Guidance, navigation and control algorithms for autonomous agricultural systems

Martina Mammarella[1], **Cesare Donati**[1], Fabrizio Dabbene[1]
[1]IEIIT-CNR, Torino, Italy, [2]Department of Electronics and Telecommunications, Politecnico di Torino, Torino, Italy

Fully-autonomous vehicles, both aerial (UAVs) and ground (UGVs), could provide great benefits in the Agriculture 4.0 framework when operating within cooperative architectures, thanks to their ability to tackle difficult tasks, particularly within complex irregular and unstructured scenarios such as vineyards on sloped terrains. Indeed, besides their individual potential, UGVs and UAVs can also represent valid alternatives to conventional machines and they can tackle more difficult tasks, e.g., effective agrochemicals distribution on the crop while by minimising the spray drift. In this talk, we review some of the most promising and innovative guidance, navigation and control (GNC) algorithms, which could provide suitable performances in terms of low computational demands, reduced design time, and optimal tracking capabilities for fully autonomous UVs, exploited in the agricultural framework. In particular, we present a combination of existing algorithms, e.g. Dynamic Window Approach for path planning, Kalman filter for navigation, and Model Predictive Control (MPC) for trajectory tracking, together with ad-hoc GNC schemes, designed to comply with the peculiar features of the agricultural framework and the vehicles themselves, e.g. distance filter and stochastic MPC, and here applied within the selected operative scenario to assess the achievable benefits and improvements compared to other schemes already available in the literature.