Ph.D. in Information Technology: Thesis Defenses

February 19th, 2020

Room Seminari "N. Schiavoni" – 14.00

Marco BAUR – XXXI Cycle

"Autonomous driving at the limits of handling"

Advisor: Prof. **Luca Bascetta**

Abstract:

To be safer than their human counterparts, automatic pilots must be able to control the car up to its limits of handling. Therefore, this PhD thesis focuses on the analysis and design of autonomous vehicles path tracking controllers, able of exploiting all the grip made available by tyre-ground interaction.

Firstly, attention has been devoted to path tracking controllers able to manage the so-called drifting technique. An autonomous drifting stabilization and path tracking controller has been designed and experimentally tested on a specifically built experimental platform, which consists in an autonomous 1:10 scale radio controlled car. The dynamic similarity between the scaled car and a real vehicle, which has been verified, allows to use this setup as a realistic experimental setup for the evaluation of the proposed control strategies.

Secondly, the analysis of a control oriented model, originally conceived by a Stanford research group and featured by front tyre lateral force as the control input in place of front tyre steering angle, has been performed. An explanation and analytical demonstration of the reason behind the fish tailing phenomenon, which occurs at high speed, has been conducted. After that, a possible solution has been proposed and assessed, by means of simulations performed on a realistic multibody Dymola vehicle.

Andrea CASALINO – XXXII Cycle

"Allowing a real collaboration between humans and robots"

Advisor: Prof. **Paolo Rocco**

Abstract:

Collaborative Robotics is emerging as one of the most active lines of research in robotics. That term indicates a group of methodologies and techniques that allow robots to work side by side with humans. The human should execute highly cognitive tasks, like e.g. assembly operations that could be too difficult to fully automatize, while robots have to both undertake autonomous operations

and assist the humans in many ways. The combination of the human flexibility and the robots efficiency can significantly improve the production process. This level of interaction requires at least the sharing of a common space. This topic has attracted the interest of many researchers in the recent years and many controlling algorithms have been developed to allow a safe coexistence of humans and robots. In this context, tracking the human motion is of paramount importance. Then, a safe motion controller can optimize the trajectory of the robots with the aim of dodging humans. We can state that the safe interaction of humans and robots, while performing disjoint tasks, is something achieved.
For this reason, the aim of this thesis was to study more in depth the collaboration between human and robot. In particular, this was done by focusing on industrial contexts, where typical applications are collaborative assemblies (or co-assemblies). In such scenarios, humans and robots have to execute alternating tasks, with the aim of realizing a set of possible finite products. The robots have to adapt and synchronize with the humans, since the collaboration was conceived as human-centric: it’s the human that regulates the interaction. To this purpose, robots have to interpret the human intentions as well as to predict them in order to take the best actions for providing a reliable assistance. Such an interpretation is possible only through increased cognitive capabilities. For this, sensors can be exploited to produce a large amount of data describing the workspace surrounding a robot, which are at a second stage interpreted by machine learning techniques.

PhD Committee:
Prof. **Francesco Casella**, DEIB
Prof. **Alessandro De Luca, U**niversita' di Roma La Sapienza
Prof. **Alessandro V. Papadopoulos,** Mälardalen University