



PhD Course in
ROBOTICS AND INTELLIGENT MACHINES

**Curriculum: Robotics and Intelligent Machines for
Hostile and unstructured environments**

Research themes

1. HUMAN-CENTRIC PERCEPTION FOR HUMAN ROBOT INTERACTION AND REHABILITATION – ISTITUTO ITALIANO DI TECNOLOGIA 2

The main goal of the curriculum “Robotics and Intelligent Machines for Hostile and unstructured environments” is to address problems related to the study and development of enabling technologies and complex systems that will allow robots and intelligent machines to work in situations where the environment is dynamic, partially or totally unknown, hard to predict in advance, and possibly very challenging. The general objective of the curriculum is to form scientists and research technologists capable of working in multidisciplinary teams on projects where the interaction with a complex environment plays a crucial role in technological development and design.


The research theme offered in the second call of this year by the Italian Institute of Technology (IIT), will be assigned to the best applicants of the theme offered.

The ideal candidates are students with a strong background in robotics and intelligent machines from different perspectives: please check individual requirements for each research theme.

The students will perform their research project at the Hosting Institution (described in the research project sheet).

International applicants are encouraged and will receive logistic support with visa issues, relocation, etc.

**1. Human-centric perception for human robot interaction and rehabilitation
– Istituto Italiano di Tecnologia**

Curriculum: Hostile and unstructured environments	
Hosting Institution Istituto Italiano di Tecnologia	
Department: Event-Driven Perception for Robotics	
Tutor(s): Dr. C. Bartolozzi, Dr. G. Goyal	
<p>Description: Human observation is crucial in robots that interact with humans in unconstrained scenarios. This includes intention understanding, based on human tracking, action recognition, gaze tracking, hands tracking, with movements that happen at very different temporal and spatial scales [1]. Event-cameras offer a sparse perception that reduces the computational cost and a high-dynamic range that adapts to different lightning conditions and that adapt to the intrinsic dynamics of the observed phenomena. Current state-of-the-art models do not fully exploit event-cameras characteristics and their advantages, and new models and methods need to be explored [2,3]. These models need to exploit the temporal resolution and information from event-driven cameras, work robustly in real-time and reduce the training datasets, and be capable of adapting quickly to diverse subjects not well represented in the datasets.</p>	
<p>Requirements: Applicants are expected to show experience, skills and interest amongst:</p> <ul style="list-style-type: none"> • Computer vision for robotics • Artificial intelligence and machine learning • Deep learning • Unconventional sensors, and event-cameras • Python, Pytorch • C++ programming 	
<p>References: [1] Nazzaro, G., Emanuele, M., Laroche, J., Esposto, C., Fadiga, L., D'Ausilio, A., & Tomassini, A. (2023). The microstructure of intra-and interpersonal coordination. <i>Proceedings of the Royal Society B</i>, 290(2011), 20231576. [2] Goyal, G., Di Pietro, F., Carissimi, N., Glover, A. and Bartolozzi, C., 2023. MoveEnet: Online high-frequency human pose estimation with an event camera. In <i>Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition</i> (pp. 4024-4033). [3] Vullers Y., Gava L., Glover A., Bartolozzi C., Towards Low-power, High-frequency Gaze Direction Tracking with an Event-camera. <i>ECCV Workshop: Eyes of the Future: Integrating Computer Vision in Smart Eyewear</i>.</p>	
<p>Company name and link (for industrial projects): Not applicable</p>	
<p>Number of positions available:</p>	

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Main Research Site https://edpr.iit.it
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Funding Scheme: This doctorate grant is fully funded by the European Commission, under the Grant Agreement ID 101120727 "PRIMI" https://primi-project.eu/ CUP: J53C23000740006.
Scholarship Amount: <ul style="list-style-type: none">• Fascia 4: 19,500 €/year