget for research (5.700 euro): 1st year: 1.900 euro; 2nd year: 1.900 euro; 3rd year: 1.900 euro

Teaching assistantship (availability of funding in recognition of supporting teaching activities by the PhD student): there are various forms of financial 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 regulation.