



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

**PNRR 118 INTERDISC Research Field: BIOINSPIRED AND FLEXIBLE COLLABORATIVE
ROBOTICS**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

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

One of the main objectives of the Italian plan for recovery and resilience (PNRR) is the address of the health of the society (PNRR-Mission 6). Overall, the National Health Service (SSN) has adequate health outcomes, a high life expectancy at birth, even though health expenditure on GDP is lower than the EU average. However, lower back pain and musculoskeletal injuries are serious concerns for workers subjected to physical workload and manual material handling tasks. Spine assistive exoskeletons are being developed to support the spine and distribute the spine load. Back support exoskeletons have the potential to significantly minimize the underlying causes that lead to work-related musculoskeletal pathologies. The real effect on potentially preventing back injury occurrence, has yet to be evaluated, as till today substantial technical challenges and inadequate safety standards hinder the large-scale implementation in workplaces. A major technical challenge is to develop a solution with an intermediate level of assistance that can represent an optimal response allowing, at the same time, a better fit (and comfort and acceptability) and reliability in the delivery of assistive forces.

The objective of this project is to develop and pilot test in a relevant environment a platform to assist the low-back in work environment facing the following challenges: i) providing good back support in terms of physical load reduction at muscles and skeletal levels during static or dynamic conditions; ii) not hindering non assisted



	<p>joints/degree of freedom; iii) optimizing the kinematic compatibility, ergonomics and safety of the solution; iv) including an intelligent layer able to adapt to the environment and to monitor the good health of the worker.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The achievement of the proposed objectives is based on the integration of four methodologies.</p> <p>T1) Mechatronic design. The project aims to investigate new bioinspired design paradigms of exoskeletons based on anisotropic or orthotropic models of flexible structures assuming a mechanical compliance, optimized on biomechanical models of human indications.</p> <p>T2) Control. The project aims to integrate the measurement of man-machine interaction "inside" the flexible element, considered as a continuous mechanical system, for example by measuring the deformation of one or more portions of it to make the interaction as natural as possible.</p> <p>T3) Modular anthropomorphic design of the structure and of the anchoring system to the body. Analysis of human and system needs to proceed with the definition of a set of "design for wearability" guidelines and development of the system in accordance.</p> <p>T4) Monitoring tool. Development of models to monitor and detect potential hazardous situations for the worker.</p>
<p>Educational objectives</p>	<p>PhD graduate will be able to have an interdisciplinary knowledge of technologies and processes related to new paradigms in human assistance and empowerment. The proposal is part of the university's multidisciplinary initiatives and contributes in particular to SDG3 (Good Health). The project intends to integrate the skills for the prevention and/or mitigation of work-related musculoskeletal pathologies thanks to supportive solutions.</p>
<p>Job opportunities</p>	<p>Skills and competences in the field are extremely interesting for all the companies, rehabilitation centres, and regulatory institutions involved in the prevention and assistance of muscle-skeletal work-related disorders.</p> <p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35%</p>



	higher salary, compared to Master of Science holders in the same field.
Composition of the research group	2 Full Professors 0 Associated Professors 1 Assistant Professors 0 PhD Students
Name of the research directors	Eng. Marta Gandolla, Proff. Braghin, Andreoni

Contacts	
<p><i>Email:</i> marta.gandolla@polimi.it; francesco.braghin@polimi.it;</p> <p>For questions on scholarship/support, please contact phd-dmec@polimi.it.</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

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	
By number of months at the company	0
Institution or company where the candidate will spend the period abroad (name and brief description)	ETH Zürich
By number of months abroad	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>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>