



# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

**THEMATIC Research Field: DEFECT-FREE ROBOTIC REMOTE LASER WELDING WITH  
NOVEL TEMPORAL AND SPATIAL LASER BEAM SHAPING APPROACHES**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1400.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<p><b>Motivation and objectives of the research in this field</b></p>	<p>Laser welding has demonstrated its capacity to generate high quality seams for highly demanding applications such as aerospace, aviation, automotive, and e-mobility. Both remote and proximity welding operations have been applied to robotic and cartesian systems seam types such as butt, lap and t-joint. The processed materials, thicknesses, joint configurations, and gaps can vary within the operation of a flexible welding system. This rises the necessity to control energy input both in spatial and temporal domains. Laser beam shaping with high brilliance solid state fiber lasers is a key ability that allows to form the power distribution of the beam with optical and electronical control means. The use of unconventional beam shapes such (eg. ring, flat-top, combined Gaussians), as well as beam oscillations on demand allow new parameter spaces to be explored and used. The PhD project is developed together with the BLM Group, leader in tube machinery and laser-based machine tools. The project aims to study the novel beam shaping solutions in a remote welding configuration to have a greater control over the heat input during the welding operations. The candidate will use high-end monitoring devices such as low coherence tomography to investigate the weld quality inline.</p>
<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>1. Implementation of in-source beam shaping solutions and the dedicated scanner in a flexible robotic laser</p>



	<p>welding system. Beam temporal and spatial characterization.</p> <p>2. Experimental analysis and in-process diagnostics with high speed imaging, and coaxial imaging methods. Characterization of the welds and model validation.</p> <p>3. Inline monitoring of the weld quality via multiple sensors through the use of low coherence tomography. The use of monitoring data to generate process feasibility database and parameter selection.</p>
<b>Educational objectives</b>	<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>
<b>Job opportunities</b>	<p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to Master of Science holders in the same field.</p> <p>List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research: BLM Group (<a href="http://www.blmgroup.com">www.blmgroup.com</a>), TU Munich, University of Stuttgart, ENSAM Paris, LUT.</p>
<b>Composition of the research group</b>	<p>1 Full Professors                  1 Associated Professors                  1 Assistant Professors                  5 PhD Students</p>
<b>Name of the research directors</b>	<p>Prof. Ali Gokhan Demir</p>

<b>Contacts</b>	
<p>Prof. Ali Gökhan Demir <i>Phone:</i> 02 23998590 <i>E-mail:</i> <a href="mailto:aligokhan.demir@polimi.it">aligokhan.demir@polimi.it</a></p> <p><a href="https://www.mecc.polimi.it/ricerca/sezioni/tecnologie-meccaniche-e-produzione/">https://www.mecc.polimi.it/ricerca/sezioni/tecnologie-meccaniche-e-produzione/</a></p> <p>For questions about scholarship/support, please contact <a href="mailto:phd-dmec@polimi.it">phd-dmec@polimi.it</a>.</p>	



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
<p>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 5.707,13.</p> <p>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. 700 euro/month- net amount).</p> <p>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.</p>