



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

**PNRR 630 Research Field: INTELLIGENT IN LINE RECOGNITION OF PROCESS DEFECTS IN
WELDING PROCESSES FOR OIL AND GAS APPLICATIONS**

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	
<p>Motivation and objectives of the research in this field</p>	<p>Welding processes are fundamental today for the production of large components in the oil and gas industry, especially those made from high-temperature resistant alloys. These alloys are carefully chosen for their composition and subsequent treatments, offering a good balance between processability and the expected performance. Among these welding processes are traditional arc methods, which have seen significant innovations in recent years, and laser processes, which are inherently more automatable and digital. Given this context, there is a strong motivation to develop in-line sensing and measurement methods to assess the quality of welding processes. Such methods would enable the reconstruction of weld quality and the detection of defects, leading to actions that could include both recognition/certification and correction/repairing. Through the digitalization of welding processes and the identification of defects using non-destructive and in-line methods, the goal is to reduce the defect rate in assembly processes. This approach aims to increase the sustainability of the entire production cycle of components, ensuring higher reliability and performance in critical industrial applications.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research will focus on implementing advanced in-line sensing and measuring techniques for laser and arc welding processes within automatic and flexible welding systems. This will involve the integration of cutting-edge</p>



	<p>systems. This will involve the integration of cutting-edge solutions to monitor and control the welding processes in real time. To achieve these objectives, experimental analysis and in-process diagnostics will be conducted using high-speed imaging and coaxial imaging methods. These techniques will provide detailed insights into the welding process, enabling precise characterization of the welds and validation of the developed models. Additionally, inline monitoring of weld quality will be performed using multiple advanced sensors. The data collected from these sensors will be utilized to create a comprehensive process feasibility database. This database will facilitate optimal parameter selection and improve the accuracy of quality predictions, ensuring high reliability and performance in welding applications.</p>
<p>Educational objectives</p>	<p>We provide doctoral candidates with high-level scientific training, fostering and refining research and problem solving abilities by focusing on both theoretical and experimental skills. A PhD in Mechanical Engineering will be able to layout, draft and carry on original research, by leading a research group or working in a team.</p>
<p>Job opportunities</p>	<p>Expertise in laser and arc welding processes, in line sensing and monitoring methods for defects identification, machine-learning and process related AI methods certainly makes the PhD candidates very appealing for a wide range of high-end positions. These range from the more oriented to sensing and non-destructive testing methods to those more related to the laser and arc welding processes.</p> <p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field. Employment statistics of PhDs can be found at:</p> <p>https://cm.careerservice.polimi.it/en/employment-statistics/ .</p> <p>List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research: Nuovo Pignone Baker Hughes, Technical University of Munich</p>



Composition of the research group	4 Full Professors 4 Associated Professors 4 Assistant Professors 15 PhD Students
Name of the research directors	prof. B.Previtali, B.Colosimo, A.Matta, G.Moroni

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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	Nuovo Pignone Tecnologie S.r.l.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	Technical University of Munich
By number of months abroad	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. 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.	