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# CONTROL ARCHITECTURES FOR ROBUST MULTI-ROBOT AUTONOMOUS SYSTEMS

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The control of complex dynamic systems, both in their behaviour and in their mission, goes through the implementation of multi-loop control architectures based on information about the system internal state and from the environment, as well as on the mission plan state. This results in systems that are becoming increasingly autonomous, for which requirements in terms of safety and reliability, as well as expected performance, are increasingly high. Research works developed at ONERA in the field of control for autonomous systems cover all levels of the control architectures, which are basically structured with respect to temporal aspects, as well as the level of abstraction that they entail for the system dynamic.

We will consider them in presentation by increasing level. We will discuss the advances achieved recently in the robust control techniques of uncertain dynamic systems generally implemented at the lower control level and we will discuss their extensions to consider input and output constraints, as well as the hybrid nature of most of the systems considered. To design "task" level control primitives that take place just above the previous control loops, we will introduce sensor-based robust and non-linear control techniques. These are based on information on the environment extracted from exteroceptive sensors, to estimate their state and to adapt system behaviour to uncertainties and perturbations. Multi-sensor and/or multi-objective controls will be discussed in this particular context.

We will also present several recent results in the field of trajectory tracking based on visual navigation techniques in complex environments, which combine objectives and constraints within the same control architecture. We will discuss how model predictive control (MPC) techniques and advanced optimization techniques can be used for solving the resulting control problems. In addition, we will discuss several ongoing developments of these methods by exploiting distributed model predictive control techniques (DMPC) and predictive control of hybrid systems. Finally, integration with the control architectures at the upper level of reactive, predictive and distributed planning capabilities will be proposed to accommodate time constraints and uncertainties in decision.