POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

THEMATIC Research Field: ADVANCED, SMART, AND SUSTAINABLE MANUFACTURING

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 fourth industrial revolution (namely Industry 4.0) and European starting plans (Horizon and NextGenerationEU), with their strategic orientations for EU research and innovation, calls for accelerating the twin (i.e., green and digital) transition. A paradigm shift to address various challenges including digital production, big data analysis and artificial intelligence, global production sustainability and circular economy, climate changes and smart cities is required. In this framework, advanced, smart, and sustainable manufacturing processes and systems act as key enabling technologies for providing high-precision, high-value, and high-performance custom-designed components at minimum waste.The research activity carried out with this scholarship can specifically focus on one or more subtopics within these main research frameworks: • *Advanced manufacturing processes:* Among others, additive manufacturing for metals, ceramics, and polymers, micromachining, laser, and waterjet-based technologies are the available technological platform where production digitalisation and self-consciousness can be pursued. Research at this level can concern new process development as well as innovative hybrid solutions conception. • *Smart process monitoring, inspection, and control:* Smart solutions for sensing and inspection and innovative strategies for intelligent data fusion, big data

	analysis, quality process monitoring, control and inspection are key factors to achieve sustainable zero-defect manufacturing. • *Advanced manufacturing systems:* Innovative solutions for configuring and managing manufacturing and de-manufacturing systems are eventually needed to drive the whole production system toward smart, high-performance, and sustainable solutions.
Methods and techniques that will be developed and used to carry out the research	Rigorous experimental methods, physical models, and numerical simulations will be combined to design, implement, and validate the innovative solutions proposed. Team-working will be stimulated with the aim of providing appropriate solutions to actual challenges, which require multidisciplinary skills.
Educational objectives	Doctoral candidates will acquire competences on design, optimisation, and sensing/controlling of new advanced manufacturing processes and systems.
Job opportunities	Italy and Lombardy Region have leading positions in manufacturing worldwide. 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. List of Universities, Companies, Agencies and/or Nationalor International Institutions that are cooperating in the research: MIT - Massachusetts Institute of Technology, TUM - Technical University of Munich, ESA - European Space Agency, Shanghai Jiao Tong University, Georgia Tech University, STIIMA-CNR – www.stiima.cnr.it, ATV S.p.A., Ansaldo Energia S.p.A., Avio Aero, BLM Group, GE Avio s.r.l., Leonardo – AgustaWestland S.p.A., Lima Corporate, Marposs S.p.A., Prima Industrie S.p.A., Tenova S.p.A.
Composition of the research group	4 Full Professors 4 Associated Professors 6 Assistant Professors 30 PhD Students
Name of the research directors	proff. Colosimo, Matta, Moroni, Previtali

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)	--

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.

POLITECNICO DI MILANO

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	
Motivation and objectives of the research in this field	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.
Methods and techniques that will be developed and used to carry out the research	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

	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.
Educational objectives	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.
Job opportunities	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. 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: https://cm.careerservice.polimi.it/en/employment-statistics/ . 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

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

Contacts
Phone +39 02 2399 8530 Email : barbara.previtali@polimi.it https://www.mecc.polimi.it/ricerca/sezioni/tecnologie-meccaniche-e-produzione/ 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)	--

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.

POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

PNRR 630 Research Field: ROBOT-AIDED ADVANCED MANUFACTURING PROCESSES FOR THE CONSTRUCTION AND FURNITURE SECTOR

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 retail and luxury sectors often face complete renovation of the stores and their furniture. A fundamental component of the restoration activities is the realization of metallic structures both for structural and aesthetic purposes. From this point of view there is a great interest in developing novel approaches which reduce the environmental impact of such activities alongside increasing the efficiency and productivity of the production methods.The research activities conducted during the PhD research will enable the development of advanced manufacturing processes for the joining and finishing of metallic components exploiting low impact technologies on the environment (ranging from arc to laser welding as well as innovative finishing techniques). Moreover, the research will involve the integration of digital models and robotic approaches to support the digitalization of the manufacturing techniques. The research will assess alternative approaches to perform joints in metallic materials in order to guarantee appropriate mechanical properties whilst exploring materials with higher recyclability materials (such as Al-alloys). Moreover, the use of ecological finishing methods of the manufactured components will be explored in order to assess alternative solutions to current electroplating methods.
Methods and techniques that will be developed and used to carry out the research	Within the framework of the present research, novel approaches for the welding of structural and aesthetic components will be developed. The research will be

	components will be developed. The research will be conducted employing both robotised arc and laser welding systems. Researchers involved are required to design, develop and implement technological solutions to improve the current manufacturing methods. The research activities will require characterization of the joint in terms of both metallography as well as mechanical characteristics. Moreover, with regards to finishing processes novel approaches will assessed as opposed to current electroplating techniques. Materials will also need to be characterised in terms of the surface quality and aesthetic appearance.
Educational objectives	The PhD candidate is expected to develop high level technical skills in the field of research previously mentioned. The candidate will need to operate independently both manufacturing and materials characterization equipment. Design of experiments techniques will be developed to conduct empirical investigations and assess their results. Moreover, the candidate will develop scientific communication skills by participating at international conferences and writing papers for peer reviewed journals. The researcher may also be involved in teaching activities further developing a strong scientific profile apt for a career both in the research and development field as well as in the university.
Job opportunities	Employment statistics of PhDs can be found at: https://cm.careerservice.polimi.it/en/employment-statistics/ . Within this research activity, the candidate will collaborate with Sice Previt, one of the leader companies in providing high-end solutions for the realisation of furniture shops for the retail and luxury sectors. Research activities will also be conducted in collaboration with the Technical University of Munich and the University of Stuttgart.
Composition of the research group	4 Full Professors 4 Associated Professors 4 Assistant Professors 15 PhD Students
Name of the research directors	proff. 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)	Sice Previt S.p.A.
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/University of Stuttgart
By number of months abroad	6

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