



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

THEMATIC Research Field: ACTIVE ACOUSTIC INVISIBILITY CLOAK THROUGH ROBOTIC SWARMS

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

Cloaking refers to the possibility of achieving perfect concealment of objects with respect to incident radiation. Acoustic cloaking can be obtained steering the speed of sound around an object. This requires an anisotropic layer around the object to be concealed. Usually, this anisotropic layer is not available in nature and must be obtained by the engineering of its microstructure. Currently, most approaches rely on passive or active layers of (meta)materials covering the object to protect. However, the latter usually suffer from limitations due to the size and weight of the cloak itself and due to the loss of performances when exposed to different incidence angles. The aim of this project is to overcome these issues following a new paradigm: steering the incident waves using a field of controllable agents, that is a robotic swarm that can be controlled and reconfigured to adjust the stiffness/density distribution around the object to conceal. Besides the theoretical aspects of this research project, the candidate will have the opportunity to build and test the developed control logics on an underwater swarm in the instrumented pool of our laboratory.

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

As anticipated above, the candidate will use and develop its routines to implement the control logics to be deployed on the robotic swarm. Thus, the basics of robotics and microcontrollers for embedded systems will be required to control the swarm.



Educational objectives	This research topic involves both cutting-edge technology development and the use of state-of-the-art control techniques that are becoming ever more relevant in the industry, with applications going from search and rescue operations to underwater pipeline inspection. As such, this PhD project is perfectly suited for candidates pursuing either an academic or an industrial career.
Job opportunities	Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary as compared to Master of Science holders in the same field.
Composition of the research group	1 Full Professors 3 Associated Professors 0 Assistant Professors 4 PhD Students
Name of the research directors	Prof. Francesco Braghin

Contacts
<p><i>Phone:</i> (02 2399) 8306 <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
<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>Our candidates are strongly encouraged to spend a research period abroad, joining high-level</p>



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.