POLITECNICO DI MILANO

PhD in SCIENCE, TECHNOLOGY AND POLICY FOR SUSTAINABLE CHANGE - 39th cycle

THEMATIC Research Field: DEVELOPMENT OF INNOVATIVE METHODS FOR ATMOSPHERIC DIFFUSE EMISSION MONITORING AND MITIGATION

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	Diffuse emissions of greenhouse gases (GHG), Volatile Organic Compounds (VOC) and odours are generally difficult to be monitored and quantified. This difficulty in turn also hinders the development and the application of suitable mitigation strategies. In this context, the study and the development of novel methods for a better monitoring of such emissions would be extremely important in order to control and mitigate environmental impacts. Considering that also the regulations related to environmental monitoring are continuously evolving, such novel methods could set the basis for policymakers to develop new policies for atmospheric pollution control and mitigation of the effects of climate change. For the first 18-24 months, the research activity will be carried out within the framework of the ESCAPE "ENVIRONMENTAL SITES CH4 (METHANE) ASSESSMENT PLATFORM EUROPE" project, funded by the Eureka Eurostars program. ESCAPE final goal is to develop a new cloud-based online platform, combining space-based and ground datasets, including meteorological data, with AI-based solutions and algorithms for spotting emissions and pollution from landfill and brownfield sites. Regarding specifically the objectives of this PhD position, the combination of ground data combined with near real-time micrometeorological data would offer a unique advantage to apply micrometeorological methods for the indirect estimation of heterogeneous extended sources such as landfills/brownfield sites. The application of

	micrometeorological methods with ground data obtained via sensors is an incremental innovation compared with current monitoring techniques. Indeed, sensors can be used to create concentration maps for a specific pollutant but not to measure total emission flux from a site. A method for providing near real-time estimations of gaseous emissions from landfills/brownfield sites would represent an innovation compared to the current state-of-the-art, enabling an unique solution to obtain spatially and temporally distributed information on diffuse/ fugitive emissions. This type of information is essential to identify and apply possible emission mitigation strategies for recovering more landfill gas, reducing environmental and health impacts and thus increasing the sustainability of the involved processes. Moreover, the use of machine and deep learning solutions that are executed directly where data are generated (i.e., the Sensors Toolbox) represents a novel and relevant technological enhancement. In fact, moving the processing (and in particular the intelligence processing) as close as possible to where data are generated, allows to make Sensors Toolboxes autonomous, more energy efficient and increase the security and privacy of the overall monitoring applications. After the end of the ESCAPE project, the research activity will continue exploring the application to other pollutants (e.g., odours) and other emission sources (a.o., waste treatment facilities).
Methods and techniques that will be developed and used to carry out the research	The research will include the following activities: •Sensor survey and selection: The survey will be aimed to the selection of the sensors to be used for the detection and measurement of the gases that are typically emitted from the selected sites at the concentrations of interest. Sensors will be evaluated based on their detection limit, cost, dimensions, energy consumption, reliability and reproducibility, with the purpose of integrating them into a pocket solution providing near real-time information on environmental emissions. The survey will involve the study of the scientific literature as well as the technical documentation on commercially available gas sensors. Specific electrochemical sensors as well as non-specific

	(or partially specific) sensors such as Metal Oxide Semiconductor (MOS) sensors will be included in the survey in order to design the best solution for a low-cost and portable device to be used in ambient air. •Lab calibration and testing: sensor properties in terms of sensitivity, selectivity and repeatability towards target gases/ mixtures will be assessed at different concentrations in controlled conditions. Moreover, the effects of interfering agents such as temperature and humidity will be studied to develop suitable compensation strategies. •Testing in the field: sensor technologies will be tested in the field considering different emitting sites. One of the investigated sites will probably be an operative landfill close to Turin, in Northern Italy. •Sensors data processing and emissions estimate: Sensors responses will be processed exploiting suitable machine and deep learning tools for the purpose of quantifying the concentration of the pollutants under examination (e.g., CH_4, H_2S, odours, etc.). Moreover, the possibility to use concentration values in combination with micrometeorological data for a near real-time, indirect estimation of emissions will be studied. The research activity will also include the evaluation of the possibility to integrate the developed solutions into European environmental policies and regulations.
Educational objectives	The student shall 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 acquire an important knowledge in the field of environmental emission monitoring and improve his/he skills for developing machine and deep learning algorithms on environmental data.
Job opportunities	The specific skills developed during this PhD program, which include a deep knowledge of environmental monitoring issues and related regulations, as well as the

	capability to develop machine and deep learning algorithms, are very much appreciated for all those companies working in the field of providing products or services for the environmental sectors, thereby including (among others): manufacturers and distributors of hardware/ software environmental monitoring tools, consultants, multi-utility companies providing services in the field of waste treatment and energy, environmental agencies.The transversal skills developed during the research activity in the field of machine and deep learning could possibly be applied also to other sectors different from the environmental one, such as biomedical, chemistry, chemical engineering, etc.
Composition of the research group	0 Full Professors 1 Associated Professors 1 Assistant Professors 4 PhD Students
Name of the research directors	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

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

Educational activity: the student may be asked to coordinate the activity of Master?s Degree students

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

Computer and desk availability: the student will be provided with a desk and a computer to carry out his/her research activity

The student will spend time in the lab but also in the field, on landfills and other type of plants. The possession of a driving license is recommended for these activities.