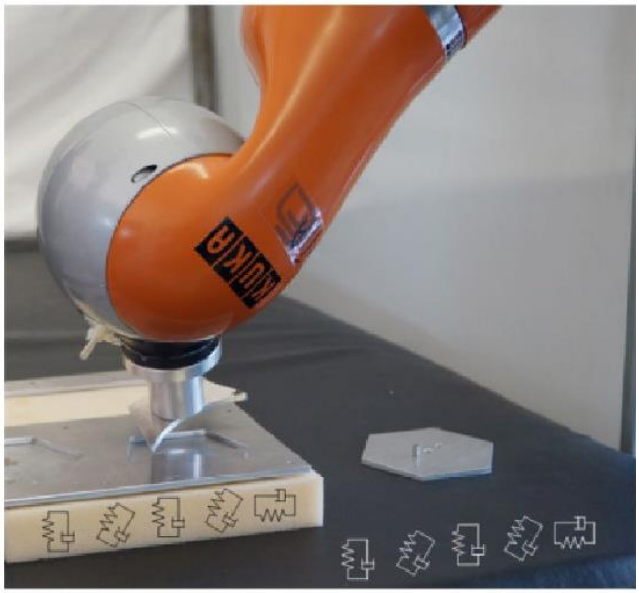
1.1. Human-robot collaboration control Exploiting AI techniques

Human-robot collaboration is increasingly demanded at industrial level. Physical collaboration is one of the hot-topics in both research and production plants, in order to empower and assist the human in onerous applications. In addition, safety is required in order to avoid critical situations that may damage the robot or hurt the human.

With this aim, the presented thesis aims to define a safe controller for physical human-robot collaboration. Based on AI techniques, a controller will be developed to take into account safety during the co-manipulation of heavy/dangerous tools. Thesis will be in cooperation with SUPSI-IDSIA (Istituto Dalle Molle di studi sull'Intelligenza Artificiale), working with a FRANKA robot for the experimental evaluation of the proposed approach.

1.2. AI techniques for interaction control under dynamics uncertainties



In the new era of robotics, manipulators have to be capable to adapt themselves to the surrounding environment, safely interacting with it while achieving target performance. The manipulator has to identify the context in which it is working, adapting its controller to the properties of the environment. However, it is not possible to tune a controller for each working scenario. Therefore, the manipulator has to implement a procedure to autonomously identify the working conditions and tune its controller consequently.

Artificial intelligence plays a fundamental role in such a field. The presented thesis aims to define a machine learning approach in order to give such degree of autonomy to the manipulator, being able to face unforeseen situations adapting it controller. Thesis will be in cooperation with SUPSI-IDSIA (Istituto Dalle Molle di studi sull'Intelligenza Artificiale), working with a FRANKA robot for the experimental evaluation of the proposed approach.

1.3. AI techniques for robot dynamics identification and compensation

Accurate robot dynamics modeling has to be provided in order to design high-performance model-based controllers.

AI techniques are exploited in this field in order to overcome standard identification techniques limitations. This thesis will define an approach for intelligent identification and compensation of the robot dynamics (such as friction effects) in order to propose an efficient and effective methodology. Thesis will be in cooperation with SUPSI-IDSIA (Istituto Dalle Molle di studi sull'Intelligenza Artificiale).

1.4. Safe co-manipulation task control based on pre-computed and online path planning

Being able to (re)plan in real-time the robot trajectory for co-manipulation tasks is important to preserve safety.

This thesis will investigate techniques allowing the real-time planning of collaborative tasks in which the human and the robot are in physical interaction, including the usage of vision systems. Thesis will be in cooperation with SUPSI-IDSIA (Istituto Dalle Molle di studi sull'Intelligenza Artificiale).