



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

**THEMATIC Research Field: COORDINATED CONTROL OF AUTONOMOUS UNDERWATER
VEHICLES THROUGH COMMUNICATION SYSTEMS**

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**

Autonomous underwater vehicles (AUVs) play a crucial role in various fields, such as research, exploration, environmental monitoring, search & rescue, infrastructure inspection, and surveillance since they can carry out tasks in a very dangerous environment without human intervention. One of the main challenges in AUV design is the development of reliable wireless communication systems, which are fundamental for remote control and operation, data transfer and telemetry, or coordination with other AUVs. The underwater environment scatters and absorbs radio waves. Thus, other technologies are employed for communications. In particular, acoustic waves are used for long-range signal transmission although suffering from limited bandwidth and ambient noise. On the other side, optical communication offers higher bandwidth but is more sensitive to water turbidity and attenuation, limiting its effective range. Therefore, it is of fundamental importance to improve the current underwater communication technologies to enhance AUV effectiveness and enable autonomous operations in challenging underwater environments. Once done, complex coordinated control strategies of AUVs can be developed and tested.

**Methods and techniques that will be
developed and used to carry out the
research**

The research will be carried out both numerically and experimentally. The AUVs will be equipped with sonars, cameras, lasers, LEDs, and other navigation sensors. Experiments will be carried out in a dedicated swimming



	Experiments will be carried out in a dedicated swimming pool equipped with arrays of speakers and microphones and then brought to open waters for assessing performance in a real environment.
Educational objectives	The PhD student will gain interdisciplinary knowledge of technologies and processes related to AUVs.
Job opportunities	Skills and competences in the field are extremely interesting for all the companies involved in the underwater world. 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.
Composition of the research group	1 Full Professors 0 Associated Professors 0 Assistant Professors 0 PhD Students
Name of the research directors	Prof. Francesco Braghin

Contacts
<p><i>Email:</i> francesco.braghin@polimi.it</p> <p>For questions about 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

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 5.707,13.



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).

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.