POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

THEMATIC Research Field: HYPERSPECTRAL IMAGING FOR BLACK PLASTICS IDENTIFICATION, SORTING AND RECYCLING

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 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	The increasing use of complex polymeric materials across various industries, such as electronics, packaging and eyewear sectors, has led to significant challenges in managing post-use products. The disposal and recycling of these materials, especially when they come in forms that are hard to differentiate, like black plastics, pose a considerable hurdle for sustainable waste management. This research is driven by the need to address these challenges by exploring advanced methods, such as hyperspectral imaging, to accurately identify and sort different types of polymers. The ultimate goal is to develop efficient processes that allow these materials to be recycled and reintroduced into production cycles, thereby supporting circular economy. By improving the recycling capabilities of complex plastics industry, this research aims to contribute to broader environmental sustainability and reduce the impact of plastic waste.
Methods and techniques that will be developed and used to carry out the research	To carry out the research, several advanced methods and techniques will be developed and employed. Central to this is the use of hyperspectral imaging (HSI) in the mid-wave infrared (MWIR) and short-wave infrared (SWIR) range, a technology that allows for the precise identification of different materials by acquiring their spectral signatures. This technique is particularly effective for polymers that are difficult to classify with conventional methods, such as black plastics. Additionally, advanced algorithms will be developed to enhance the classification

	algorithms will be developed to enhance the classification accuracy and speed, optimizing the process for real-time industrial applications, and exploring the integration of these two camera's ranges. The research will also focus on refining the acquisition of images to balance resolution and processing speed, ensuring the method can be scaled up for continuous, high throughput sorting of polymer waste in industrial recycling processes.
Educational objectives	Acquisition of competences on (i) the development of imaging technologies for automated recycling of complex materials streams, (ii) the development of Artificial Intelligence techniques for hyperspectral data analysis and material identification, (iii) characteristics of black plastics adopted in automotive and electronics, (iv) multi-sensor integration for improved identification and classification.
Job opportunities	Opportunities for jobs in different fields ranging from optical sorting, recycling, manufacturing of polymer-made products and development of digital technologies for circular manufacturing. Potential collaborations with different institutes of the Idea League network, such as TU Delft, with long term experience in circular economy and de-and remanufacturing processes and technologies. Clear link with several SDGs connected with circularity solutions for complex material streams.
Composition of the research group	2 Full Professors 1 Associated Professors 2 Assistant Professors 5 PhD Students
Name of the research directors	Prof. Marcello Colledani

Contacts
For questions about scholarship/support phd-dmec@polimi.it

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)	--

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Scholarship Increase for a period abroad	
Amount monthly	750.0 €
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 euro 6.114,50. 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. 750 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.