Course Syllabus for
DAUSY National Ph.D. Program in Autonomous Systems
(year 2023-24)

Course title	Human autonomous systems interaction
Scientific Discipline Sector	ING-INF/04
Hours of instruction	10 hours
CFU	1 CFU
Semester, period	March-April 2024
Goal	This course aims at providing PhD students with the main concepts of the well-known technology for improving human-autonomy interaction with a special focus on autonomous systems. It is especially focused on technology and case studies relevant to complex, applied environments in which people interact with autonomous systems regularly, particularly in the context of ambient assisted living. The study focus on approaches that include task inputs from humans: how to model humans and their tasks and at what level of details. Moreover, the human in-the loop approach will be introduced as a new scenario to facilitate the goal achievement, to reduce the anomalies and the unexpected responses from the system or inappropriate responses by the human in order to enhance human safety. Human-system interaction must provide people with an understanding of an autonomous system's decisions and actions, the ability to interact at appropriate levels of abstraction, and the ability to override the system's actions. New human-system engineering techniques are needed to ensure autonomous systems will be smoothly and readily adopted into society. Autonomous systems that work together in the environment should integrate the connections and interactions between them, over networks, with the physical environment, and with humans must be assured, resilient, productive, and fair in the autonomous future. Systems engineering is critical for ensuring the operational success for which the autonomous systems were intended. Autonomous systems should be analysed including concept, context, requirements, design, integration, operationalization, validation, testing and evaluation. During the course, the students will learn how the human-autonomous system interaction is achieved and how it is articulated. The workflow will include data processing, feature extraction and model training for human-robot interaction tasks, with some insights on deployment complexity; problem resolution will also be proposed by using a common engineering software (MATLAB), and the ROS (Robot Operating System). Each lesson consists in lectures, numerical examples and analysis of case studies.
Syllabus	Autonomous control of mobile based robots; Navigation and path planning; Human-Robots/systems interaction; Motion/action recognition through RGB-D camera or vision sensors; Cycles of learning for autonomous system for human interaction (learning from human demonstration, human intervention, human evaluation); Machine learning and reinforcement learning techniques;

	Algorithms for the processing workload; Data storage under a variety of conditions; Communications between systems; Interoperability during highly dynamic interactions; Cooperation across multiple systems with the human supervision; Algorithms to increase the levels of autonomy places managing; Examples of human-in-the-loop approach; Interactions between autonomous platforms; Software for assisting complex human tasks; Case studies and benchmarks.
Bibliography	Slides and supporting material from lecturer.
Examination method	End-course examination based on a project work and an oral test.