



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 37th cycle

Research Area n. 3 - Engineering Design and Manufacturing for the Industry of the Future

**THEMATIC Research Field: DESIGN AND FABRICATION OF BIOMIMETIC ROBOTS FOR
ENVIRONMENT EXPLORATION**

Monthly net income of PhDscholarship (max 36 months)

€ 1325.0

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**

Evolution has brought to the development of living organisms with extraordinary structural, embodied intelligence. Soft robotics has brought novel approaches for the design of biomimetic artifacts able to mimic the natural compliance and adaptation of bodies and behaviors of such living beings. On the other side, additive manufacturing technologies offer transformative approaches for the design of articulated and integrated solutions. This research aims at developing novel actuations and mechanisms for robotic systems by merging classic approaches with additive manufacturing and the creative designs offered by Nature. Several biological models can be investigated to develop artificial systems with high dexterity for the accomplishment of complex tasks in unstructured environments. In particular, plants and soft invertebrates will be the focus of such research. Due to their high plasticity, plants provide extraordinary examples of embodied intelligence and computation of the mechanics distributed on the whole extended body (e.g., climbing plants). These characteristics are achieved thanks to tissue organization and specialization, with integrated sensing and actuation. Soft invertebrates (e.g., octopus) have a soft body that can bend, elongate, and squeeze to adapt to complex environments. In summary, the expected work spans from



	biological investigation to design, fabrication, and characterization of the artificial counterpart. The expected outputs are patents and publications in high impact journals on the field.
Methods and techniques that will be developed and used to carry out the research	The research will be developed on 3 main topics:- the study of biological models based on the interaction of soft structures (animals and plants) and the surrounding environment, with particular focus on handling and locomotion in unstructured environments;- the realization of models useful for understanding the mechanisms underlying the functioning of such living beings;- the integrated design of bio-inspired soft robotic systems capable of performing complex tasks;The strong interdependence of the three research lines will be supported by experimental activities.The research will be carried out together with IIT Bioinspired Soft Robotics Lab. Activities will take place both in the laboratories of PoliMI and in the IIT facilities in Genoa.
Educational objectives	PhD graduate will be able to: - critically observe the functionalities of living beings capable of carrying out a complex task in an optimized way- develop the design of a robot taking inspiration from Nature- develop models capable of replicating the operating principles behind the ability of living beings to perform complex tasks and exploit them to increase knowledge on such mechanisms - manage the realization and development of a prototype both regarding the mechanical part and the control.
Job opportunities	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.
Composition of the research group	0 Full Professors 3 Associated Professors 0 Assistant Professors 10 PhD Students
Name of the research directors	Prof. Simone Cinquemani, Dr. Barbara Mazzolai

Contacts

simone.cinquemani@polimi.it; barbara.mazzolai@iit.it; 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	564.01 €
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): 2nd year: 1.534 euros 3rd year: 1.534 euros. Accommodation in Politecnico's Residences (http://www.residenze.polimi.it) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application). 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. 550 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.</p>