

# Politecnico di Milano

## PhD in Bioengineering

**Research Title: (Artificial Intelligence for Control Sharing in Mixed Human-Robot Teams | *Intelligenza Artificiale per la Condivisione del Controllo in Scenari di Collaborazione Uomo-Robot*)**

<b>Scholarships and Financial support</b>	
Monthly net income of PhD scholarship (max 36 months)	€. 1.250/mensili (In case of a change of the welfare rates during the three-year period, the amount could be slightly modified)
Number of scholarships	1
Beginning of PhD	May 1 <sup>st</sup> 2021
Deadline for application	March 8 <sup>th</sup> 2021
<b>Context of the research activity</b>	
Motivations and objectives of the research in this field	Human-robot collaboration (HRC), which falls within the general scope of physical human-robot interaction is defined when human(s), robot(s) and the environment come to contact with each other and form a tightly coupled dynamical system to accomplish a task. Ideally, each active component of such a system must be capable of observing and estimating the counterparts' contributions to the overall system's response through the fusion and processing of the sensory information. As a consequence, an appropriate reactive behaviour can be replicated or developed to complement and improve the performance of the collaborative partners. The main objective of this PhD theme is to enable effective role-allocation in mixed multi-human-robot teams. Advanced machine learning and control techniques will build the foundations of the novel Control Sharing framework. From one hand, the theme

	<p>will focus on the development of control sharing in multi-robot collaborative systems. In addition, the AI-based adaptation of the multi-robot teams to human(s) in mixed teams will be conceptualised and formulated. This will enable autonomous coordination of collaborative mixed human-robot teams so that the task requirements and human needs are simultaneously addressed.</p> <p>The successful candidates will have access to several fixed and mobile base robotic platforms already present in the lab, and several sensory systems for measuring and predicting human behaviour.</p> <p>The successful candidates will have the opportunity to join the consortium of the European project Concert, which aims at building advanced hybrid (human+robot) systems for construction and service industry.</p>
Methods and techniques that will be developed and used to carry out the research	<p>Research activities foresees extensive in lab experimentation at the Human Robot Interfaces and Physical Interaction (HRI<sup>2</sup> – hri.iit.it) of the Istituto Italiano di Tecnologia, Genova</p>
Educational objectives	<ul style="list-style-type: none"> <li>- To learn scientific research methods in bioengineering, robotics and machine learning</li> <li>- To learn team working</li> <li>- To improve scientific dissemination skills</li> </ul>
Job opportunities	<ul style="list-style-type: none"> <li>- Robotic and automation companies</li> <li>- Agile manufacturing industry.</li> <li>- Universities and research centres</li> </ul>
Composition of the research group	<ul style="list-style-type: none"> <li>- POLIMI: 1 Full Professor, 2 Associated Professors, 2 Assistant Professors <a href="http://www.nearlab.polimi.it">www.nearlab.polimi.it</a></li> <li>- HRI<sup>2</sup> Laboratory: <a href="https://hri.iit.it/">https://hri.iit.it/</a></li> </ul>
Names of the research directors	<p><i>Arash Ajoudani (IIT)</i> <i>Elena de Momi (POLIMI)</i></p>
Contacts	<p><a href="mailto:arash.ajoudani@iit.it">arash.ajoudani@iit.it</a> <a href="mailto:elena.demomi@polimi.it">elena.demomi@polimi.it</a></p>
<b>Additional support</b>	
<p><u>Housing:</u> financial aid per PhD student per year (gross amount)</p>	<p><u>Foreign students* inserire solo se rilevante</u> 1<sup>st</sup> year: ....euros per student 2<sup>nd</sup> year..... euros per student 3<sup>rd</sup> year: ....euros per student</p> <p>(max number of financial aids available....., given in order of merit)</p> <p><u>Out-of-town residents (more than 80 Km out of Milano)</u> 1<sup>st</sup> year: ...euros per student 2<sup>nd</sup> year: ...euros per student 3<sup>rd</sup> year: ... euros per student</p> <p>(max number of financial aids available....., given in order of merit)</p>

**Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other informations**

IIT will provide a desk, a personal laptop and if necessary a desktop PC to the candidate during the whole PhD period