IIT-HUA international joint PhD program

2 fully funded doctoral positions in robotics

PhD positions

The Istituto Italiano di Tecnologia (Dr. Arash Ajoudani, Director of the Human-Robot Interfaces and Interaction (HRI²) laboratory) and the Harokopio University of Athens (Ass. Prof. Georgios Th. Papadopoulos, Head of the HUA computer vision group) offer the following 2 PhD candidate positions in robotics (**doctoral dissertation starting date scheduled for Q1 2025**):

- Position #1: "**Multimodal Learning for Policy Generalization and Intention Prediction in Human-Robot Collaboration**"
- Position #2: "**Explainable and Augmented Intelligence for Skill Transfer in Human-Robot Collaboration**"

Detailed descriptions of the provided position are given below.

PhD supervision and hosting

The selected candidates will be co-supervised by IIT and HUA, as follows:

- The selected candidates will be hosted by IIT HRI² lab (30, Via Morego, Genova, Italy)
- Provision for short-term research visits to HUA computer vision group will be provided (9, Omirou Str., Tavros, Athens, Greece)
- The PhD degree will be awarded by HUA, department of Informatics and Telematics
- IIT will provide a certificate of hosting/supervising the doctoral candidate

Funding

The selected candidates will be funded by the European HEU RnD project TORNADO (foundaTion mOdels for Robots that haNdle smAll, soft and Deformable Objects), where both IIT and HUA participate as partners (project description provided below). Funding is secured for a 42-month period, while competitive financial benefits of ~30.000 euros annual gross income (~19.200 euros net income) are foreseen.

Application process

Interested individuals can express their interest and send their CV to Dr. Arash Ajoudani (**Arash.Ajoudani@iit.it**) and Ass. Prof. Georgios Th. Papadopoulos (**G.Th.Papadopoulos@hua.gr**). A motivation letter of up to 2 pages will be assessed favorably.

Details about the PhD application process are provided at **this** link.

Application deadline: **Jan-31, 2025**.

The doctoral dissertation starting date is scheduled for Q1 2025.

Prerequisites

Master’s (second-cycle) degree (or equivalent) in robotics, informatics, computer science, data science, artificial intelligence, electrical engineering or related field

Excellent programming skills (Python programming language preferred)

Excellent knowledge of English (both written and spoken)

Additional skills (will be considered a plus)

Knowledge of fundamental principles of machine learning and/or deep learning

Experience with PyTorch (or other similar) software package for implementing deep learning methods

Previous scientific publications in related fields (e.g. robotics, artificial intelligence, etc.)

Preferred skills

Excellent communication skills and ability/willingness for teamwork

Intrinsic motivation to perform cutting-edge research

Personal characteristics/skills, such as high self-organization, high level of creativity, thoroughness, and problem-solving ability

Position #1: “Multimodal Learning for Policy Generalization and Intention Prediction in Human-Robot Collaboration”: Human-robot collaboration is becoming increasingly essential across domains, from manufacturing to healthcare. However, creating adaptive systems capable of handling dynamic and unpredictable environments remains a significant challenge. Traditional robot policies often fail to generalize effectively in complex human-robot interaction scenarios, while the lack of robust human intention prediction hampers smooth collaboration. By integrating multimodal learning approaches with dynamic human intention modeling, this research seeks to bridge the gap between adaptability and reliability in human-robot collaboration, enabling robots to anticipate, adapt, and act in ways that align with human intentions and changing contexts. The primary goal is to develop a unified framework that combines multimodal inputs, such as visual, semantic, and contextual data, to create generalizable robot policies and predictive human intention models. This framework will leverage techniques like continual learning and ontology-based reasoning to adapt to evolving scenarios. Another critical objective is to enhance policy efficiency and robustness by exploring how multimodal analysis can guide robots in learning and responding to dynamic and socially interactive environments, fostering seamless collaboration.

Position #2: “Explainable and Augmented Intelligence for Skill Transfer in Human-Robot Collaboration”: As robots increasingly learn skills from humans, the clarity of AI decision-making processes and the effectiveness of learning interfaces become critical. Ambiguity in robot decision-making undermines trust and efficiency in collaborative tasks, while traditional skill transfer methods struggle to provide intuitive feedback and learning support. Augmented Reality (AR) and Explainable AI (XAI) offer transformative potential to bridge this gap. AR enhances human-robot interactions by creating intuitive interfaces for skill demonstration, while XAI fosters transparency by clarifying decision-making processes, thereby building trust and improving learning outcomes. This research aims to develop AR-powered interfaces and XAI frameworks that facilitate effective skill transfer in human-robot collaboration. A core objective is to design systems that allow humans to intuitively demonstrate tasks, while enabling robots to learn efficiently through augmented and explainable processes. By integrating XAI, the project also seeks to enhance transparency in robot actions, making them interpretable and alignable with human intentions. Ultimately, this work aspires to create a foundation for human-robot collaboration that is both intuitive and trust-driven, with applications in training, manufacturing, and beyond.

TORNADO project abstract: TORNADO will develop an innovative, multifunctional and adaptive cloud robotics platform, supporting advanced navigation of an autonomous mobile robot (AMR) within complex, time-varying, real-world, human-populated indoor environments. The TORNADO AMR will be able to manipulate small, soft or deformable objects (SSDs) to an unprecedented degree of success, as well as to naturally interact with humans via hand gestures or verbal conversation, by exploiting the zero-shot generalization abilities of deep neural Foundation Models (FMs) for robotics. The AMR's intelligence will rely on a pool of pretrained cloud-hosted FMs, which shall be further adjusted on-the-fly to the current situation via Out-of-Distribution Detection, Test-Time Adaptation and Few-Shot Adaptation subsystems. These will exploit human feedback if available, but will also support autonomous and dynamic cognitive adaptation. Additionally, the TORNADO system will be able to automatically select and set-up on-the-fly the most suitable combination of FMs and non-neural robotics algorithms during deployment, depending on the current situation. In cases of failure, on-the-fly skill acquisition will be supported via integrated, novel Learning-from-Demonstration methods facilitated by an innovative Augmented Reality (AR) interface and eXplainable AI (XAI) algorithms. The adaptive TORNADO system will allow the robot to perform difficult, non-repetitive manipulation tasks on previously unseen SSDs that may change shape during handling, as well as to flexibly adjust to SSDs of different sizes during operation. Measurement of human trust to interactive robots and human behavioral modeling will aid optimal integration/acceptance of TORNADO into society. Validation will take place at TRL-5 in 3 different industrial Use-Cases: flexible small gears manipulation and deformable ply-sheets handling (gears factory), palliative patient care (hospital) and product quality sampling/waste collection (dairy processing plant).