Politecnico di Milano

PhD in Bioengineering

Real-time monitoring of the human intention and physical capabilities in physical human-robot collaboration

Scholarships and Financial support	
Monthly net income of PhD scholarship (max 36 months)	€. *1200*
Number of scholarships	1
Beginning of PhD	May 1, 2017
Deadline for application	*March 6, 2017*
Context of the research activity	
Motivations and objectives of the research in this field	Recent technological advances in hardware design of the robotic platforms enabled the implementation of various control modalities for improved physical interactions with humans and unstructured environments. An important application area for the integration of robots with such advanced physical interaction capabilities is human-robot collaboration, representing high economic and social impacts and maintaining the sense of purpose of the involved people, as the robots do not completely replace the humans from the work process. Nevertheless, since the human behaviour is usually highly unpredictable and difficult to model, the need for the development of appropriate human-robot interfaces to enable the robot to predict or extract the human intention from various feedback modalities (human motor behaviour, vision, interaction force, voice commands, etc.) becomes crucial. Therefore, the main objective of this PhD theme is to develop multimodal human robot interfaces for real-time monitoring of the human intention (high-level) and physical capabilities (e.g. fatigue). On the robot side instead, adaptive and hybrid controllers will be developed to achieve effective physical interactions with the human and the external environment. For more details, please see http://hri.iit.it/research/physical-human-robot-interaction-and-collaboration

	Previous example videos can be found at: https://www.youtube.com/watch?v=9iNr9KervKU and https://www.youtube.com/watch?v=e3t5odKe6_c
Methods and techniques that will be developed and used to carry out the research	Sensory fusion of the human bio-signals and task sensory data to extract kinematic and dynamic parameters that are necessary for robot control. In the meantime, novel hybrid adaptive robot controllers will be developed to achieve seamless and intuitive physical interactions with the external environment. Our focus will be on a minimum-degree of robot pre-programming. Our novel techniques will applied to the IIT humanoid robots such as **COMAN** (https://www.amarsi-project.eu/coman), **WALK-MAN** (https://www.walk-man.eu/), and **CENTAURO** (https://www.centauro-project.eu/) in human-humanoid collaborative settings.
Educational objectives	The program's first educational objective is to expand the candidate's knowledge on the understanding of the organization of the human sensorimotor functions. The gained knowledge will be used to develop multi-modal human-robot interfaces which enable seamless and intuitive physical interactions with robots. In addition, the candidate's programming skills and capabilities in robot controller design will be strengthened.
Job opportunities	With the fast increasing presence of robots in collaborative task execution scenarios in industry or service applications, the knowledge gained within this program will open several opportunities for the candidate. In particular, the main objective of the industry 4.0 is to equip the robots with smart interfaces so that the collaborative industrial tasks will be executed efficiently and intuitively.
Composition of the research group	Istituto Italiano di Tecnologia (IIT) Principal Investigator 1 (Dr. Arash Ajoudani) Number of Post-Docs 3 Number of PhD students 3 http://hri.iit.it https://iit.it/people/arash-ajoudani POLIMI Number of Assistant Professors 1 (Dr. Elena De Momi) Number of Post-Docs 1 Number of PhD students 10 www.nearalb.polimi.it/medical
Names of the research directors	*Arash Ajoudani, PhD (IIT)* *Academic supervisor:* *Elena De Momi, PhD (POLIMI)*
E-mail address, phone number and web-page	***Istituto Italiano di Tecnologia (IIT)*** *Arash Ajoudani, Ph.D.* *Tenure Track Researcher* *Head of Human-Robot Interfaces and Physical Interaction (HRI2) Lab* *Via Morego 30, 16163, Genova, Italy* *0039 010 71781 466* *arash.ajoudani@iit.it* *Webpage: https://iit.it/people/arash-ajoudani* ***POLIMI***

	Elena De Momi *0039 02 2399 9017* *elena.demomi@polimi.it* *www.nearlab.polimi.it/medical*
List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research	1. Istituto Italiano di Tecnologia 2. Politecnico di Milano
Additional support	
Housing: financial aid per PhD student per year (gross amount)	*Foreign students* inserire solo se rilevante* 1st year: ….euros per student 2nd year….. euros per student 3rd year: ….euros per student (max number of financial aids available…., given in order of merit) *Out-of-town residents (more than 80 Km out of Milano)* 1st year: …euros per student 2nd year: …euros per student 3rd year: … euros per student (max number of financial aids available…., given in order of merit)
Funding for educational activities (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences): funding per PhD student per year	*1st year: 0,00 euros per student* *2nd year: 0,00 euros per student* *3rd year: 0,00 euros per student*
Teaching assistantship: availability of funding in recognition of support to teaching activities by the PhD student	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.
Computer availability:	IIT will provide a personal powerful laptop and if necessary a desktop PC to the candidate during the whole PhD period
Desk availability:	IIT will provide a personal desk to the candidate during the whole PhD period