POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

THEMATIC Research Field: AUTONOMOUS ROBOTIC SOLUTION FOR EV BATTERY DISASSEMBLY

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	In light of pressing societal issues, such as climate neutrality, industry digitization, and the circular economy, this PhD focuses on enhancing recycling practices for electric vehicle (EV) battery packs. The specific goal is to develop and apply advanced robotics solutions utilizing reinforcement learning (RL) techniques for the autonomous disassembly of EV battery packs. By integrating robotics and machine learning, it will be possible to address the associated critical issues, such as - safety (i.e., ensuring the safety of both the operators and the environment during the disassembly process) - efficiency (i.e., maximizing the speed and effectiveness of the disassembly process) - complexity (i.e., EV battery packs are composed of multiple components that are tightly integrated, making the disassembly process intricate and challenging) - sustainability (i.e. promoting sustainable practices during the disassembly process)
Methods and techniques that will be developed and used to carry out the research	The candidate will start the research by delving into robotics and machine learning algorithms. On the one side, currently developed robotic systems for disassembly (especially targeting the automotive sector) will be analyzed. On the other hand, machine learning approaches for robotic task learning and generalization will be analyzed. This phase will serve as a first step to understanding what's already available in the considered domain before designing ad hoc methodologies. Drawing

	domain before designing ad hoc methodologies. Drawing upon existing studies and software (e.g., robotic simulation environments such as Isaac Gym), the candidate will devise strategies and codes to tackle the aforementioned challenges effectively. Then, the candidate will develop learning (e.g., RL and generative AI) and sim2real - real2sim algorithms to address the target disassembly task. Finally, experimental tests will be performed to evaluate the performance of the robotic system in the proposed context. This work will partially include activities within the AUTOMAT project, a Horizon EU-funded project with international partners (both academic and industrial partners).
Educational objectives	The PhD candidate is expected to develop solid competencies in robotics and machine learning (especially considering RL and generative AI). The candidate is also expected to acquire competencies in nonlinear dynamics, multi-physical modelling, and optimization algorithms. Contextually, strong coding skills in Matlab/Python/C++ will be gained.
Job opportunities	Job opportunities span various disciplines such as engineering, sustainability, materials science, and project management, offering diverse career paths for individuals interested in advancing sustainable practices in the field of electric vehicle technology. Some partner universities are: Technical University of Munich (TUM) - Germany, University of Oxford - UK, and ETH Zurich - Switzerland.
Composition of the research group	1 Full Professors 0 Associated Professors 1 Assistant Professors 2 PhD Students
Name of the research directors	Prof. Francesco Braghin

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	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.