



PhD in BIOINGEGNERIA / BIOENGINEERING - 38th cycle

THEMATIC Research Field: BIO-INSPIRED DESIGN AND SMART CONTROL OF A LOWER LIMB SOFT EXOSKELETON

Monthly net income of PhDscholarship (max 36 months)

€ 1250.0

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

Exoskeletons are currently used in different domain applications, including military, industrial and medical. One of the main prominent applications are in rehabilitation tasks. However, rehabilitation exoskeletons are mostly used exclusively inside the clinics and are rarely used in activities of daily living. One of the main reasons is the usability and wearability of the classical hard exoskeletons. Soft exoskeletons have a good potential to be used in daily live activities by people with mobility impairments. At the XoLab group, within the department of Advanced Robotics, we coordinated the XoSoft EU project (www.xosoft.eu) where we developed a soft modular lower limb exoskeleton for the assistance of people with mobility problems. This PhD will continue this research, with focus on the improvement of the actuator arrangement following bio-inspired concepts, as well as the implementation of novel smart control systems that can adapt to the user's conditions in real-time. Thus, the work will include the study of lower limb musculoskeletal biological structures, neural network algorithms for the smart control system, development of the required system improvements and laboratory testing with healthy subjects. Collaborations with external clinical partners are expected for the definition of the requirements, for the clinical



	assessment of the results and for the final validation of the system with the target patient group (to be defined during the course of the PhD).
Methods and techniques that will be developed and used to carry out the research	<p>This PhD will involve research in different areas:</p> <ol style="list-style-type: none"> 1) Biomechanics 2) Mechatronics 3) Actuation and control 4) Machine Learning 5) Testing and validation <p>The prototypes will be tested on healthy subjects under an already approved experimental protocol. Testing with patients will be subject to collaborations with external centers.</p>
Educational objectives	<ul style="list-style-type: none"> - Learning to organize and manage a research project - Mechatronics, programming, robot control, data analysis - Team-work capabilities - Student supervision and mentoring - Public speaking and outreach activities
Job opportunities	<p>Academia (in Italy or abroad)</p> <p>Research centers</p> <p>Hospitals: rehabilitation</p> <p>Industry: robotics, wearable devices</p>
Composition of the research group	<p>1 Full Professors</p> <p>1 Associated Professors</p> <p>3 Assistant Professors</p> <p>15 PhD Students</p>
Name of the research directors	PROF. ELENA DE MOMI PROF. DARWIN G. CALDWELL (IIT)

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	625.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: funding for participation in courses, summer schools, workshops and conferences.</p> <p>Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD student.</p> <p>There are various forms of financial of 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 regulation.</p> <p>A desk and a PC will be given to the student for the time needed to carry out research, with accesso to HPC resources (internal and external, e.g., from CINECA).</p>